

# **TOKYO SUMMIT-IV**

**4th international conference on innovative  
studies of contemporary sciences**

## **The Book of Full Texts**



**July 29-31, 2021**

**Tokyo, Japan**

**Tokyo, Japan**

# The Book of Full Texts

## Editors

**Assoc. Prof. Maya Kupravishvili**  
**Zhuldyz Sakhi**

**All rights of this book belong to ISPEC Publishing House**  
**Authors are responsible both ethically and juridically**  
**ISPEC Publications - 2021©**

**ISBN: 978-625-7720-52-6**  
**Issued: 20.08.2021**

# ABOUT SYMPOSIUM

## 4th INTERNATIONAL CONFERENCE ON INNOVATIVE STUDIES OF CONTEMPORARY SCIENCES

- Keynote & Invited participation type

### DATE - PLACE

- July 29-31, 2021  
Tokyo, JAPAN

### ORGANIZATION

- İKSAD
- Atlas International Journal
- Ejons International Journal

### ORGANIZATION COMMITTEE

Prof. Dr. Mustafa Talas  
Dr. WU Yicheng  
Dr. Mariam RASULAN  
Dr. Umrhan TURKYILMAZ  
Dr. Minji YANG  
Dr. Maria HOOKS  
Zhuldyz SAKHI  
Elvan CAFAROV

### LANGUAGES

Japanese, Turkish, English

### NUMBER OF ACCEPTED PAPERS

- 152

### NUMBER OF REJECTED PAPERS

- 21

### EVALUATION PROCESS

- All applications have undergone a double-blind peer review process

### PRESENTATION

- Oral presentation

### TOTAL NUMBER OF INTERNATIONAL PAPERS

Turkey-67

- Azerbaijan, Georgia, Iraq, USA, India, Tunisia, Morocco, Greece, Vietnam, Romania, Kazakhstan, Ethiopia, Romanian, Vietnam, Sri Lanka, Malaysia, Canada, South Africa, Saudi Arabia, Bulgaria, Nigeria, Libya, Algérie -85

## **SCIENTIFIC & REVIEW COMMITTEE**

**Prof.Dr. Akina FUMIKO**

Osaka University

**Prof. Dr. Hiroshi NAKAHARA**

Sapparo City University

**Prof. Dr. Mustafa TALAS**

Omerhalisdemir University

**Assoc. Prof. Dr. Sehrana KASIMI**

Azerbaijan MEA

**Assoc. Prof. Dr. Sevean YILDIZ**

Akdeniz University

**Dr. Akira HIBIKI**

Tohoku University

**Dr. Hoshi NAGATAMO**

Asian University

**Dr. Minji YANG**

*Busan University*

**Dr. Yicheng WU**

Minzu University

**Dr. MACHUNWANGLIU KAMEI**

University of the People, Pasadena, California

**Dr. Zhi Huan MENCHUANG**

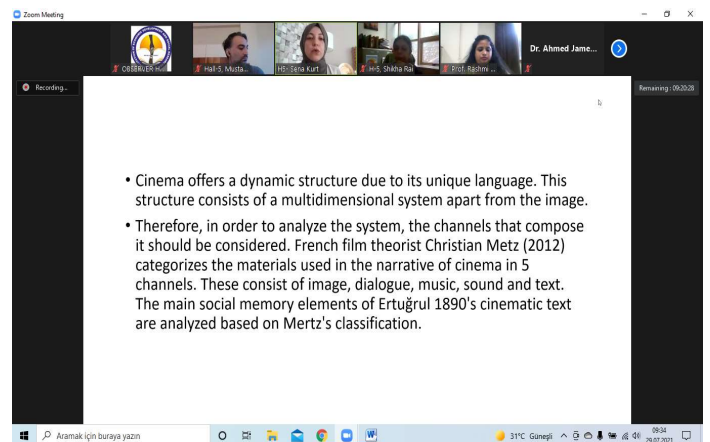
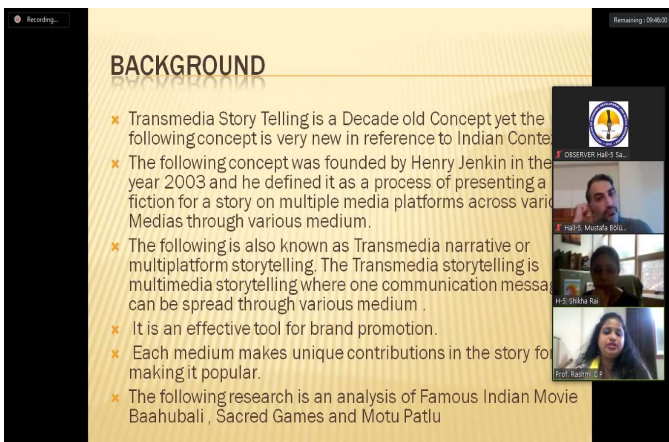
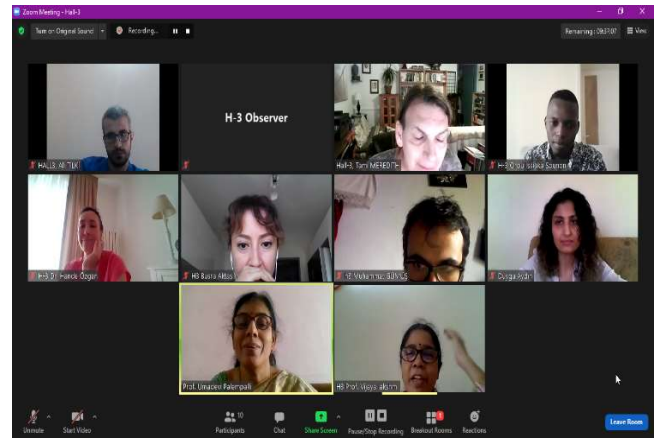
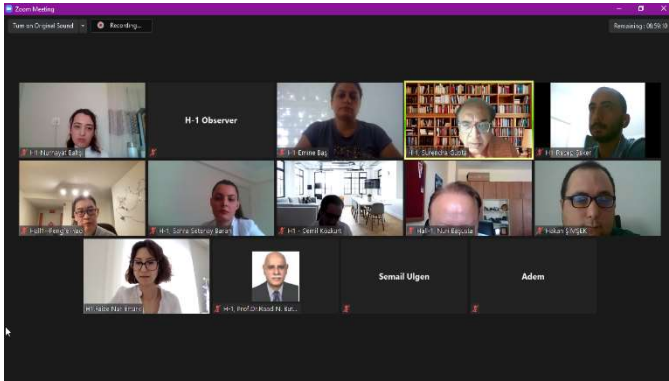
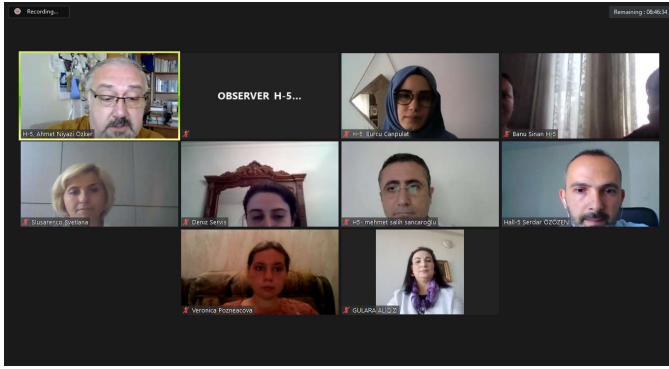
Renmin University

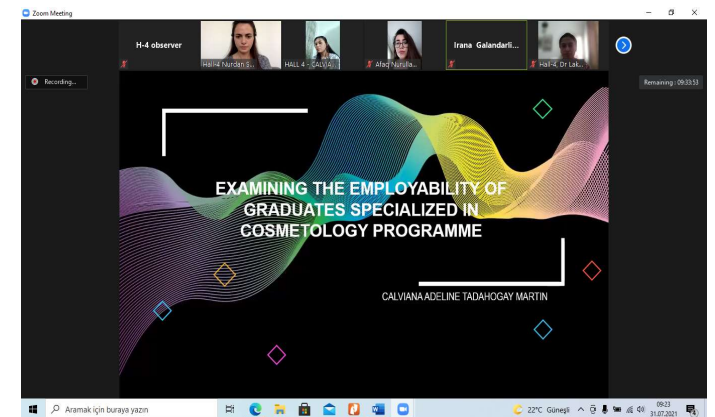
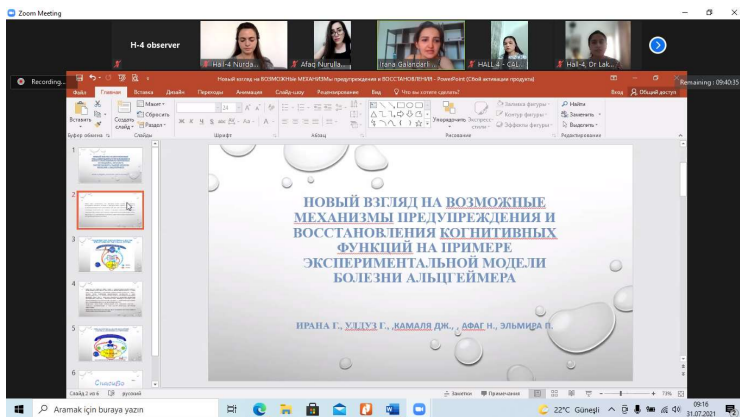
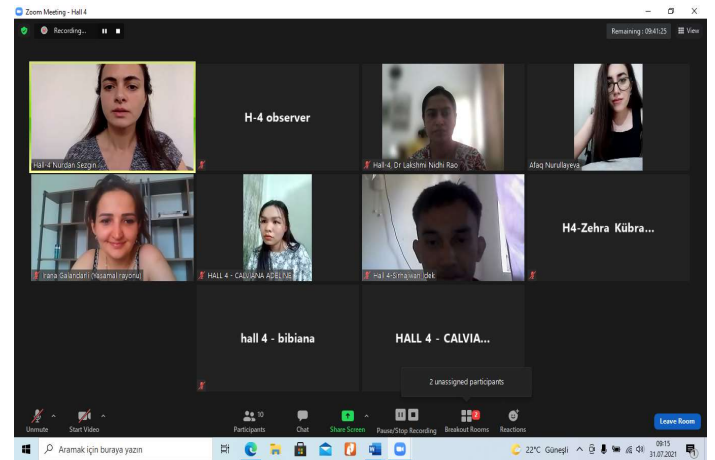
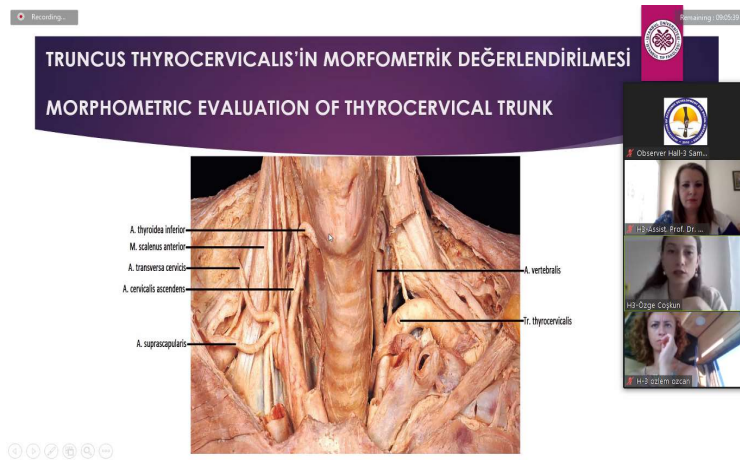
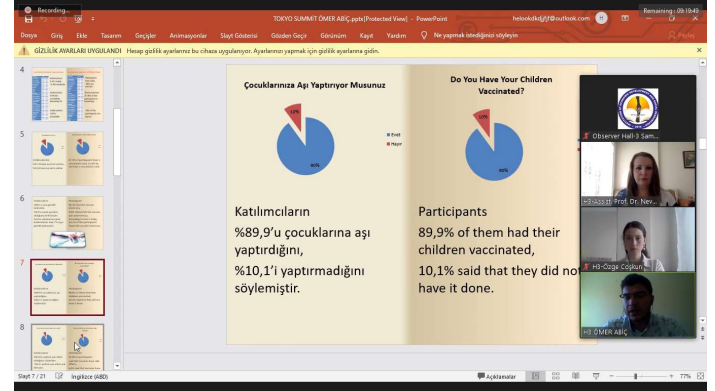
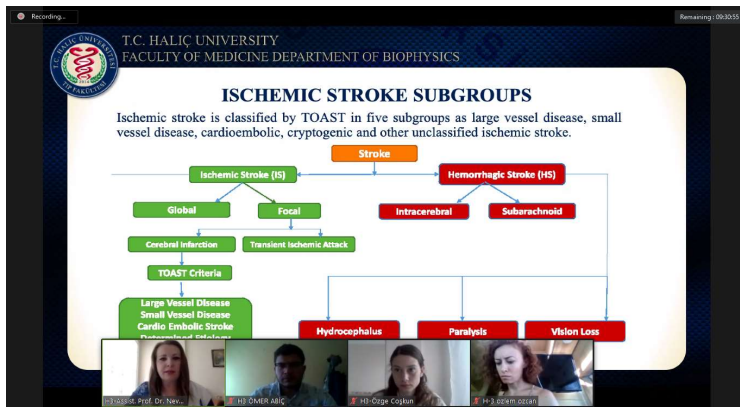
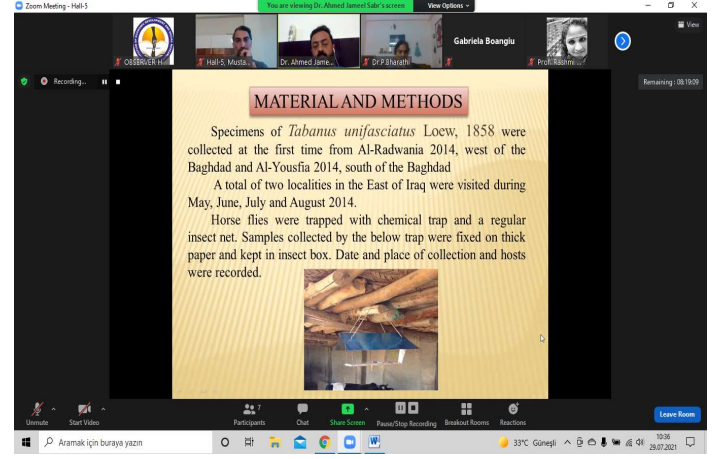
**Cengiz TOPDEMIR**

Awarded Mathematician

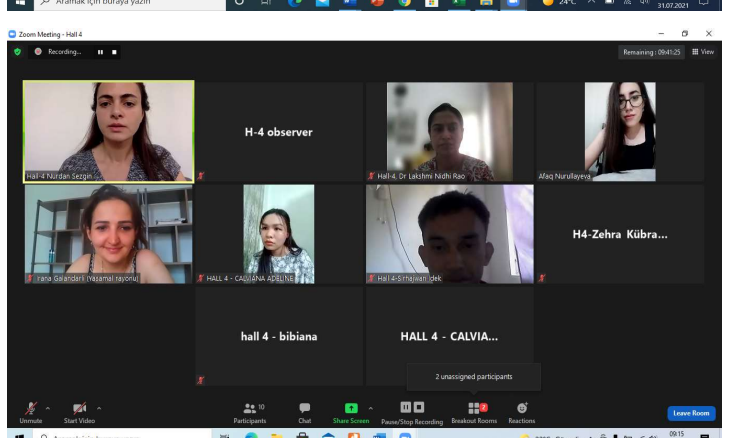
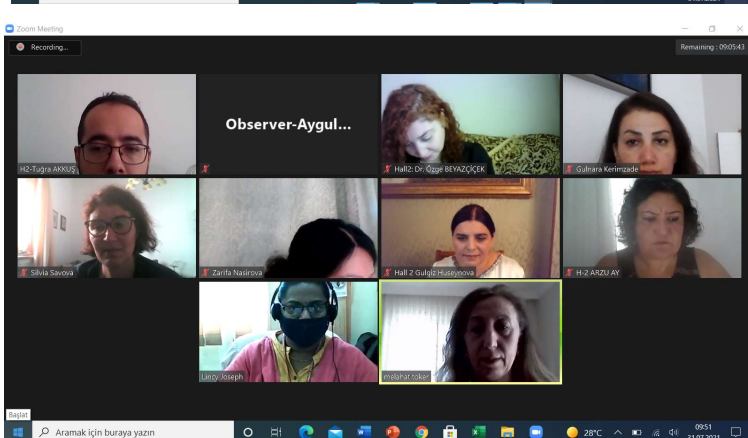
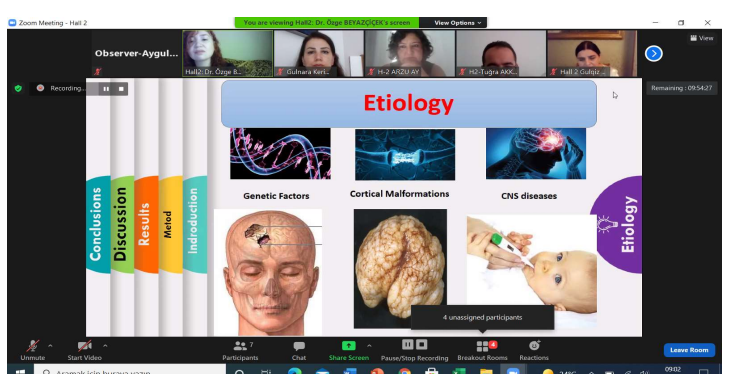
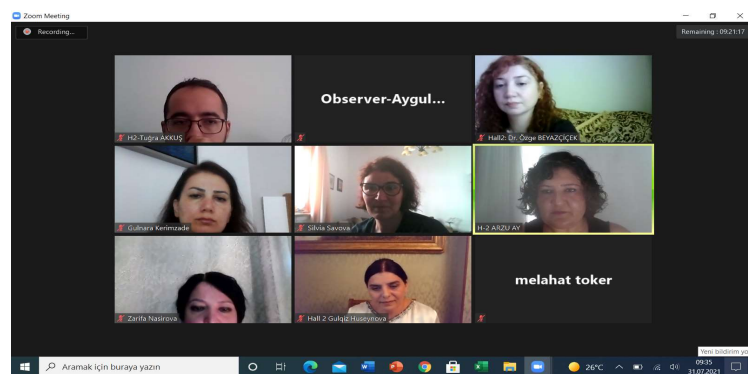
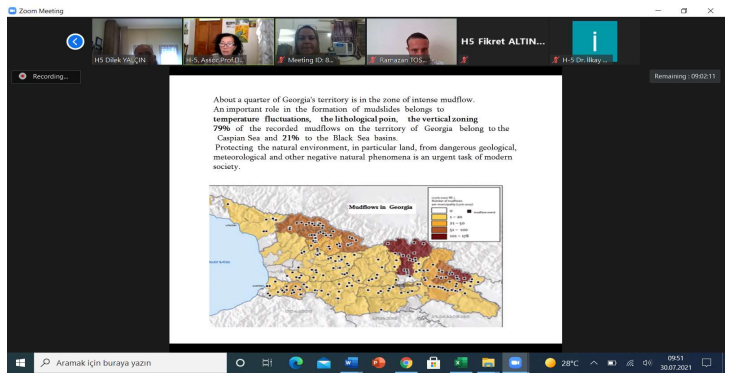
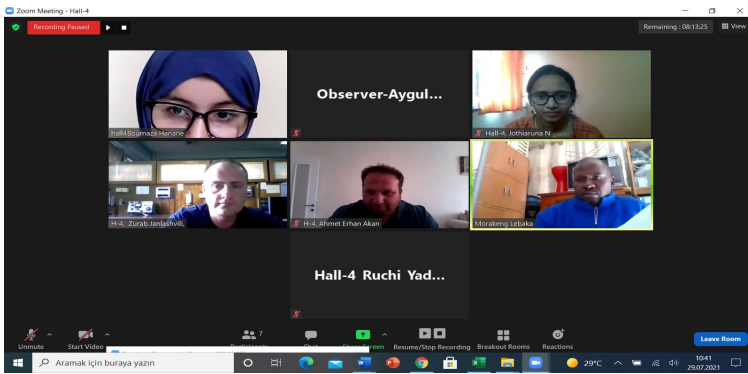
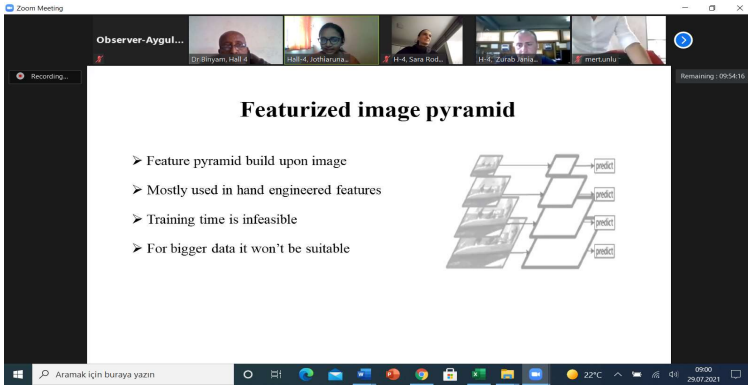
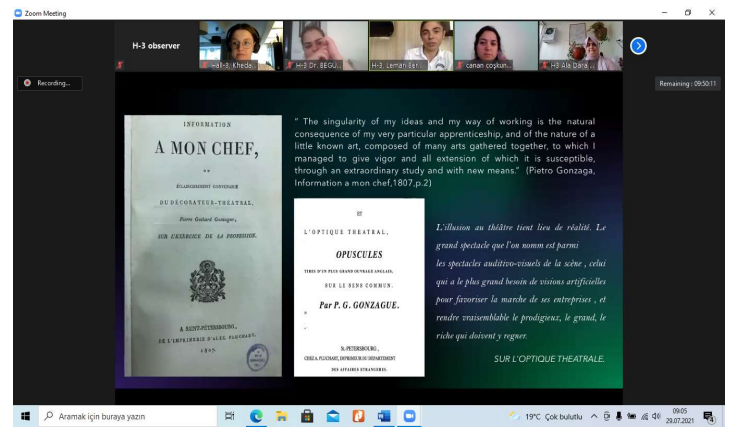
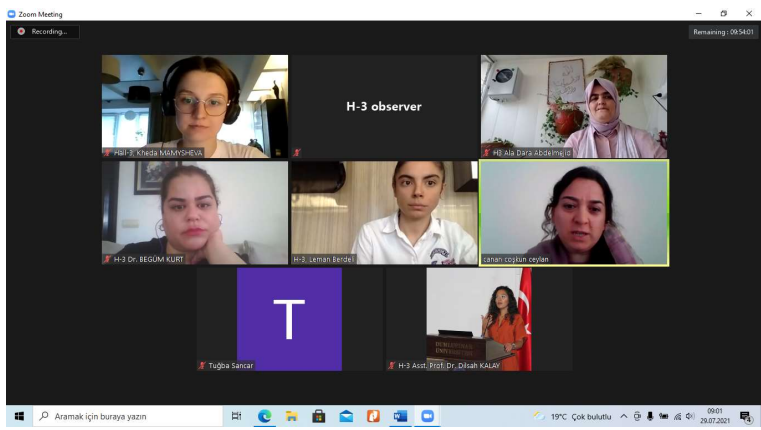


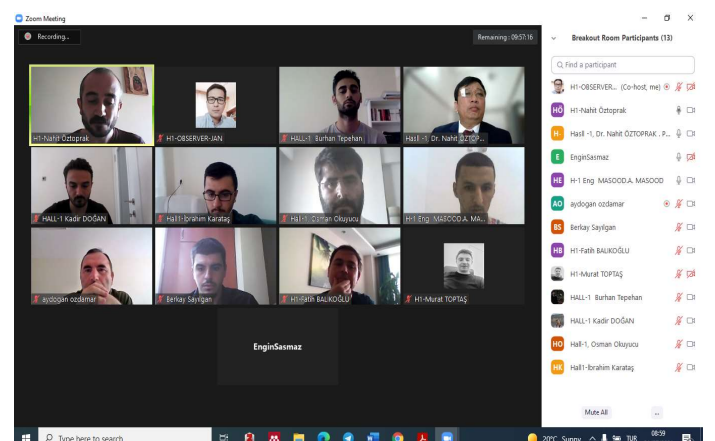
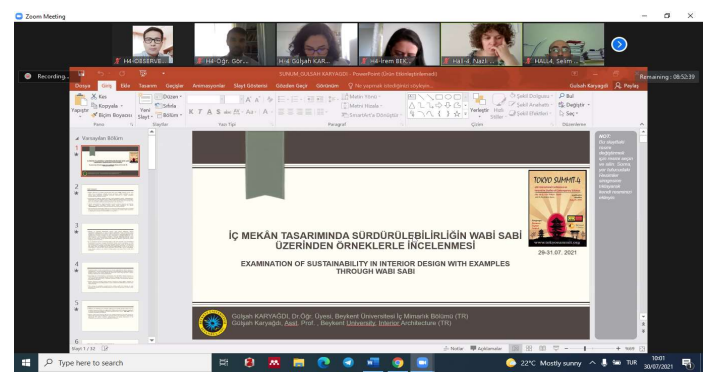
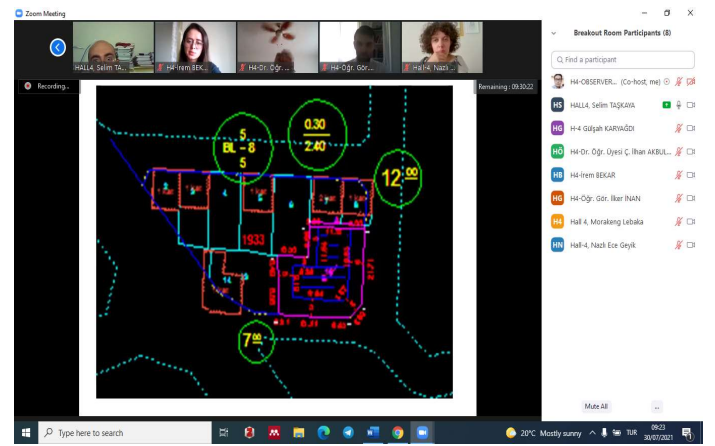
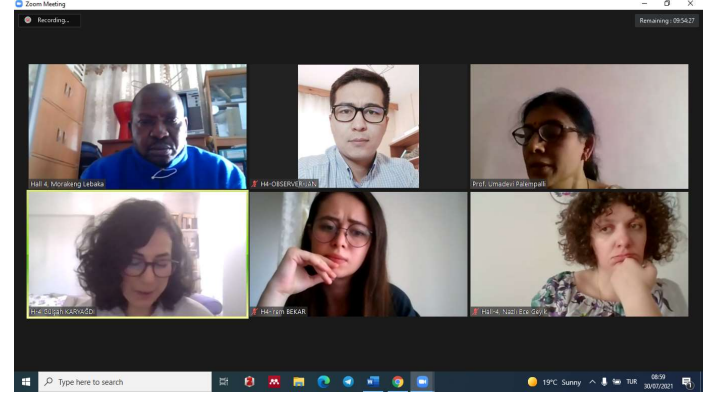
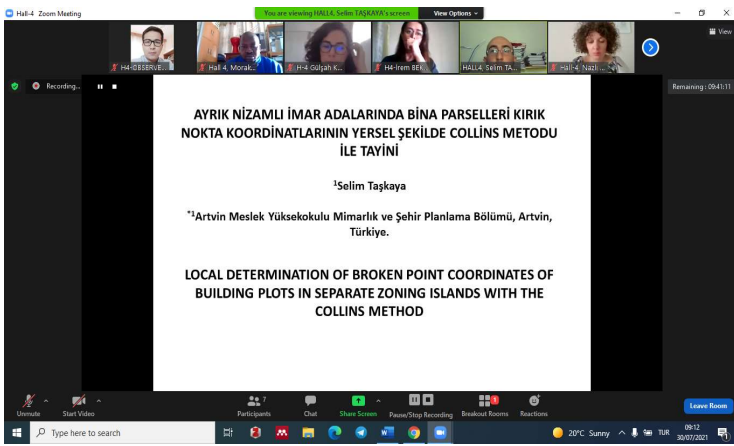
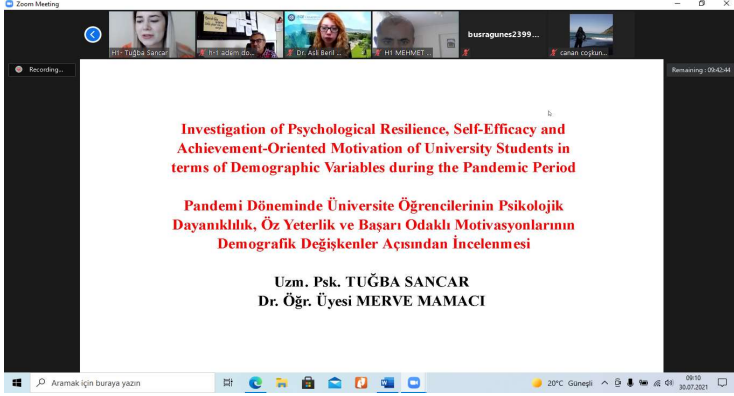
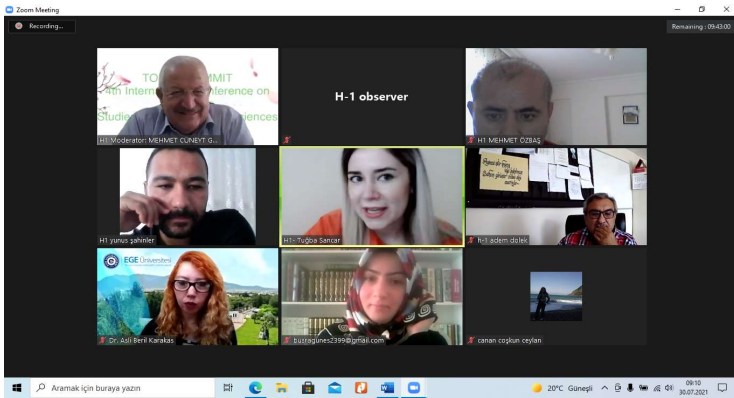
# CONFERENCE GALLERY













**TOKYO SUMMIT**

**4<sup>TH</sup> INTERNATIONAL CONFERENCE ON INNOVATIVE  
STUDIES OF CONTEMPORARY SCIENCES**

**JULY 29–31, 2021**

**TOKYO, JAPAN**

**CONFERENCE PROGRAM**





**Meeting ID: 833 6404 6776**  
**Passcode: 708610**

**IMPORTANT, PLEASE READ CAREFULLY**

- ❖ To be able to attend a meeting online, login via <https://zoom.us/join> site, enter ID "Meeting ID or Personal Link Name" and solidify the session.
- ❖ The Zoom application is free and no need to create an account.
- ❖ The Zoom application can be used without registration.
- ❖ The application works on tablets, phones and PCs.
- ❖ The participant must be connected to the session 5 minutes before the presentation time.
- ❖ All congress participants can connect live and listen to all sessions.
- ❖ Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

**Points to Take into Consideration - TECHNICAL INFORMATION**

- ◆ Make sure your computer has a microphone and is working.
- ◆ You should be able to use screen sharing feature in Zoom.
- ◆ Attendance certificates will be sent to you as pdf at the end of the congress.
- ◆ Requests such as change of place and time will not be taken into consideration in the congress program.

**Before you login to Zoom please indicate your name surname and hall number,  
exp. H-1 Dr. Zhuldyz SAKHI**

**Participants Countries:**



# -Opening Ceremony-

**29.07.2021**

**Tokyo Local Time: 14<sup>40</sup>-15<sup>00</sup>**

**Ankara Local Time: 08<sup>40</sup>-09<sup>00</sup>**

---

## **Dr. Yingxu Wang**

President, International Institute of Cognitive Informatics and Cognitive Computing (I2CICC)  
Visiting Professor: Stanford Univ. (2008|16), MIT (2012), UC Berkeley (2008), Oxford Univ. (1995 | 2-18-22)  
Dept. of Electrical and Software Engineering  
Schulich School of Engineering and Hotchkiss Brain Institute  
University of Calgary, Canada  
2500 University Drive, NW, Calgary, AB, Canada T2N 1N4

**“Emergence of Contemporary Abstract Sciences: From Intelligence, Knowledge, Information, and Data Sciences to Intelligent Mathematics”**



**Tokyo**



**29.07.2021 | HALL-1**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



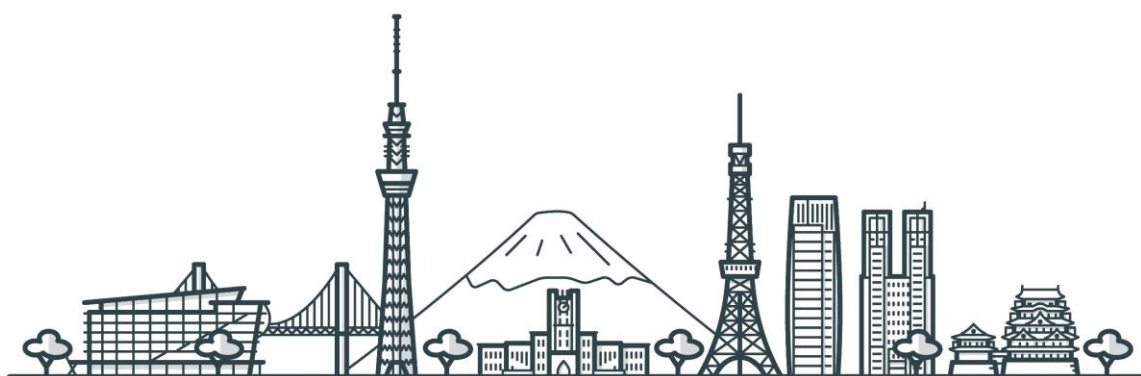
**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Pengfei Yao**

Prof. Dr. Raad N. Butris	University of Duhok, Iraq	PERIODIC SOLUTIONS OF VOLTERRA INTEGRO-DIFFERENTIAL EQUATIONS WHICH HAVE THE RETARDED ARGUMENT WITH BOUNDARY CONDITIONS OF GAMMA FUNCTIONS
Lect. Dr. Emine BAŞ	Selçuk University, Turkey	PERFORMANCE ANALYSIS OF GRAY WOLF OPTIMIZATION AND SALP SWARM ALGORITHM
Cemil KÖZKURT	Bandırma Onyedi Eylül University, Turkey	SOLUTION OF THE STEP-CONE PULLEY PROBLEM WITH RECENT OPTIMIZATION ALGORITHMS
Pengfei Yao Surendra M. Gupta	Northeastern University Boston, USA	COLONY OPTIMIZATION ALGORITHM FOR SOLVING U-SHAPED DISASSEMBLY LINE BALANCING PROBLEM WITH MULTIPLE OBJECTIVES
Nurhayat Bahşi Semail Ülgen	Antalya Bilim University, Turkey	NURSE SCHEDULING PROBLEM AND OPTIMIZATION FOR ANTALYA TRAINING AND RESEARCH HOSPITAL
Hakan Şimşek Faize Nur Ertürk Recep Şeker	Antalya Bilim University, Turkey	A FUZZY LOGIC METHOD AND PATH ALGORITHM FOR ENERGY AND TIME MANAGEMENT OF A SMART CLEANING MACHINE
Prof.Dr.Nuri Başusta	Firat University	AGE DETERMINATION STUDIES FROM DIFFERENT STRUCTURES OF THE PURPLE DYE MUREX (BOLINUS BRANDARIS) INHABITING AEGEAN SEA
Sahra Setenay Baran Belma Aslim	Gazi University	In-Silico Prediction and In-Vitro Validation of Inhibitor Activity of Allocryptopine against Acetylcholine Esterase Enzyme in the Drug Development for Alzheimer's Disease



**Tokyo**

**29.07.2021 | HALL-2**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Prof. Dr. Ismail KARACAN**

Zeynel Abidin SARI M. Deniz TURAN Mustafa BOYRAZLI Murat ERDEMOĞLU	Iskenderun Technical University, Turkey Firat University, Turkey İnönü University, Turkey	PHOTOCHEMICAL OXIDATION AND DISSOLUTION OF COPPER SLAG IN ACIDIC MEDIA
Ilavenil K. K Senthil Kumar. V	Nehru Memorial College, India SRM-TRP Engineering College, India	ANTIMICROBIAL INVESTIGATION AND DOCKING ANALYSIS OF QUINOLINE COMPOUNDS
Safi Khaoula Yaltese Mohamed Athmane Belhadi Salim Mabrouki Tarek Kouahla Ilyas	May 8th 1945 University, Algeria University of Tunis El Manar, Tunisia	OPTIMIZATION OF AISI D3 STEEL USING CARBIDE CUTTING TOOL (CVD) BASED ON TAGUCHI AND TOPSIS APPROACHES
Issam Jilal Soufian El Barkany Zahra Bahari Ola Sundman Abderahmane El Idrissi Mohamed Abou-Salama Abderrahmane Romane Chahid Zannagui Hassan Amhamdi	Pluridisciplinaire de Nador, Maroco	NEW QUATERNIZED CELLULOSE BASED ON HYDROXYETHYL CELLULOSE (HEC) GRAFTED EDTA: SYNTHESIS, CHARACTERIZATION AND APPLICATION FOR Pb (II) AND Cu (II) REMOVAL
Dermentzis Konstantinos Kokkinos Nikolaos Marmanis Dimitrios	International Hellenic University, Greece.	APPLICATION OF ELECTROCHEMICAL METHODS FOR TREATMENT OF DRILLING FLUID WASTEWATER
Marmanis Dimitrios Kokkinos Nikolaos Dermentzis Konstantinos	International Hellenic University, Greece.	LANDFILL LEACHATE TREATMENT BY COMBINED ELECTROCHEMICAL PROCESS
KOKKINOS Nikolaos MARMANIS Dimitrios DERMENTZIS Konstantinos	International Hellenic University, Greece.	THE CONTRIBUTION OF VIRTUAL REALITY IN AWARENESS AND PREPAREDNESS OF CHEMICAL INDUSTRY PROFESSIONALS
Md. Mahbubor Rahman Prof. Dr. Ismail KARACAN	Bangladesh University of Textiles, Bangladesh Erciyes University, Turkey	STRUCTURE AND PROPERTIES OF THERMALLY STABILIZED POLY(HEXAMETHYLENE ADIPAMIDE) AS CARBON FIBER PRECURSOR: X-RAY DIFFRACTION, TGA, AND FT-IR SPECTROSCOPY ANALYSIS
F. Nihan Dogan M. Ekrem Karpuzcu	Istanbul Technical University, Turkey Istanbul Technical University, Turkey	MODELING THE IMPACT OF LAND USE CHANGE ON THE HYDROLOGY OF A DRINKING WATER BASIN
Chkhartishvili Nodari Chkhartishvili Nino Torotadze Soso	Georgian Technical University	GEORGIAN VITICULTURE-WINEMAKING – KARTLI AGROCLIMATIC ZONE
Oanh Thi Truong Sang Quang Tran Van Ngo Thai Bich Binh Thuy Dang	Nha Trang University, Vietnam. The University of Danang- University of Science and Technology	EZRAD BARCODE SPECIES VERIFICATION OF BLACK SHARKMINNOW LABEO CHRYSOPHEKADION (CYPRINIFORMES: CYPRINIDAE) IN THE LOWER MEKONG RIVER BASIN



**Tokyo**

**29.07.2021 | HALL-3**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



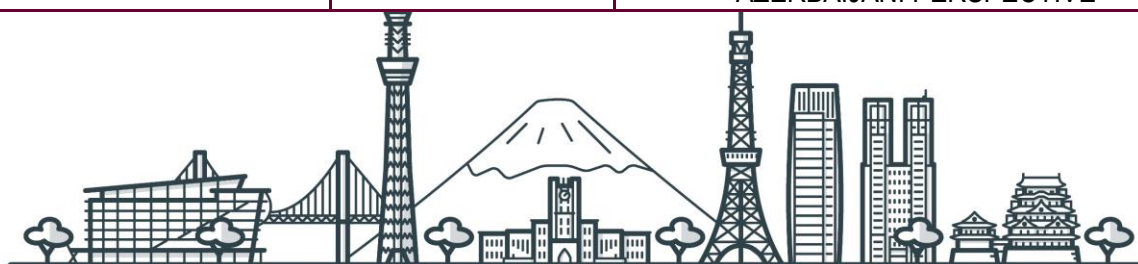
**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Leman BERDELI**

Dr. Canan COŞKUN	MEB, Turkey	PSYCHOLOGICAL PERSPECTIVES OF THE STUDY CALLED THE STRANGE LIBRARY BY HARUKI MURAKAMI
Hawzhen Slewa Issa , Ala Dara abdul Majed	Koya University, Iraq	THE FOUNDATIONS OF AESTHETICS IN THE TEXT IN THE VISION OF THE POET "MAEDUMI"
Assist. Prof. Dr. Begüm KURT	Çağ University, Turkey	THE PERCEPTION OF THE CHAOTIC WORLD IN ARCHAIC MAN: DEMONS IN SUMERIAN AND TURKISH MYTHOLOGIES
Leman BERDELI	Sapienza Università di Roma	IMAGINARY SPECIAL EFFECTS IN THE CLASSICAL ROMANTIC GESAMTKUNSTWERK FANTASY
Maralkhanim Aliyeva	Azerbaijan State Pedagogical University, Azerbaijan	INTEGRATED APPROACH IN TEACHING CONDUCTOR AS THE BASIS FOR THE DEVELOPMENT OF THE CREATIVE PERSONALITY OF FUTURE MUSIC TEACHERS
Naila Yusifova	Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan	FEATURES OF THE ORIGIN OF AZERBAIJANI ORONYMS
Asst. Prof. Dilşah KALAY Lect. Turgut KALAY	Kütahya Dumlupınar University, Turkey. Mimar Sinan Fine Arts University, Turkey.	THE CONNOTATIONS OF JAPANESE WORDS WRITTEN IN KANJI ALPHABET: A "COLOR" FUL REPRESENTATION
Kheda Mamysheva	Nazarbayev University, Nur- Sultan city, Kazakhstan	RUSSIAN IN KAZAKHSTAN: LANGUAGE IDEOLOGIES, LINGUISTIC PROCESSES, AND REACTIONS OF THE CHECHEN-INGUSH DIASPORA ON LINGUISTIC CHANGES
Asst. Prof. Ulviyya Nasirova Samira Hasanova Fidan Naghiyeva	Odlar Yurdu University, Baku, Azerbaijan	DIFFICULTIES IN TRANSLATION OF TECHNICAL TERMS
Togrul Refail Salmanzade	Baku State University	THE ROLE OF MULTICULTURALISM ON THE DIALOGUE OF CIVILISATIONS: THE AZERBAIJANI PERSPECTIVE



**Tokyo**

**29.07.2021 | HALL-4**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



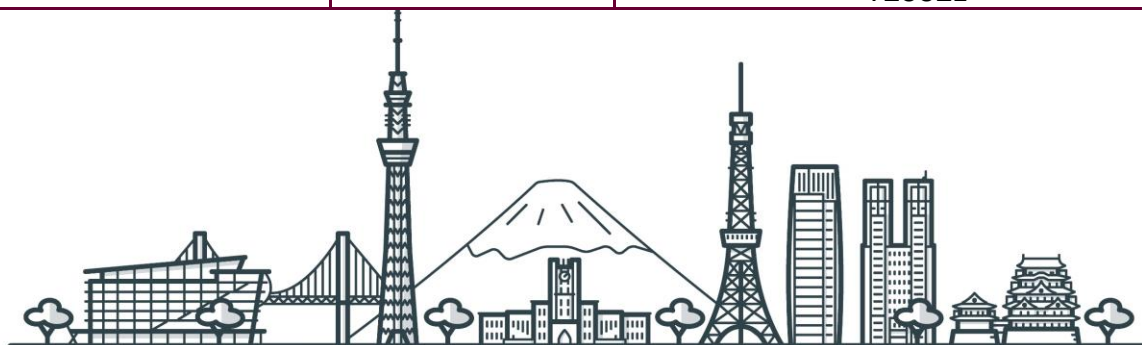
**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Binyam Zigta**

Jothiaruna N Anny Leema A	Vellore Institute of Technology, India	DIFFERENT MULTI-SCALE FEATURE MAPS FOR OBJECT DETECTION
Kadir Mert Unlü Sinan Çalışkan	Ektam Machinery, Turkey	EFFECTED FACTORS OF OPP LABELLING PERFORMANCE
Sara Rodriguez Joseph Youssif Saab Jr. Alexandre Martuscelli Faria Marcos de Mattos Pimenta	Sao Paulo State University Maua Institute of Technology	PNOISE AND THE IMPORTANCE OF WIND TURBINE NOISE PREDICTION
Lecturer Dr. Ahmet Erhan AKAN	Tekirdağ Namık Kemal University, Turkey	TECHNO-ECONOMIC ANALYSIS OF AN OFF- GRID HYBRID ENERGY SYSTEM WITH HOMER PRO
Ramin Chikhladze Ketevan Chikhladze Zurab Janiashvili	Georgian Technical University, Georgia	INFLUENCE OF IMPURITIES ON THE PROPERTIES OF NEW TRANSFORMER OIL
Hanane Boumaza Salim Belhadi Mohamed Athmane Yallese Abdelkrim Haddad Kouahla Ilyas	May 8th 1945 University, Algeria	APPLICATION OF THE TAGUCHI-DEAR METHODOLOGY IN MULTI-CRITERIA DECISION MAKING DURING THE DRY TURNING OF INCONEL 718
Ruchi Yadav Rashmi Priyadarshini R M Mehra	Sharda University, India	DETECTION OF EPILEPTIC SEIZURES USING WIRELESS SYSTEMS
H. C. Das Ankit Kumar S. K. Patra	Institute of Physics Homi Bhabha National Institute, India.	NEUTRON STAR IN THE PRESENCE OF DARK MATTER
Abdullayev Anar Arif	National Aviation Academy of Azerbaijan	ACCUMULATOR BATTERIES AND FUEL ELEMENTS
Ali Khalaf Hasan Dalal Naji Hameed	College of Education for Girls Kufa University, Najaf, Iraq	DESCRIPTIVE STUDY OF THE GERMANIUM 66: USING THE MSDI
Dr. Binyam Zigta	Wolaita Sodo University, ETHIOPIA	EFFECT OF THERMAL RADIATION AND CHEMICAL REACTION ON MHD FLOW OF BLOOD IN STRETCHING PERMEABLE VESSEL



**Tokyo**

**29.07.2021 | HALL-5**

**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**

**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**

**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Mustafa BÖLÜKBAŞI**

Ms. C P Rashmi Dr. Shikha Rai	Sharda University IES University Indira Gandhi National Open University, India,	TRANSMEDIA STORY TELLING AND IMAGE PROJECTION IN THE INDIAN CONTEXT: A STUDY OF EMERGING TRENDS THROUGH COMPARATIVE ANALYSIS OF FILM, WEB SERIES AND ANIMATION
Sena Kurt	Giresun University, Turkey	THE RELATIONSHIP OF INTERNATIONAL COLLECTIVE MEMORY AND CINEMA: ERTUĞRUL 1890 (125 YEARS MEMORY/ KAINAN 1890)
Dr. Paluri Bharathi Prof. P. Vijayalakshmi	Sri Padmavati Women's University, India	THE EFFECTS OF THE COVID-19 PANDEMIC ON JOURNALISM: MENTAL HEALTH IMPLICATIONS ON JOURNALISTS, MEDIA PERSONS AND SUPPORT STAFF
Dr. Mustafa BÖLÜKBAŞI	Uşak University, Turkey	PANDEMIC, INFODEMIC AND INFORMATION DISORDER: A QUALITATIVE CONTENT ANALYSIS ON FALSE INFORMATION DURING CORONAVIRUS
Gabriela Boangiu	"C. S. Nicolăescu- Plopșor", Craiova, of the Romanian Academy	FEMINISM, FEMININITY AND SOCIAL ISSUES IN ROMANIAN GLOSSY MAGAZINES
Thi My Hanh DINH , Van Hung TRAN, Tu Thanh NGO	The University of Danang - University of Science and Education, Danang, Vietnam	ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION - OPPORTUNITIES AND CHALLENGES IN THE CONTEXT OF THE WORLD AND VIETNAM
Ahmed Jameel Sabr	College of Education for Pure Sciens Ibn Al-Haitham, University of Baghdad.	MORPHO-TAXONOMIC STUDY OF TABANUS UNIFASCIATUS LOEW, 1858 (DIPTERA: TABANIDAE). NEW RECORD FOR IRAQ





**29.07.2021 | HALL-6**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Assoc. Prof. Dr. F. Oben ÜRÜ**

P.B.D. Fernando M.D. Pushpakumari	University of Sri Jayawardenepura, Sri Lanka	BLURRED LINES OF WORK-LIFE BALANCE: HOW COVID-19 PANDEMIC REDEFINED THE PERFORMANCE OF ENTRYLEVEL CAREER- WOMEN IN PRIVATE BANKING SECTOR, SRI LANKA
Assoc. Prof. Dr. F. Oben ÜRÜ Assoc. Prof. Dr. Ebru GÖZÜKARA	Istanbul Arel University, Turkey	ASSESSING THE EVOLUTION OF SUSTAINABILITY-LED INNOVATION WITH CASES
M.A.K.De.S., Jayasekera M.D Pushpakumari	University of Sri Jayawardenapura, Sri Lanka	CAN ETHICAL BANKING DO JUSTICE TO CUSTOMER INVESTMENTS?
Dr Muhammad Emad Al- Shaikh	Faisal University	CHARACTERISTICS AND BEST PRACTICES OF ENTREPRENEURIAL MARKETING: LESSONS FOR YOUNG ENTREPRENEURS
Adegboyega S. OYEWOLE Lateef Abiodun SALAMI Toriola, Anu Keshiro Adebosin, Walid Gbadebo	College of Primary Education, NOFORIJA, Lagos Hallmark University, Nigeria	THE COMPARATIVE ANALYSIS OF MANAGEMENT SYSTEMS IN NIGERIAN AND UKRAINIAN UNIVERSITIES
Fatma ALTUNTAS	Istanbul Ayyansaray University, Turkey	CLUSTERING WIND ENERGY TECHNOLOGIES WITH THE K-MEANS METHOD
Dr. Vaniki Joshi Lohani Dr. Mohit Lohani	Jawaharlal Nehru University, Delhi Linen Design Company, INDIA	A STUDY OF A CIVIC CROWDFUNDING CAMPAIGN IN INDIA
Dr. Mohit Lohani Dr. Kapil Sharma Dr. Prabhu Narayan Mishra	Linen Design Company, INDIA Devi Ahilya University, INDIA	A STUDY ON THE EFFECT OF DEMOGRAPHIC VARIABLES ON ELECTRONIC SERVICE QUALITY OF PRODUCT ECOMMERCE IN INDIA
Raghavendra B S Dr. Chandan Chavadi Dr. Ravikeerthi J V	Accenture Financial analyst Bangalore India Presidency College	A STUDY ON AWARENESS OF SMALL FIRMS ON CUSTOMER SATISFACTION WITH COST SAVINGS IN REVERSE LOGISTICS
Assoc.Prof. Dr. Levent AKSU	Balikesira University	THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND CONSUMPTION OF ENERGY RESOURCES IN TURKEY



**Tokyo**

**30.07.2021 | HALL-1**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



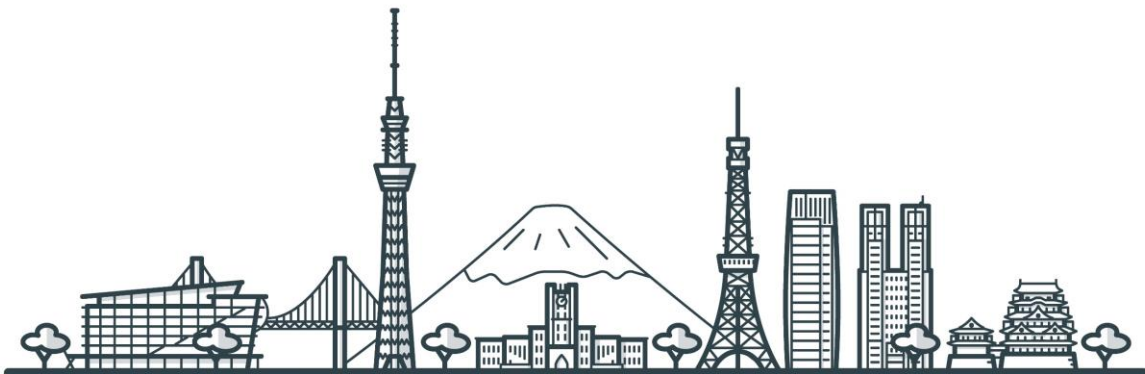
**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Mehmet Cüneyt GÖKÇE**

Yunus ŞAHİNLER Büşra Fatma ÜN Taner ATASOY	Kütahya Dumlupınar University, Turkey Cardiff Metropolitan University Cardiff Wales İstanbul Gelişim University, Turkey	SPORTS PSYCHOLOGY IN THE WORLD AND IN TURKEY
Tuğba Sancar Merve Mamacı	İstanbul Kent University, Turkey Fenerbahçe University, Turkey	AN INVESTIGATION ON PSYCHOLOGICAL RESILIENCE, SELF-EFFICACY AND ACHIEVEMENT- ORIENTED MOTIVATION OF UNIVERSITY STUDENTS DURING PANDEMICS IN TERMS OF DEMOGRAPHIC VARIABLES
Asli Beril KARAKAS Ali Saffet GONUL	Ege University, Turkey	BRAIN VOLUME CHANGES IN MAJOR DEPRESSIVE DISORDER: A NOVEL METHOD
Mehmet ÖZBAŞ Adem DÖLEK	Erzincan Binali Yıldırım University, Turkey	ISLAMIC SOLUTIONS TO LONELY PROBLEMS
Dr. Mehmet Cüneyt GÖKÇE	Harran University, Turkey	DAILS OF DEISM



**Tokyo**



**30.07.2021 | HALL-2**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Ali BAYKAL**

Đinh Thị My Hanh Ngô Tứ Thành Tran Van Hung	University of Danang, Hanoi University of Science and Technology, Vietnam	THE IMPACT OF ARTIFICIAL INTELLIGENCE - THE FUTURE OF HIGHER EDUCATION
Hayati DOKDEMİR Mehmet ÖZBAŞ	Ege University, Turkey Erzincan Binali Yıldırım University, Turkey	INITIAL REGULATIONS AND IN THE FIELD OF EDUCATION DURING II. CONSTITUTIONAL PERIOD (1908-1918)
Ismail Olaniyi MURAINA Sakibu Olajide SAIBU Adebisi Sylvester OLUDE	Ogunsanya College of Education Ogunsanya College of Education Lagos Nigeria	THE USE OF APPEALING TECHNOLOGIES TOWARDS ENSURING HIGH LEVEL OF INTERACTIVITY IN LEARNERS AND TEACHERS
Elesta Sawadi Dencisca Ellyvia Sidin	Keningau Vocational College, Malaysia	WHEEL OF LIFE: TEACHING SCIENCE THROUGH AN ADAPTED VERSION OF SPIN THE WHEEL GAME
Yunus Doğan Veli Batdı Hanen Abazeed	Firat University, Turkey Gaziantep University, Turkey Kilis 7 Aralık Universtiy	A META-THEMATIC ANALYSIS OF THE EFFECTS OF SOCRATIC (QUESTION- ANSWER) METHOD ON EDUCATION
Tamilla Bagirova	Azerbaijan State Pedagogical University	HISTORIKAL ROOTS OF THE PROBLEM OF EDUCATION OF THE INDIVIDUAL AND SOCIETY
Dr Adam Andani MOHAMMED Dr Mpawenimana Abdallah SAIDI Dr Bougangué BASSOUMAH	Social Work Studies, 2 Universiti Malaysia Sarawak UNIMAS, Malaysia University for Development Studies (UDS), Tamale, Ghana	APPROPRIATE LEARNING MANAGEMENT SYSTEM: A SYSTEMATIC REVIEW ON FLEXIBLE TEACHING AND LEARNING
Marlena Daneva Marina Nikolova	Technical University of Sofia, Bulgaria	ETHNO-CULTURAL ASPECTS OF LEARNING ATTITUDES
Ali BAYKAL	Bahçeşehir University, Turkey	COVID19, FRAGILITY, AND HIGHER EDUCATION: HOW INTER-CORRELATED THEY ARE?
Tolga ÖZKAPTAN	Ankara University	VIOLENCE AGAINST WOMEN IN LATIN AMERICA



**Tokyo**

**30.07.2021 | HALL-3**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Tami Meredith**

Manasi, Khidkikar Dr. Walter Andzel Timothy Marshall Thomas Koc Kim Spaccarotella Rachael Milbrook	Kean University, USA	LIFESTYLE BEHAVIORS AND EFFECT OF COVID-19
Tami Meredith Maryanne Fisher	Dalhousie University, Canada Saint Mary's University, Canada	STUDENTS' PERSPECTIVES ON REAL AND IDEAL USES OF INSTRUCTOR'S TIME
Prof. Peddiboyina Vijaya Lakshmi Prof. Palempalli Uma Maheswari Devi	Sri Padmavati Mahila Visvavidyalayam, Tirupati, India Sri Padmavati Mahila Visvavidyalayam, Tirupati, India	TRANS- DISCIPLINARY RESEARCH: A KEY TO COMPREHEND ADOLESCENT HEALTH
Busra AKTAS	Burdur Mehmet Akif Ersoy University, Turkey	GUT-BRAIN AXIS IN PARKINSON'S DISEASE
Full prof. Milen Penerliev, PhD Assoc. Prof. Veselin Petkov	University of Shumen "Konstantin Preslavski" Bulgaria	APPLICATION OF HUMAN GEOGRAPHY METHODS FOR COVID-19 RESEARCH
Muhammet Gümüş Sibel Orhan Emine Kızılkaya Elif MALTAŞ	Cumhuriyet University, Turkey Namık Kemal University, Turkey Karamanoğlu Mehmet Bey University, Turkey Hacı Bayram Veli University, Turkey	THE RELATIONSHIP BETWEEN OPERATIONAL LEADERSHIP AND KNOWLEDGE MANAGEMENT
Ali Tilki Assoc. Prof. Rabia SOHBET	Gaziantep University, Turkey	THE RELATIONSHIP OF OCCUPATIONAL HEALTH SAFETY AND MOTIVATION IN HEALTHCARE WORKERS
Duygu Aydın Dr. Burcu Yuksel	Kocaeli University	REDUCING THE TOXIC EFFECT OF THE ISOTHIAZOLINONE COMPOUND USING VERMICOMPOST
Orou Issiaka SOUNON Hande ÖZGEN	Yıldırım Beyazıt University	EFFECTS OF TOXIC EMOTIONAL EXPERIENCES AND PERCEIVED ORGANIZATIONAL SUPPORT ON POSITIVE WORK BEHAVIORS, WITHDRAWAL BEHAVIORS, AND ANTAGONISTIC WORK BEHAVIORS



**Tokyo**

**30.07.2021 | HALL-4**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



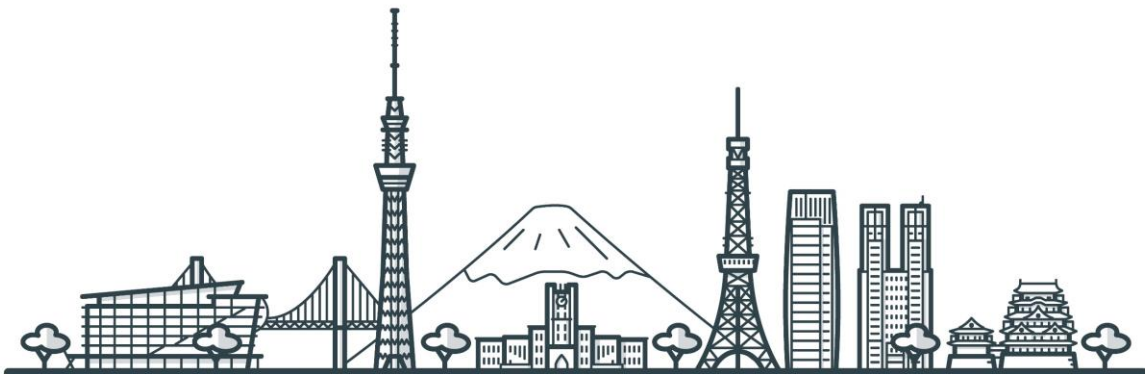
**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Gülşah KARYAĞDI**

Morakeng Edward Kenneth Lebaka	University of Zululand, South Africa	SPIRITUALITY AND ITS RELEVANCE TO SAINT JOHN APOSTOLIC CHURCH: MAPHOPHA CONGREGATION
Amal AL mousa Massouda Qurban	Prince Sattam Unveracity, Saudi Arabia king Saud Unveracity, Saudi Arabia	SPACE-TIME AS AN ENTRANCE TO DESIGN DEVELOPMENT EXERCISES FOR ART TALENTED
Selim Taşkaya	Artvin Meslek Yüksekokulu, Türkiye	LOCAL DETERMINATION OF BROKEN POINT COORDINATES OF BUILDING PLOTS IN SEPARATE ZONING ISLANDS WITH THE COLLINS METHOD
Şebnem ERTAŞ BEŞİR İrem BEKAR	Akdeniz University, Turkey. Karadeniz Technical University, Turkey	LOCALITY IN FURNITURE FEATURES: EASTERN BLACK SEA REGION
Çetin İlhan AKBULUT İlker İNAN Nazlı Ece GEYİK	Doğuş University, Turkey İstanbul Gelişim University, Turkey İzmir Kavram Vocational School	EGİL CAVES AND CASTLE
Dr. Gülşah KARYAĞDI	Beykent University, Turkey	EXAMINATION OF SUSTAINABILITY IN INTERIOR DESIGN WITH EXAMPLES THROUGH WABI SABI



**Tokyo**

**30.07.2021 | HALL-5**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Assoc. Prof. Dr. Maya KUPRAVISHVILI**

Muazaz Azeez AL-Hadeethi Basma M. Al-Obaidi	Baghdad University, Iraq	AN ANATOMICAL AND CHEMICAL COMPARISON STUDY OF EPIPREMNUM AUREUM CULTIVATED IN SOIL AND SOILLESS
Nino Chkhartishvili Londa Mamasakhlisashvili Jaba Abaishvili	Georgian Technical University Scientific-Research Center of Agriculture	THE EFFECT OF GREEN HARVEST ON THE WINE QUALITY
Maya KUPRAVISHVILI	Georgian Technical University, Georgia	MLETA'S GORGE AS A REPRESENTATIVE FACE OF THE MUDFLOW WATERCOURSES OF GEORGIA
Ms. Sonal Chaudhary Dr. Shalini Porwal	Amity University Uttar Pradesh, Noida, Uttar Pradesh	FABRICATION OF BIOENZYMES BY BACTERIA IN PAPER AND PULP INDUSTRY
İlkay AÇIKGÖZ ERKAYA Dilek YALÇIN	Kırşehir Ahi Evran University, Turkey Gazi University Turkey	UNDER GLOBAL SUSTAINABILITY MICROALGAE SPIROGYRA SP. DETERMINATION OF FATTY ACID COMPOSITION OF STRAINS AND ESTABLISHING SCALABILITY IN APPLICATIONS
Ramazan TOSUN Sulhattin YAŞAR	Iğdır University, Turkey Karamanoglu Mehmetbey University, Turkey	EFFECT OF MIXTURE FUNGAL INOCULANT ON NUTRITIONAL COMPOSITION OF SUNFLOWER MEAL BY WAY OF FERMENTATION
Mine KÖKTÜRK Fikret ALTINDAĞ Güneş ÖZHAN Arzu ODUNKIRAN	Iğdır University, Iğdır Van Yüzüncü Yıl University, Turkey Dokuz Eylül University Turkey	NEUROTOXIC EFFECTS CAUSED BY SODIUM NITRITE IN ZEBRAFISH EMBRYOS/LARVAE (DANIO RERIO)



**Tokyo**

**31.07.2021 | HALL-1**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Nahit ÖZTOPRAK**

Ho Duc Tuan Mai Duc Nghia	Nha Trang University, Nha Trang city, VietNam Air Force Officer's college, Nha Trang city, VietNam	STUDY ON THE EFFECT OF THE HIGH- PRESSURE PUMP'S CAM-PROFILE ON FUEL INJECTION PARAMETERS AND DIESEL ENGINE POWER OF THE FISHING VESSEL
Burhan TEPEHAN İsmail Yasin SÜLÜ	İnönü Üniversite, Makine Mühendisliği Bölümü, Malatya/TÜRKİYE	ANALYSIS OF LAYER ARRANGEMENTS FOR LIGHTENED AND STRENGTHENED LAYERED COMPOSITE HELMET DESIGN
Ress. Asst. Murat Toptaş Prof. Dr. Mehmet Yılmaz	Inonu University, Turkey	DESIGN OF SMART FIRE EXTINGUISHING AMMUNITION
Kadir DOĞAN İsmail Yasin SÜLÜ	Inonu University, Turkey	COMPARISON OF STRESSES IN HEALTHY TEETH WITH AMALGAM-RESTORED TEETH UNDER COMPRESSIVE LOAD
Giorgi Noselidze	Georgian Technical University, Georgia	THE HYDRAULICAL COMPARISON AND ECONOMICAL EFFECTIVENESS OF PRACTICAL PROFILE SPILLWAY AND BROAD THRESHOLD STILL WAY BUILDINGS
Berkay SAYILGAN Engin ŞAŞMAZ Aydoğan ÖZDAMAR	Ege University, Turkey Valf Sanayi A.Ş., Turkey. Ege University, Turkey	OPTIMIZATION OF LPG CYLINDER VALVE SAFETY PIN
Nahit ÖZTOPRAK	Dokuz Eylül University, Turkey	QUASI-STATIC INDENTATION (QSI) RESISTANCE AT DIFFERENT LOADING RATES AND COMPRESSIVE RESPONSE OF HOT TOOL WELDED (HTWD) DISSIMILAR THERMOPLASTIC JOINTS
Masood A. Masood Abdussalam Ali Ahmed Zayad M. Sheggaf	Bani Waleed University, Bani Waleed, Libya College of Technical Sciences, Bani Waleed, Libya.	THE PERFORMANCE OF EXHAUST GAS RECIRCULATION (EGR) ON A SINGLE- CYLINDER DIESEL ENGINE (EMISSIONS LEVELS)
İbrahim KARATAŞ Abdulkadir BUDAK	Osmaniye Korkut Ata University, Turkey	PREDICTION OF LABOR ACTIVITY RECOGNITION IN CONSTRUCTION WITH MACHINE LEARNING ALGORITHMS
Dr. Osman OKUYUCU	Tekirdağ Namık Kemal University, Turkey	STEEL FIBER REINFORCED FLOWABLE FILL



**Tokyo**



Nino Kacharava Natali Maisuradze Nia Iskandarova	San Diego State University Georgia, Georgia	TRAFFIC CONGESTION AND EFFICIENT WAYS TO DEAL WITH IT IN TBILISI, GEORGIA
Halis Kandaş Fatih Balıkoğlu Tayfur Kerem Demircioğlu	Dokuz Eylül University Balıkesir University	EXPERIMENTAL STUDY ON QUASI-STATIC PUNCH SHEAR RESISTANCE OF GRID- SCORED FOAM CORE SANDWICH COMPOSITES

**31.07.2021 | HALL-2**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

### HEAD OF SESSION: Prof. Dr. Lincy Joseph

Dr. Ersin BEYAZÇİÇEK Dr. Özge BEYAZÇİÇEK	Duzce University, Turkey	EFFECTS OF OXYMATRINE ON THE PENICILLIN INDUCED EPILEPTIFORM ACTIVITY IN RATS: AN ELECTROPHYSIOLOGICAL STUDY
Prof. Dr. Lincy Joseph Prof. Dr. Mathew George	Sharda University, Noida, India	ANTI-DIABETIC POTENTIAL OF NEWLY SYNTHESIZED OXYGEN AND NITROGEN CONTAINING HETEROCYCLIC DERIVATIVES
Prof. Dr. Mathew George Prof. Dr. Lincy Joseph	Sharda University, Noida, India	NOVEL PRESCRIBING PATTERN AND IMPACT ON PSYCHOSOCIAL HEALTH OF PATIENTS UNDERGOING HAEMODIALYSIS
Slaveyka Paneva Silvia Tsanova-Savova Stefan Velikov	Medical University, Sofia	TOTAL PHENOLIC AND TOTAL FLAVONOIDS CONTENT OF BULGARIAN MEDICAL PLANTS
Assist. Prof. Dr. Arzu AY	Trakya University, Turkey	DETERMINATION OF THE RELATIONSHIP BETWEEN CYP1A1 T1101C (rs 1048943) GENE VARIATION AND SERUM COPPER LEVELS IN COLORECTAL CANCER PATIENTS
KERIMZADE G.E.	Azerbaijan Medical University, Baku, Azerbaijan	TO THE INTERNAL STRUCTURE OF THE FACIAL NERVE
Assist. Prof. Tuğra AKKUŞ	Harran University, Sanliurfa-TURKEY	THE EFFECT OF BIRTH TYPE ON TOTAL THIOL AND NATIVE THIOL IN ALEPPO GOATS AND KIDS
Shekhmous H. Hussien Sherzad M. Hussein Sarbast I. Mustafa Renas H.Issa Mwafaq S. Berwary	University of Duhok, Duhok, Iraq	MAY CHICKEN CORONAVIRUS MUTATE INTO COVID-19-LIKE VIRUS?
Dr. Melahat Toker Prof. Dr. Mehmet İriadam	Başkent University, Turkey Harran University, Turkey	DETERMINATION OF THE FREQUENCY OF PULMONARY STRAIN IN HUMAN AND ANIMALS BY ECHOCARDIOGRAPHY



**Tokyo**

Huseynova Gulgiz Agagasan Nasirova Zarifa Jahangir	Azerbaijan Medical University, Baku, Azerbaijan	FEATURES OF THE MIELINIZATION IN DIFFERENT PARTS OF THE OCULOMOTOR NERVE
---	---	--

**31.07.2021 | HALL-3**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



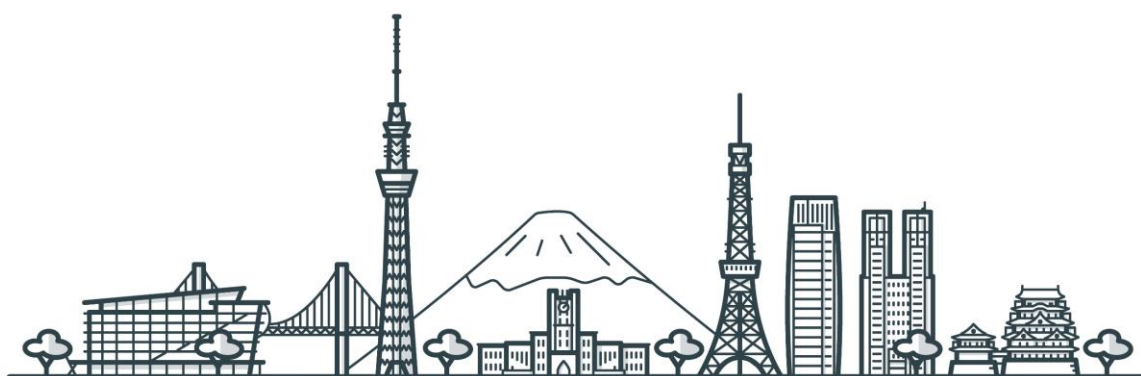
**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

### HEAD OF SESSION: Assist. Prof. Dr. Nevra Alkanli

SAGHOURI EL IDRISSI Imane KETTANI Rajae FERRAHI Moha BRHADDA Najiba ZIRI Rabea	National Institute of Agronomic Research (INRA), Morocco University of Ibn Tofail, Morocco	STUDY OF THE ADAPTATION TO WATER DEFICIT OF SOME HARD WHEAT VARIETIES: POTENTIAL INTEREST OF THESE VARIETIES FOR PRODUCTION IMPROVEMENT
Assist. Prof. Dr. Nevra Alkanli Assist. Prof. Dr. Alev Bakir	Haliç University, Turkey Haliç University, Turkey	INVESTIGATION OF PLASMA TOTAL HOMOCYSTEINE LEVELS IN ISCHEMIC STROKE PATIENTS AND PATIENT SUBGROUPS
Ömer ABIÇ Assoc. Prof. Dr. Rabia SOHBET	Gaziantep University, Turkey	THE EFFECT OF FAMILY VALUES ON VACCINATION ACCEPTANCE AND REJECTION
Bouneguet Soumia Messioud Salah	Université de Jijel/LGCE , Algérie	VERTICAL AND HORIZONTAL DYNAMIC IMPEDANCES OF SUCTION FOUNDATIONS
Hayriye Kul Karaali Duygu Ilgın Özlem Özcan	Manisa Celal Bayar University, Turkey	PHYSIOTHERAPY AND REHABILITATION DEPARTMENT STUDENTS AND NATIONAL COLOR CODING SYSTEM IN HEALTH CARE
Ozge COŞKUN Özcan GAYRETLİ Osman COŞKUN Buse Naz ÇANDIR Ayşin KALE Adnan ÖZTÜRK	İstanbul University, Turkey	MORPHOMETRIC EVALUATION OF THYROCERVICAL TRUNK
Kamala Sh. Babazade, Aghasamid B. Isayev	Azerbaijan medical University, Azerbaijan	ANATOMICAL VARIANTS OF THE INCISIAL FORAMEN



**Tokyo**



**31.07.2021 | HALL-4**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Dr. Nurdan Sezgin**

Afaq Nurullayeva Irana Galandarli	Azerbaijan National Academy of Sciences, Institute of Physiology named after Academician Abdullav Garayev, Baku, Azerbaijan	ROLE OF ADMINISTRATION OF SEROTONIN- MODULATING ANTICONSOLIDATION PROTEIN IN MITIGATION OF PRO-OXIDATIVE EFFECTS OF HIGH DOSES OF $\gamma$ -IRRADIATION
Irana Galandarli Afaq Nurullayeva	Azerbaijan National Academy of Sciences, Institute of Physiology named after Academician Abdullav Garayev, Baku, Azerbaijan	STUDY OF THE REHABILITATION ROLE OF SELENIUM-CONTAINING CURCUMA AND SAFRON PREPARATIONS IN THE EXPERIMENTAL MODEL OF ALZHEIMER'S DISEASE
Calviana Adeline Tadahogay Martin	Keningau Vocational College, Keningau, Sabah	EXAMINING THE EMPLOYABILITY OF GRADUATES SPECIALIZED IN COSMETOLOGY PROGRAMME
MSc Zehra Kubra Yilmaz Prof. Dr. Belma Aslim Assoc. Prof. Dr. Ozlem Ozdemir	Gazi University, Turkey	IN VITRO ANTIOXIDANT PROPERTIES OF 2-(4- (2 HYDROXYBENZYLIDENEAMINO)BENZYLIDENE AMINO)BENZOIC ACID
Dr. Lakshmi Nidhi Rao Dr. Aditya Shetty	A.B.Shetty Memorial Institute of Dental sciences, Nitte Deemed to be University, India	EMERGENCE OF BIO-INSPIRED POLYDOPAMINE AS A BIOMATERIAL
Nurdan Sezgin Şükriye Karadayı Beytullah Karadayı	Kütahya Health Sciences University, Turkey Altınbaş University, Turkey İstanbul University- Cerrahpaşa, Turkey	PUBLISHING RATES OF ABSTRACTS PRESENTED AT THE AMERICAN ACADEMY OF FORENSIC SCIENCES MEETINGS IN 2011 AND 2016
Işıl Sezen Ermiş İlhan Özdemir Engin DEVECİ	Atatürk University Dicle University	EVALUATION OF THE IMPORTANCE OF GRANULOSA CELLS AND CASPASE-3, TNF- IMMUNE ACTIVITY IN IVF FERTILIZATION SUCCESS
Ilhan Ozdemir Engin DEVECİ Cenap EKİNCİ Şamil ÖZTÜRK	Atatürk University Dicle University	EVALUATION OF THE EFFECTS OF OXIDATIVE STRESS-INDUCED CHANGE IN OVARIAN GERM CELLS IN INFERTILITY
Işıl Sezen Ermiş İlhan Özdemir Engin DEVECİ	Dicle University	EVALUATION OF IL-10, CASPAS-6 EXPRESSION IN STEM VILLUS STRUCTURE IN

**Tokyo**

Çanakkale Onsekiz Mart  
University

THE CONNECTING ROOT IN NORMOTENSIVE  
AND PLACENTA PREVIA PATIENTS

**31.07.2021 | HALL-5**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

### HEAD OF SESSION: Prof. Dr. Ahmet Niyazi ÖZKER

Banu HAS Sinan ÇINAR	Ege University, Turkey	MILITARY EXPENDITURES AND ECONOMIC GROWTH IN TURKEY: COINTEGRATION AND CAUSALITY ANALYSIS
GULARA RAHIMOVA NARMIN GULIYEVA	Baku State University, Azerbaijan	CONSTRUCTION OF ECONOMETRIC MODEL BASED ON ECONOMIC INDICATORS AND FORECAST WITH THE BEST MODEL
GULARA RAHIMOVA NARMIN GULIYEVA	Baku State University, Azerbaijan	EXAMPLES OF REGRESSION AND CORRELATION ANALYSIS IN ECONOMETRIC STUDIES
Svetlana Slusarenco Veronica Pozneacova	Moldova State University, Moldova	THE CONCEPT OF SOCIAL CONTRACT IN JOHN LOCKE'S POLITICAL PHILOSOPHY
Mehtap Aracı Kazıcı	Nevşehir Hacı Bektaş Veli University, Turkey	OVERVIEW OF EMPLOYEE THEFT IN TURKEY AND IN THE WORLD AND STUDIES ON PREVENTION
Serdar ÖZÖZEN	Uludag University, Turkey	MEASUREMENT OF JAPAN'S INTRA- INDUSTRY TRADE LEVEL ACCORDING TO FACTOR INTENSITY (1988-2020)
Polya Yordanova	University of Veliko Tarnovo, Bulgaria,	RETROSPECTIVE ECONOMIC ANALYSIS FOR THE DEVELOPMENT OF THE HORSE BREEDING INDUSTRY
Dr. Kamran Ahmed Siddiqui	Imam Abdulrahman Bin Faisal University, Saudi Arabia	CLASSIFYING INTERBRANDS TOP 100 GLOBAL BRANDSBASED ON TEXTUAL AND VISUAL ELEMENTS OF LOGO DESIGN
Prof. Dr. Ahmet Niyazi ÖZKER Burcu CANPULAT	Bandırma Onyedi Eylül University, TURKEY	THE POSITION OF PUBLIC EXPENDITURES IN THE PROCESS OF ECONOMIC GROWTH: AN EVALUATION OF TURKEY
Mehmet Salih Sancaroğlu Murat Yücel	Gazi University, TURKEY	EFFICIENCY INCREASING APPROACHES AND PRIORITY IDENTIFICATION SYSTEM IMPLEMENTATION IN ITIL-BASED SERVICE DESK SYSTEMS



Tokyo

**31.07.2021 | HALL-6**



**Tokyo Local Time: 15<sup>00</sup>-17<sup>30</sup>**



**Ankara Local Time: 09<sup>00</sup>-11<sup>30</sup>**



**Meeting ID: 833 6404 6776 | Passcode: 708610**

**HEAD OF SESSION: Nusret Salman ogluy Babayev**

Garmidarova Evgeniya Igorevna Babayev Nusret Salman	<i>Finance and Financial Institutions of the State Economic University of Azerbaijan</i>	THE IMPACT OF GLOBALIZATION ON THE MANAGEMENT OF BANKING CAPITAL IN THE COUNTRIES OF THE WORLD
Hasan.Khurshud Behbuzzadeh	<i>Finance and Financial Institutions of the Azerbaijan State University of Economics,</i>	MEANS OF MONETARY REGULATION OF THE STATE AND ITS IMPLEMENTATION
Nusret Salman ogluy Babayev Habil Huseyn oglu Aslanov	<i>Finance and Financial Institutions of the Azerbaijan State University of Economics, Baku stateUniversity</i>	The country's foreign trade policy and its role in integration into the international economy
Ramiz Najafli	Baku State University	KALBAJAR MUSEUM OF HISTORY AND ETHNOGRAPHY AS A SOURCE FOR THE STUDYING OF HISTORICAL MONUMENTS
Dr. Gökberk DURMAZ Dr. Güray ALPAR	University of Ankara (ASBU), Ankara, TURKEY Institute of Strategic Thinking, Ankara, TURKEY	JAPAN AND THE USA IN THE ERA OF HIGHLY-SKILLED IMMIGRATION: COMPARISON BETWEEN TSUKUBA SCIENCE CITY AND PALO ALTO (SILICON VALLEY)
Dr. Haydar HOŞGÖR	Uşak University	THE EFFECT OF INTERNET ADDICTION ON THE HAPPINESS AND LONELINESS LEVELS OF MEDICAL SECRETARY CANDIDATES
Assoc. Prof. Sarkhan Khaveri	Scientific secretary of the Presidium of ANAS Azerbaijan	AZERBAIJAN FOLKLORE IN THE CONTEXT OF FUNCTIONAL STRUCTURAL SYSTEM DURING REPRESSION
Büşra GÜNEŞ	Firat University, Turkey	RESEARCH ON PSYCHOLOGICAL RESILIENCE IN ADOLESCENTS: A SCALE DEVELOPMENT STUDY
Thu Hang Pham	The People's Police Academy, Hanoi, Vietnam	SOCIAL LOAFERS' CONTINUOUS SOCIAL LOAFING – A MEDIATOR IN THE RELATIONSHIP BETWEEN TEAMMATES' SOCIAL COMPENSATION AND LOW TEAM PERFORMANCE



**Tokyo**

# CONTENT

CONGRESS ID	I
PROGRAM	II
PHOTO GALLERY	III
CONTENT	IV

Author	Title	No
Emine BAŞ	PERFORMANCE ANALYSIS OF GRAY WOLF OPTIMIZATION AND SALP SWARM ALGORITHM	1-9
Cemil KÖZKURT	SOLUTION OF THE STEP-CONE PULLEY PROBLEM WITH RECENT OPTIMIZATION ALGORITHMS	10-20
Pengfei Yao, Surendra M. Gupta	ANT COLONY OPTIMIZATION ALGORITHM FOR SOLVING U-SHAPED DISASSEMBLY LINE BALANCING PROBLEM WITH MULTIPLE OBJECTIVES	21-26
Raad N. Butris & Sahla B.Abd	PERIODIC SOLUTIONS OF VOLTERRA INTEGRO-DIFFERENTIAL EQUATIONS WHICH HAVE THE RETARDED ARGUMENT WITH BOUNDARY CONDITIONS OF GAMMA FUNCTIONS	28-55
Nuri BAŞUSTA	AGE DETERMINATION STUDIES FROM DIFFERENT STRUCTURES OF THE PURPLE DYE MUREX (BOLINUS BRANDARIS) INHABITING AEGEAN SEA	56-61
Zeynel Abidin SARI , M. Deniz TURAN, Mustafa BOYRAZLI, Murat ERDEMOĞLU	PHOTOCHEMICAL OXIDATION AND DISSOLUTION OF COPPER SLAG IN ACIDIC MEDIA	62-67
Ilavenil K. K, Senthil Kumar . V	ANTIMICROBIAL INVESTIGATION AND DOCKING ANALYSIS OF QUINOLINE COMPOUNDS	68-71
Md. Mahbubor RAHMAN Ismail KARACAN	STRUCTURE AND PROPERTIES OF THERMALLY STABILIZED POLY(HEXAMETHYLENE ADIPAMIDE) AS CARBON FIBER PRECURSOR: X-RAY DIFFRACTION, TGA, AND FT-IR SPECTROSCOPY ANALYSIS	72-78
Canan COŞKUN	PSYCHOLOGICAL PERSPECTIVES OF THE STUDY CALLED THE STRANGE LIBRARY BY HARUKI MURAKAMI	79-86
Hawzhen Slewa Issa , Ala Dara abdul Majed	THE FOUNDATIONS OF AESTHETICS IN THE TEXT IN THE VISION OF THE POET "MAEDUMI"	87-101
Begüm KURT	THE PERCEPTION OF THE CHAOTIC WORLD IN ARCHAIC MAN: DEMONS IN SUMERIAN AND TURKISH MYTHOLOGIES	102-114
Aliyeva Maralkhanim Tofig gizi	INTEGRATED APPROACH IN TEACHING CONDUCTOR AS THE BASIS FOR THE DEVELOPMENT OF THE CREATIVE PERSONALITY OF FUTURE MUSIC TEACHERS	115-122
Asst. Prof. Dilşah KALAY, Lect. Turgut KALAY	THE CONNOTATIONS OF JAPANESE WORDS WRITTEN IN KANJI ALPHABET: A "COLOR"FUL REPRESENTATION	123-128
Kheda MAMYSHEVA	RUSSIAN IN KAZAKHSTAN: LANGUAGE IDEOLOGIES, LINGUISTIC PROCESSES, AND REACTIONS OF THE CHECHEN-INGUSH DIASPORA ON LINGUISTIC CHANGES	129-139
Sara Rodriguez, Joseph Youssif Saab Junior, Alexandre Martuscelli de Faria, Marcos de Mattos Pimenta	PNOISE AND THE IMPORTANCE OF WIND TURBINE NOISE PREDICTION	140-149
Ramin Chikhladze Ketevan Chikhladze Zurab Janiashvili	INFLUENCE OF IMPURITIES ON THE PROPERTIES OF NEW TRANSFORMER OIL	150-154
Abdullayev Anar Arif	ACCUMULATOR BATTERIES AND FUEL ELEMENTS	155-165
Sena KURT	THE RELATIONSHIP OF INTERNATIONAL COLLECTIVE MEMORY AND CINEMA: ERTUĞRUL 1890 (125 YEARS MEMORY/ KAINAN 1890)	166-175

<b>Mustafa BÖLÜKBAŞI</b>	PANDEMIC, INFODEMIC AND INFORMATION DISORDER: A QUALITATIVE CONTENT ANALYSIS ON FALSE INFORMATION DURING CORONAVIRUS	176-181
<b>Ahmed Jameel Sabr</b>	MORPHO-TAXONOMIC STUDY OF TABANUS UNIFASCIATUS LOEW, 1858 (DIPTERA: TABANIDAE). NEW RECORD FOR IRAQ	182-188
<b>M.A.K.De.S., Jayasekera M.D Pushpakumari</b>	CAN ETHICAL BANKING DO JUSTICE TO CUSTOMER INVESTMENTS?	189-194
<b>Levent AKSU</b>	THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND CONSUMPTION OF ENERGY RESOURCES IN TURKEY	195-214
<b>Asli Beril KARAKAS, Ali Saffet GONUL</b>	BRAIN VOLUME CHANGES IN MAJOR DEPRESSIVE DISORDER: A NOVEL METHOD	215-222
<b>Mehmet ÖZBAŞ, Adem DÖLEK</b>	ISLAMIC SOLUTIONS to LONELY PROBLEMS	223-236
<b>Mehmet Cüneyt GÖKÇE</b>	DAILS OF DEISM	237-240
<b>Hayati DOKDEMİR Mehmet ÖZBAŞ</b>	INITIAL REGULATIONS AND PUBLICATIONS IN THE FIELD OF EDUCATION DURING II. CONSTITUTIONAL PERIOD (1908-1918)	241-254
<b>Bagirova Tamilla Ali kızı</b>	HISTORIKAL ROOTS OF THE PROBLEM OF EDUCATION OF THE INDIVIDUAL AND SOCIETY	255-261
<b>Ismail Olaniyi MURAINA, Sakibu Olajide SAIBU, Adebisi Sylvester OLUDE</b>	THE USE OF APPEALING TECHNOLOGIES TOWARDS ENSURING HIGH LEVEL OF INTERACTIVITY IN LEARNERS AND TEACHERS	262-268
<b>Yunus DOĞAN, Veli BATDI, Hanen ABAZEED</b>	A META-THEMATIC ANALYSIS OF THE EFFECTS OF SOCRATIC (QUESTION-ANSWER) METHOD ON EDUCATION	269-278
<b>Adam Andani MOHAMMED, Mpawenimana Abdallah SAIDI, Dr Bougangué BASSOUMAH</b>	APPROPRIATE LEARNING MANAGEMENT SYSTEM: A SYSTEMATIC REVIEW ON FLEXIBLE TEACHING AND LEARNING	279-287
<b>Marlena Daneva , Marina Nikolova</b>	ETHNO-CULTURAL ASPECTS OF LEARNING ATTITUDES	288-295
<b>Ali BAYKAL</b>	COVID19, FRAGILITY, AND HIGHER EDUCATION: HOW INTER-CORRELATED THEY ARE?	296-302
<b>Tami Meredith, Maryanne Fisher</b>	STUDENTS' PERSPECTIVES ON REAL AND IDEAL USES OF INSTRUCTOR'S TIME	303-309
<b>Busra AKTAS</b>	GUT-BRAIN AXIS IN PARKINSON'S DISEASE	310-315
<b>Orou Issiaka SOUNON, Hande ÖZGEN</b>	EFFECTS OF TOXIC EMOTIONAL EXPERIENCES AND PERCEIVED ORGANIZATIONAL SUPPORT ON POSITIVE WORK BEHAVIORS, WITHDRAWAL BEHAVIORS, AND ANTAGONISTIC WORK BEHAVIORS	316-328
<b>Rabia SOHBET Ali Tilki</b>	THE RELATIONSHIP OF OCCUPATIONAL HEALTH SAFETY AND MOTIVATION IN HEALTHCARE WORKERS	329-339
<b>Selim TAŞKAYA</b>	LOCAL DETERMINATION OF BROKEN POINT COORDINATES OF BUILDING PLOTS IN SEPARATE ZONING ISLANDS WITH THE COLLINS METHOD	340-347
<b>Şebnem ERTAŞ BEŞİR İrem BEKAR</b>	LOCALITY IN FURNITURE FEATURES: EASTERN BLACK SEA REGION	348-356
<b>Gülşah KARYAĞDI</b>	EXAMINATION OF SUSTAINABILITY IN INTERIOR DESIGN WITH EXAMPLES THROUGH WABI SABI	357-368
<b>Muazaz Azeez AL-Hadeethi, Basma M. Al-Obaidi</b>	AN ANATOMICAL AND CHEMICAL COMPARISON STUDY OF EPIPREMNUM AUREUM CULTIVATED IN SOIL AND SOILLESS	369-379
<b>Maya Kupravisvili</b>	MLETA'S GORGE AS A REPRESENTATIVE FACE OF THE MUDFLOW WATERCOURSES OF GEORGIA	380-389
<b>Ramazan TOSUN, Sulhattin YAŞAR</b>	EFFECT OF MIXTURE FUNGAL INOCULANT ON NUTRITIONAL COMPOSITION OF SUNFLOWER MEAL BY WAY OF FERMENTATION	390-396
<b>Mine KÖKTÜRK, Fikret ALTINDAĞ, Güneş ÖZHAN, Arzu ODUNKIRAN5</b>	NEUROTOXIC EFFECTS CAUSED BY SODIUM NITRITE IN ZEBRAFISH EMBRYOS/LARVAE (DANIO RERIO)	397-407
<b>Ho Duc Tuan, Mai Duc Nghia</b>	STUDY ON THE EFFECT OF THE HIGH-PRESSURE PUMP'S CAM-PROFILE ON FUEL INJECTION PARAMETERS AND DIESEL ENGINE POWER OF THE FISHING VESSEL	408-413



<b>Burhan TEPEHAN, İsmail Yasin SÜLÜ</b>	ANALYSIS OF LAYER ARRANGEMENTS FOR LIGHTENED AND STRENGTHENED LAYERED COMPOSITE HELMET DESIGN	414-427
<b>Murat Toptaş Mehmet Yılmaz</b>	DESIGN OF SMART FIRE EXTINGUISHING AMMUNITION	428-435
<b>Kadir DOĞAN, İsmail Yasin SÜLÜ</b>	COMPARISON OF STRESSES IN HEALTHY TEETH WITH AMALGAM-RESTORED TEETH UNDER COMPRESSIVE LOAD	436-444
<b>Giorgi NOSELIDZE</b>	THE HYDRAULICAL COMPARISON AND ECONOMICAL EFFECTIVENESS OF PRACTICAL PROFILE SPILLWAY AND BROAD THRESHOLD STILL WAY BUILDINGS	445-449
<b>Berkay SAYILGAN, Engin ŞAŞMAZ, Aydoğan ÖZDAMAR</b>	OPTIMIZATION OF LPG CYLINDER VALVE SAFETY PIN	450-462
<b>Nahit ÖZTOPRAK</b>	QUASI-STATIC INDENTATION (QSI) RESISTANCE AT DIFFERENT LOADING RATES AND COMPRESSIVE RESPONSE OF HOT TOOL WELDED (HTWED) DISSIMILAR THERMOPLASTIC JOINTS	463-472
<b>Masood A. Masood, I.S. Naser, Abdussalam Ali Ahmed, Zayad M. Sheggaf, Ahmad A. M. Idris</b>	EVALUATION AND INFLUENCE OF HOT EXHAUST GAS RECIRCULATION TECHNOLOGY ON THE PERFORMANCE OF A SINGLE-CYLINDER DIESEL ENGINE AND EMISSION LEVELS	473-486
<b>Nino Kacharava , Natali Maisuradze , Nia Iskandarova</b>	TRAFFIC CONGESTION AND EFFICIENT WAYS TO DEAL WITH IT IN TBILISI, GEORGIA	487-495
<b>Arzu AY</b>	DETERMINATION OF THE RELATIONSHIP BETWEEN CYP1A1 T1101C (rs 1048943) GENE VARIATION AND SERUM COPPER LEVELS IN COLORECTAL CANCER PATIENTS	496-502
<b>KERIMZADE G.E.</b>	TO THE INTERNAL STRUCTURE OF THE FACIAL NERVE	503-505
<b>Nevra Alkanli, Alev Bakir</b>	INVESTIGATION OF PLASMA TOTAL HOMOCYSTEINE LEVELS IN ISCHEMIC STROKE PATIENTS AND PATIENT SUBGROUPS	513-519
<b>Ömer ABİÇ, Rabia SOHBET</b>	THE EFFECT OF FAMILY VALUES ON VACCINATION ACCEPTANCE AND REJECTION	520-525
<b>Işıl Sezen Ermiş, İlhan Özdemir, Engin DEVECİ</b>	EVALUATION OF THE IMPORTANCE OF GRANULOSA CELLS AND CASPASE-3, TNF-IMMUNE ACTIVITY IN IVF FERTILIZATION SUCCESS	526-531
<b>İlhan Özdemir, Engin DEVECİ , Cenap EKİNCİ, Şamil ÖZTÜRK</b>	EVALUATION OF THE EFFECTS OF OXIDATIVE STRESS-INDUCED CHANGE IN OVARIAN GERM CELLS IN INFERTILITY	533-535
<b>Işıl Sezen Ermiş, İlhan Özdemir, Engin DEVECİ</b>	EVALUATION OF IL-10, CASPAS-6 EXPRESSION IN STEM VILLUS STRUCTURE IN THE CONNECTING ROOT IN NORMOTENSIVE AND PLACENTA PREVIA PATIENTS	536-544
<b>GULARA RAHIMOVA NARMIN GULIYEVA</b>	EXAMPLES OF REGRESSION AND CORRELATION ANALYSIS IN ECONOMETRIC STUDIES	545-554
<b>GULARA RAHIMOVA NARMIN GULIYEVA</b>	CONSTRUCTION OF ECONOMETRIC MODEL BASED ON ECONOMIC INDICATORS AND FORECAST WITH THE BEST MODEL	555-563
<b>Svetlana Slusarenco , Veronica Pozneacova</b>	THE CONCEPT OF SOCIAL CONTRACT IN JOHN LOCKE'S POLITICAL PHILOSOPHY	564-571
<b>Ahmet Niyazi ÖZKER, Burcu CANPULAT</b>	THE POSITION OF PUBLIC EXPENDITURES IN THE PROCESS OF ECONOMIC GROWTH: AN EVALUATION OF TURKEY	572-583
<b>Mehmet Salih SANCAROĞLU, Murat YÜCEL</b>	EFFICIENCY INCREASING APPROACHES AND PRIORITY IDENTIFICATION SYSTEM IMPLEMENTATION IN ITIL-BASED SERVICE DESK SYSTEMS	584-592
<b>Garmidarova Evgeniya Igorevna Babayev Nusret Salman</b>	THE IMPACT OF GLOBALIZATION ON THE MANAGEMENT OF BANKING CAPITAL IN THE COUNTRIES OF THE WORLD	593-603
<b>Nusret Salman ogluy Babayev Habil Huseyn oglu Aslanov</b>	THE COUNTRY'S FOREIGN TRADE POLICY AND ITS ROLE IN INTEGRATION INTO THE INTERNATIONAL ECONOMY	604-609
<b>Ramiz Najafli</b>	KALBAJAR MUSEUM OF HISTORY AND ETHNOGRAPHY AS A SOURCE FOR THE STUDYING OF HISTORICAL MONUMENTS	610-615

<b>Gökberk DURMAZ</b> <b>Güray ALPAR</b>	JAPAN AND THE USA IN THE ERA OF HIGHLY-SKILLED IMMIGRATION: COMPARISON BETWEEN TSUKUBA SCIENCE CITY AND PALO ALTO (SILICON VALLEY)	616-620
<b>Haydar HOŞGÖR</b>	THE EFFECT OF INTERNET ADDICTION ON THE HAPPINESS AND LONELINESS LEVELS OF MEDICAL SECRETARY CANDIDATES	621-631
<b>Thu Hang Pham</b>	SOCIAL LOAFERS' CONTINUOUS SOCIAL LOAFING – A MEDIATOR IN THE RELATIONSHIP BETWEEN TEAMMATES' SOCIAL COMPENSATION AND LOW TEAM PERFORMANCE	632-637
<b>Sərxan XAVƏRİ</b>	REPRESSİYA İLLƏRİNDƏ AZƏRBAYCAN FOLKLORŞÜNASLIĞI FUNKSIONAL STRUKTUR SİSTEMİ KONTEKSTİNDƏ	638-642



## PERFORMANCE ANALYSIS OF GRAY WOLF OPTIMIZATION AND SALP SWARM ALGORITHM

**Lecturer Dr. Emine BAŞ**

ORC-ID: 0000-0003-4322-6010

*Kulu Vocational School, Selçuk University, 42075, Konya, Turkey*

### Abstract

This article focuses on two intuitive methods that exemplify the lifestyle of living things with the leader chosen by the herd. Algorithms used in the study; Gray Wolf Optimization (GWO) and Salp Swarm Algorithm (SalpSA). Herd behavior is a common behavior of animals of similar size and brought together in the same place or migrating in the same direction. Gray wolves often act on average 5-12 wolves. Each gray wolf in the herd has a different mission and name. Different names are given to gray wolves according to their work; alpha, beta, delta, and omega. Another important algorithm is the Salp Swarm (SalpSA) algorithm. SalpSA examined the lifestyle of the Salp herd. SalpSA is inspired by the fusion behavior of salps while navigating the oceans and searching for food. The common feature of the two algorithms in this article is that they are herd-based algorithms. It has been compared with the examination of GWO and SalpSA methods and they tested on benchmark optimization problems. In addition, a performance comparison is made with Jaya and BA algorithms. GWO and SalpSA are more successful than the BA algorithm. But they could not pass the performance of the Jaya algorithm. The obtained results were satisfactory for the algorithms but it can be improved in other ways.

**Keywords:** Gray wolf, Salp swarm, Optimization

### 1. Introduction

In recent years, heuristic methods have become very popular. The most important reason for this is that it can be easily adapted to many different problem types. Nowadays, there are old and new methods that involve the difficult problems and solution suggestions which many researchers research and try to solve (İhsan and Ülker, 2017; Baş and Ülker, 2020). Nowadays, scientists are researching solutions to different problems. The lives of animals are modeled and new algorithms are found. Different algorithms have been developed for problems in the literature. There are two algorithms that are newly used and whose successes are remarkable. The two algorithms we use in the study have a common feature. Gray wolves and salp swarm live in flocks and have a leader. Both algorithms have been proposed by Mirjalili et al. Mirjalili et al. improved GWO in 2014 and Mirjalili et al. improved SalpSA in 2017. In the study, we examine these two algorithms and compare them according to success rates. In Section 2, GWO and SalpSA algorithms are introduced. In Section 3, GWO and SalpSA were run on thirteen unimodal and multi-modal benchmark problems, and their performance was demonstrated, and comparisons were also made with BA and Jaya algorithms.

### 2. Material and Method

#### 2.1. Salp Swarm Algorithm

Salps belong to the Salpidae family and have a transparent barrel-shaped body (Mirjalili et al., 2017). The most important feature of salps is their fusion behavior. In deep oceans, salps form a swarm called the salp chain. They use this behavior to obtain better food. SalpSA was created inspired by these behaviors of salp herds. First of all, salp chains are modeled

mathematically. For this, the population is divided into two groups (leader and followers). The leader is the salp at the front of the chain, whereas the rest of the salps are considered followers (Mirjalili et al., 2017). Salps (leaders) use Equation 1 to change position for SalpSA.

$$x_j^1 = \begin{cases} F_j + c_1 ((ub_j - lb_j)c_2 + lb_j) & c_3 \geq 0 \\ F_j - c_1 ((ub_j - lb_j)c_2 + lb_j) & c_3 < 0 \end{cases} \quad (1)$$

where  $x_j^1$  shows the position of the first salp (leader),  $F_j$  shows food source.  $c_1, c_2$ , and  $c_3$  show random integers.  $ub_j$  and  $lb_j$  show upper bound and lower bound, respectively.  $c_1$  is the most important value for SalpSA. Because the ability of exploration and exploitation is adjusted by this value for SalpSA.

$$c_1 = 2e^{-\left(\frac{4l}{L}\right)^2} \quad (2)$$

where  $l$  is the current iteration and  $L$  is the maximum number of iterations.  $c_2$  and  $c_3$  can be randomly selected values between  $[0, 1]$ .

Salps (followers) use Equations 3-5 to change position for SalpSA.

$$x_j^i = \frac{1}{2}at^2 + v_0t \quad (3)$$

$$a = \frac{v_{final}}{v_0} \quad (4)$$

$$v = \frac{x - x_0}{t} \quad (5)$$

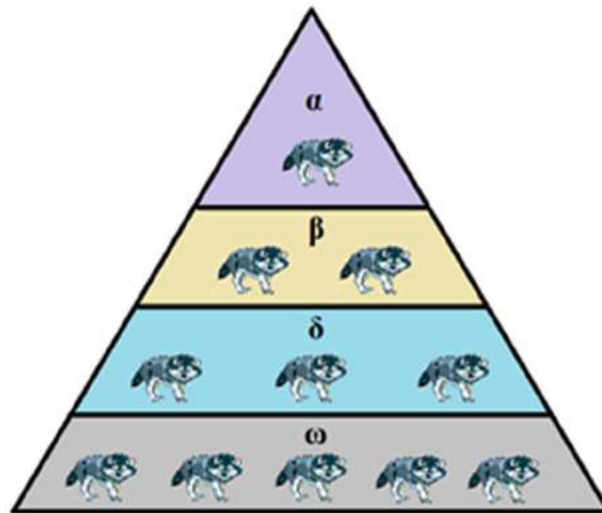
where  $i \geq 2$ ,  $x_j^i$  shows the position of  $i$ th follower salp in  $j$ th dimension,  $t$  is time,  $v_0$  is the initial speed.

## 2.2. Gray Wolf Optimizer

Gray wolves are very good hunters. Gray wolves catch prey with their strategy. Gray wolves circulate on average 5-12 wolves. Only one leader wolf manages the hunt. Details of the GWO algorithm are described in other sections.

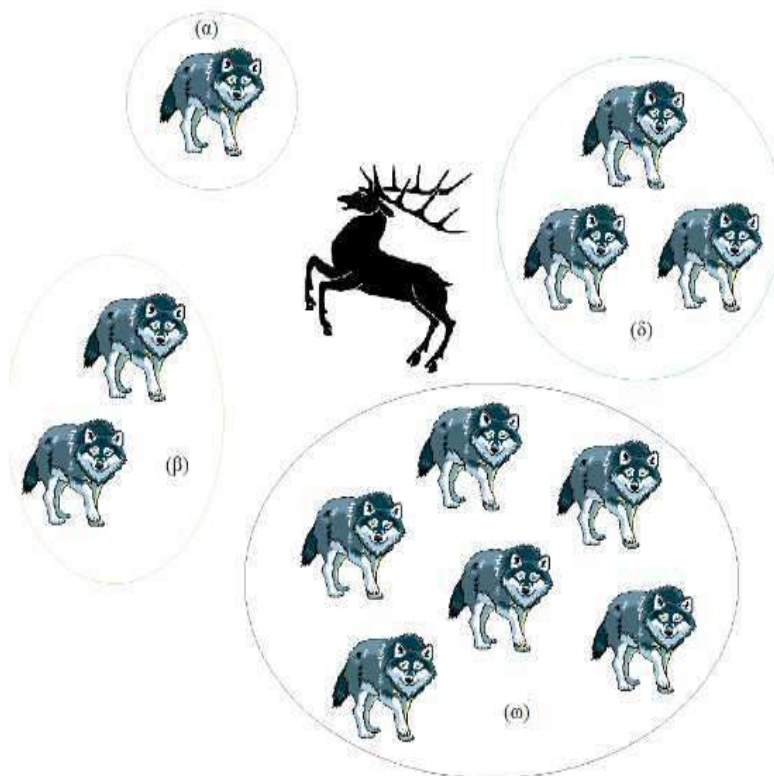
### 2.2.1. Hierarchy

It wolves are called alpha, beta, delta, and omega, according to their duties in the herd (Fig 1.). The leader wolf, which forms the first structure of the hierarchy, is called alpha ( $\alpha$ ). The leader wolf finds the flock's accommodation, decides to wake up, and chooses the hunt. The decisions taken by the leader are considered as an order by other wolves. Betas ( $\beta$ ), which form the second structure of the hierarchy, are the wolves that help alpha decisions. The other level is called delta ( $\delta$ ). Delta ( $\delta$ ) assumed the task of scouting, scouting, and hunting of the group. These names are; it is a member of omega ( $\omega$ ), the last level of the gray wolf hierarchy if it is not alpha, beta, or delta. Omegalar ( $\omega$ ) takes care of the herd's babies and serves other jobs.



**Fig 1.** Gray wolf hierarchy

Gray wolves surround the prey and immobilizing the prey. When the hunting process begins, the prey is surrounded by a flock of wolves (Fig 2). How the prey is surrounded by wolves is decided by the leading wolf and is applied by other wolves without question. Working and hunting gray wolves are considered an important behavior by scientists. The survival behavior of gray wolves is examined and modeled in the Gray Wolf Optimization (GWO) algorithm (Mirjalili et al., 2014).



**Fig 2.** Location of wolves to hunt

#### 2.1.2 Encircling or Trapping Prey

Wolves in the flock surround the prey. These behaviors are modeled by Equations.

$$D = |C \cdot X_p(t) - A \cdot X(t)| \quad (6)$$

$$X(t + 1) = X_p(t) - A \cdot D \quad (7)$$

Alpha, is tasked with making a strategy to catch prey. The hunting strategy of gray wolves is modeled mathematically (Mirjalili et al., 2014).

$$D\alpha = |C1 \cdot X\alpha - X| \quad (8)$$

$$D\beta = |C2 \cdot X\beta - X| \quad (9)$$

$$D\delta = |C3 \cdot X\delta - X| \quad (10)$$

$$X1 = |X\alpha - A1(D\alpha)| \quad (11)$$

$$X2 = |X\beta - A2(D\beta)| \quad (12)$$

$$X3 = |X\delta - A3(D\delta)| \quad (13)$$

$$X(t + 1) = (X1 + X2 + X3)/3 \quad (14)$$

$D\alpha$ ,  $D\beta$ ,  $D\delta$  hunter and wolf (alfa, delta, beta) distance between  $X\alpha$ ,  $X\beta$ ,  $X\delta$  alfa, beta, and delta hunter position for wolves,  $X$  gray wolf  $i$ .  $C1$ ,  $C2$ ,  $C3$ ,  $A1$ ,  $A2$ ,  $A3$  coefficient vectors for alpha, beta, and delta wolves.  $X1$ ,  $X2$ ,  $X3$  show trial vectors for alpha, beta, and delta courses. Fig. 3 shows the hunting mechanism of the gray wolf group (Mirjalili et al., 2014).

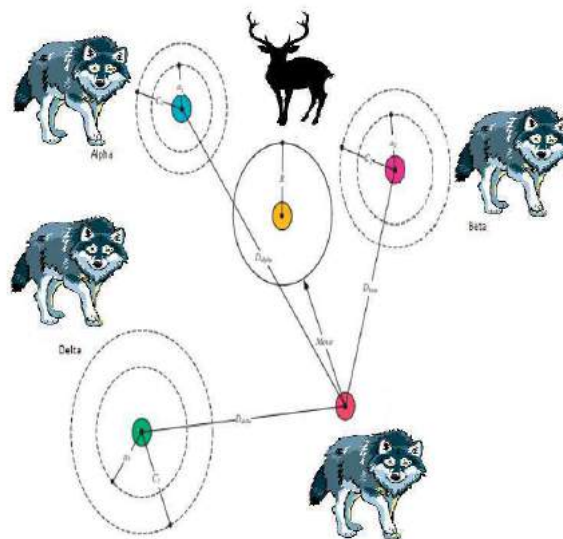
Gray wolves are divided into groups by wrapping around the prey.  $A$  is a parameter that can be a randomly selected value between  $[-2, 2]$ . If  $|A| > 1$ , the wolves continue to attack their prey. The process of hunting gray wolves ends with eating prey.

### 2.1.3 Hunting of Prey

At this stage, the value of parameter  $\alpha$  decreases, and therefore the range of changes of parameters  $A$  becomes smaller. A random value is selected for parameter  $A$  in the range  $[-1, 1]$ . The next position of the search tool is located anywhere between its current position and the position of the hunt.

### 2.1.4 Search

Gray wolves are generally called alpha, beta, and delta based on their location. Parameter  $A$  is randomly selected for the parameter in the range  $[-1, 1]$ . It supports the universal search of the GWO algorithm. To examine the rough code of the GWO algorithm.



**Fig 3.** Gray wolves attack prey in different positions

### 3. Results

The codings of the SalpSA and GWO algorithms were done in Matlab language. For the solutions of these two algorithms; thirteen unimodal and multimodal test optimization problems selected from the Benchmark optimization test library were used. Test functions are shown in Table 1 and Table 2. The parameter settings are shown in Table 3. Both algorithms have been studied independently 20 times. The average (avg), standard deviation (std), best and worst values of the obtained results were calculated. The results of the GWO and SalpSA were compared in Table 4. According to the results, GWO was more successful in all benchmark functions except f6 and f8. The statistical test results on GWO and SalpSA algorithms results shows in Table 5. Figure 4 shows the convergence graphs of the GWO and SalpSA algorithms. According to the results, there is a significant difference between the GWO and SalpSA results.

**Table 1.** Unimodal benchmark functions

Function	Range	$f_{min}$
$f_1(x)=\sum_{i=1}^n x_i^2$	[-100,100]	0
$f_2(x) = \sum_{i=1}^n  x_i  + \prod_{i=1}^n  x_i $	[-10,10]	0
$f_3(x) = \sum_{i=1}^n \left( \sum_{j=1}^i x_j \right)^2$	[-100,100]	0
$f_4(x) = \max_i \{ x_i , 1 \leq i \leq n\}$	[-100,100]	0
$f_5(x)=\sum_{i=1}^{n-1} [100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2]$	[-30,30]	0
$f_6(x)=\sum_{i=1}^n ([x_i + 0.5])^2$	[-100,100]	0
$f_7(x)=\sum_{i=1}^n ix_i^4 + random[0,1)$	[-1.28,1.28]	0

**Table 2.** Multimodal benchmark functions

Function	Range	$f_{min}$
$f_8(x)=\sum_{i=1}^n -x_i \sin(\sqrt{ x_i })$	[-500,500]	- 418.9829× 5
$f_9(x)=\sum_{i=1}^n [x_i^2 - 10\cos(2\pi x_i) + 10]$	[-5.12,5.12]	0
$f_{10}(x)=-20\exp\left(-0.2\sqrt{\frac{1}{n}\sum_{i=1}^n x_i^2}\right) - \exp\left(\frac{1}{n}\sum_{i=1}^n \cos(2\pi x_i)\right) + 20 + \exp(1)$	[-32,32]	0
$f_{11}(x) = \frac{1}{4000}\sum_{i=1}^n x_i^2 - \prod_{i=1}^n \cos\left(\frac{x_i}{\sqrt{i}}\right) + 1$	[-600,600]	0
$f_{12}(x) = \frac{\pi}{n} \left\{ 10\sin(\pi y_i) + \sum_{i=1}^{n-1} (y_i - 1)^2 [1 + 10\sin^2(3\pi y_{i+1})] + (y_n - 1)^2 \right\}$ $+ \sum_{i=1}^n u(x_i, 10, 100, 4); \quad y_i = 1 + \frac{x_i + 1}{4} \quad u(x_i, a, k, m)$ $= \begin{cases} k(x_i - a)^m & x_i > a \\ 0 & -a < x_i < a \\ k(-x_i - a)^m & x_i < -a \end{cases}$	[-50,50]	0
$f_{13}(x) = 0.1 \left\{ \sin^2(3\pi x_i) + \sum_{i=1}^n (x_i - 1)^2 [1 + \sin^2(3\pi x_i + 1)] \right.$ $\left. + (x_n - 1)^2 [1 + \sin^2(2\pi x_n)] \right\} + \sum_{i=1}^n u(x_i, 5, 100, 4);$	[-50,50]	0

**Table 3.** Parameter setups for GWO and SalpSA

Methods	Search Agents	Max_Iter	Dimension
<b>GWO</b>	30	500	30
<b>SalpSA</b>	30	500	30

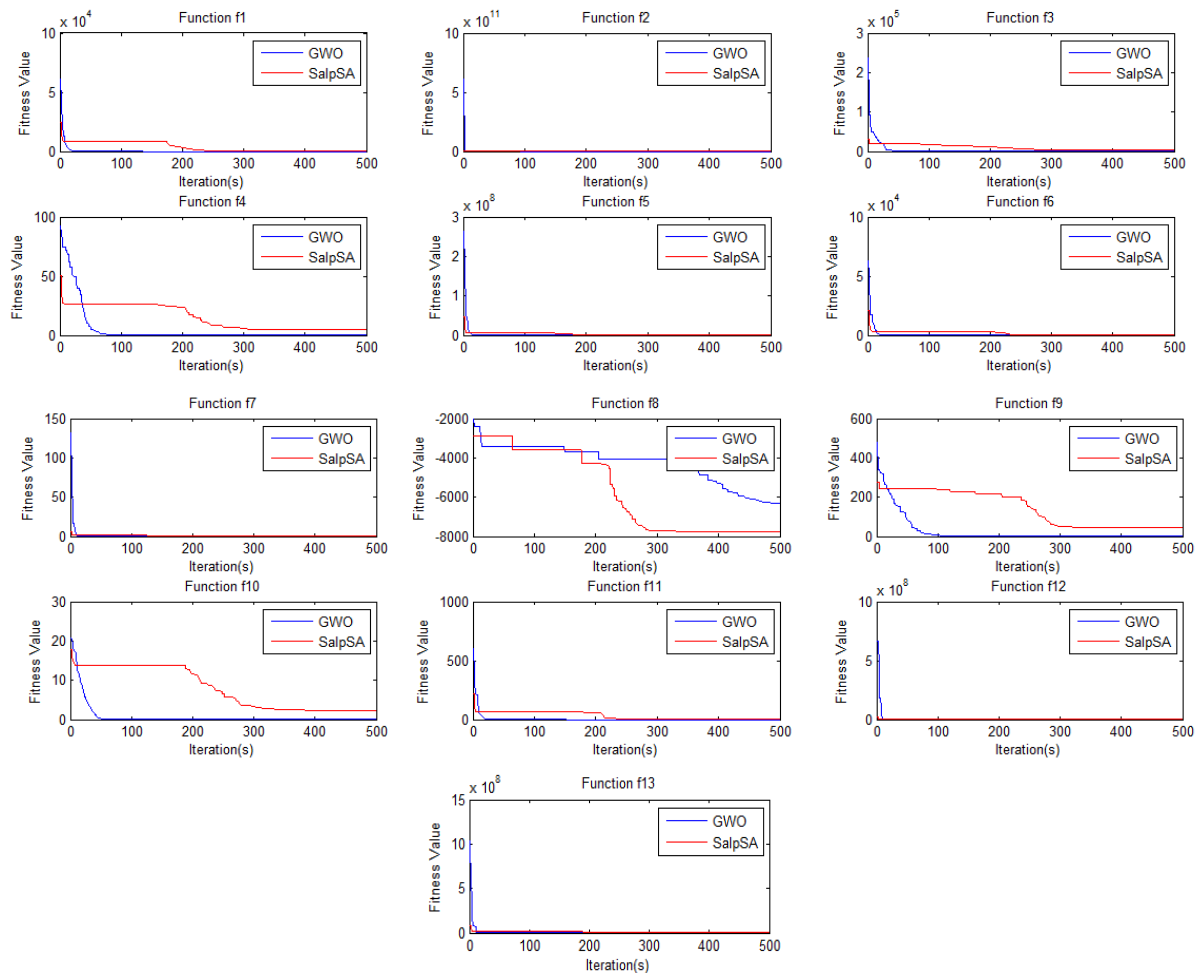
**Table 4.** GWO algorithm and SalpSA algorithm results in the benchmark optimization test library

<i>f_no</i>	<b>GWO</b>				<b>SalpSA</b>			
	<i>Avg</i>	<i>Std</i>	<i>Best</i>	<i>Worst</i>	<i>Avg</i>	<i>Std</i>	<i>Best</i>	<i>Worst</i>
<i>f1</i>	1,32E-27	1,80E-27	6,91E-29	7,69E-27	5,94E-07	1,98E-06	3,05E-08	8,96E-06
<i>f2</i>	1,38E-16	1,28E-16	1,22E-17	4,35E-16	1,90E+00	1,63E+00	1,77E-01	7,64E+00
<i>f3</i>	5,92E-05	1,78E-04	9,79E-08	7,59E-04	1,54E+03	1,03E+03	4,56E+02	3,75E+03
<i>f4</i>	7,84E-07	5,61E-07	8,67E-08	2,12E-06	1,25E+01	4,10E+00	7,45E+00	2,36E+01
<i>f5</i>	2,69E+01	7,43E-01	2,56E+01	2,80E+01	3,56E+02	4,51E+02	2,66E+01	1,37E+03
<i>f6</i>	7,28E-01	3,46E-01	2,50E-01	1,73E+00	1,24E-07	7,81E-08	3,02E-08	3,60E-07
<i>f7</i>	1,81E-03	6,59E-04	6,74E-04	3,14E-03	1,86E-01	6,47E-02	1,11E-01	3,64E-01
<i>f8</i>	-6,06E+03	8,42E+02	-7,84E+03	-3,75E+03	-7,61E+03	6,21E+02	-8,98E+03	-6,42E+03
<i>f9</i>	2,18E+00	3,49E+00	5,68E-14	1,02E+01	5,98E+01	1,59E+01	3,28E+01	8,86E+01
<i>f10</i>	1,09E-13	1,39E-14	8,62E-14	1,39E-13	3,00E+00	9,05E-01	1,50E+00	5,29E+00
<i>f11</i>	5,94E-03	1,02E-02	0,00E+00	3,31E-02	1,57E-02	1,30E-02	2,67E-03	4,86E-02
<i>f12</i>	4,61E-02	3,16E-02	6,55E-03	1,57E-01	6,96E+00	3,86E+00	2,66E+00	1,85E+01
<i>f13</i>	6,11E-01	2,35E-01	2,98E-01	1,16E+00	2,55E+01	1,35E+01	1,30E+00	4,84E+01

**Table 5.** The statistical test results on GWO and SalpSA algorithms results

<i>f_no</i>	<b>GWO - SalpSA</b>	
	<b>(p)</b>	<b>(h)</b>
<i>f1(x)</i>	8,86E-05	0
<i>f2(x)</i>	8,84E-05	0
<i>f3(x)</i>	8,86E-05	0
<i>f4(x)</i>	8,86E-05	0
<i>f5(x)</i>	8,86E-05	0
<i>f6(x)</i>	8,86E-05	0
<i>f7(x)</i>	8,86E-05	0
<i>f8(x)</i>	8,86E-05	0
<i>f9(x)</i>	8,84E-05	0
<i>f10(x)</i>	8,86E-05	0
<i>f11(x)</i>	0,0099964	0
<i>f12(x)</i>	8,86E-05	0
<i>f13(x)</i>	8,86E-05	0





**Fig 4.** Convergence graphs of the GWO and SalpSA algorithms

The success and performance of GWO and SalpSA were measured and compared with benchmark test optimizations. According to Table 4, when the results of the optimum value of thirteen different benchmark problems were examined in terms of GWO performance, it was observed that GWO in eleven problems and SalpSA in two problems gave successful results. GWO is more successful than SalpSA in all benchmark problems except f6 and f8. Finally, GWO and SalpSA have been compared with other heuristic algorithms on global optimization problems. These heuristic algorithms are BA (Yang, 2011) and Jaya (Rao, 2016) algorithms commonly used in the literature. The comparison results are shown in Table 6. According to the results, the Jaya algorithm has performed better than other algorithms in all benchmark problems except f8. The best performing algorithm after Jaya is GWO. The worst performing algorithm was BA.

**Table 6.** GWO, SalpSA, Jaya, and BA algorithms compared on dimension=30

		Jaya	BA	SalpSA	GWO
<i>f1</i>	<i>Best</i>	<b>1,35E-87</b>	4,11E+04	3,05E-08	6,91E-29
	<i>Worst</i>	<b>6,82E-75</b>	7,62E+04	8,96E-06	7,69E-27
	<i>Avg</i>	<b>6,93E-76</b>	6,38E+04	5,94E-07	1,32E-27
	<i>Std</i>	<b>2,10E-75</b>	8,33E+03	1,98E-06	1,80E-27
<i>f2</i>					

$f3$	<i>Best</i>	<b>5,25E-45</b>	7,87E+01	1,77E-01	1,22E-17
	<i>Worst</i>	<b>9,01E-42</b>	1,46E+02	7,64E+00	4,35E-16
	<i>Avg</i>	<b>1,10E-42</b>	1,18E+02	1,90E+00	1,38E-16
	<i>Std</i>	<b>2,04E-42</b>		1,63E+00	1,28E-16
$f4$	<i>Best</i>	<b>2,73E-89</b>	-	4,56E+02	9,79E-08
	<i>Worst</i>	<b>6,50E-77</b>	-	3,75E+03	7,59E-04
	<i>Avg</i>	<b>3,25E-78</b>	-	1,54E+03	5,92E-05
	<i>Std</i>	<b>1,45E-77</b>	-	1,03E+03	1,78E-04
$f5$	<i>Best</i>	<b>9,21E-46</b>	3,70E+01	7,45E+00	8,67E-08
	<i>Worst</i>	<b>6,10E-40</b>	8,89E+01	2,36E+01	2,12E-06
	<i>Avg</i>	<b>3,91E-41</b>	8,12E+01	1,25E+01	7,84E-07
	<i>Std</i>	<b>1,35E-40</b>	1,13E+01	4,10E+00	5,61E-07
$f6$	<i>Best</i>	<b>0,00E+00</b>	-	2,66E+01	2,56E+01
	<i>Worst</i>	<b>0,00E+00</b>	-	1,37E+03	2,80E+01
	<i>Avg</i>	<b>0,00E+00</b>	-	3,56E+02	2,69E+01
	<i>Std</i>	<b>0,00E+00</b>	-	4,51E+02	7,43E-01
$f7$	<i>Best</i>	<b>1,50E-12</b>	2,06E+04	3,02E-08	2,50E-01
	<i>Worst</i>	<b>1,44E-08</b>	7,98E+04	3,60E-07	1,73E+00
	<i>Avg</i>	<b>3,06E-09</b>	6,41E+04	1,24E-07	7,28E-01
	<i>Std</i>	<b>4,36E-09</b>	1,23E+04	7,81E-08	3,46E-01
$f8$	<i>Best</i>	<b>8,55E-07</b>	-	1,11E-01	6,74E-04
	<i>Worst</i>	<b>7,15E-04</b>	-	3,64E-01	3,14E-03
	<i>Avg</i>	<b>2,31E-04</b>	-	1,86E-01	1,81E-03
	<i>Std</i>	<b>1,81E-04</b>	-	6,47E-02	6,59E-04
$f9$	<i>Best</i>	-4,19E+02	-4,25E+03	<b>-8,98E+03</b>	-7,84E+03
	<i>Worst</i>	-4,19E+02	-2,46E+03	<b>-6,42E+03</b>	-3,75E+03
	<i>Avg</i>	-4,19E+02	-3,46E+03	<b>-7,61E+03</b>	-6,06E+03
	<i>Std</i>	<b>1,17E-13</b>	5,05E+02	6,21E+02	8,42E+02
$f10$	<i>Best</i>	<b>0,00E+00</b>	3,43E+02	3,28E+01	5,68E-14
	<i>Worst</i>	<b>0,00E+00</b>	4,66E+02	8,86E+01	1,02E+01
	<i>Avg</i>	<b>0,00E+00</b>	4,05E+02	5,98E+01	2,18E+00
	<i>Std</i>	<b>0,00E+00</b>	3,26E+01	1,59E+01	3,49E+00
$f11$	<i>Best</i>	<b>8,88E-16</b>	1,97E+01	1,50E+00	8,62E-14
	<i>Worst</i>	<b>8,88E-16</b>	2,07E+01	5,29E+00	1,39E-13
	<i>Avg</i>	<b>8,88E-16</b>	2,02E+01	3,00E+00	1,09E-13
	<i>Std</i>	<b>0,00E+00</b>	3,40E-01	9,05E-01	1,39E-14
$f12$	<i>Best</i>	<b>0,00E+00</b>	-	2,67E-03	0,00E+00
	<i>Worst</i>	<b>1,21E-04</b>	-	4,86E-02	3,31E-02
	<i>Avg</i>	<b>6,67E-06</b>	-	1,57E-02	5,94E-03
	<i>Std</i>	<b>2,70E-05</b>	-	1,30E-02	1,02E-02

<i>f13</i>	<i>Best</i>	<b>8,76E-10</b>	3,66E+05	2,66E+00	6,55E-03
	<i>Worst</i>	<b>5,01E-06</b>	7,11E+08	1,85E+01	1,57E-01
	<i>Avg</i>	<b>6,76E-07</b>	4,60E+08	6,96E+00	4,61E-02
	<i>Std</i>	<b>1,30E-06</b>	1,76E+08	3,86E+00	3,16E-02
	<i>Best</i>	<b>1,35E-32</b>	3,29E+07	1,30E+00	2,98E-01
	<i>Worst</i>	<b>1,35E-32</b>	1,46E+09	4,84E+01	1,16E+00
	<i>Avg</i>	<b>1,35E-32</b>	8,71E+08	2,55E+01	6,11E-01
	<i>Std</i>	<b>2,81E-48</b>	3,65E+08	1,35E+01	2,35E-01

#### 4. Conclusion

Gray Wolf Optimization (GWO), the gray wolf is inspired by the behaviors it exhibited to reach food. Salps are sea creatures with transparent barrel-shaped bodies. Salp swarm (SalpS) is inspired by behaviors in finding food. SalpSA and GWO have been adaptable to the solution of many problems. SalpSA and GWO have compared their performance in thirteen different unimodal and multi-modal benchmark functions. Convergence graphs are drawn for GWO and SalpSa. All results of the algorithms were reviewed. Performance comparison is made for GWO and SalpSA and results are shown. Performance comparison is made with Jaya and BA algorithms. The results of GWO are much better than SalpSA in most benchmark problems. A statistical test was also applied to the GWO and SalpSA results. Thus, it has been found that there is a semantic difference between the results. But GWO could not pass the Jaya algorithm. It has been proven in the literature that there are alternative heuristic algorithms in both algorithms.

In future studies, GWO and SalpSA will be hybridized with various algorithms to further develop GWO and SalpSA. There are solutions to different problems. In future studies, new studies can be done to solve many engineering problems by making a hybrid between PSO algorithm and GWO algorithms or between PSO algorithm and SalpSA algorithms.

#### References

- Baş, E., Ülker, E., (2020). An efficient binary social spider algorithm for feature selection problem, *Expert Systems With Applications* 146, 113185.
- İhsan, A. A., Ülker, E., (2017). Development of the Egyptian Vulture Optimization Algorithm with the Nearest or Farthest Neighborhood Methods, *ISMSIT2017*, Tokat - Turkey, 179 – 182.
- Mirjalili, S., Mirjalili, S.M., Lewis, A., (2014). Grey wolf optimizer, *Adv. Eng. Softw.* 69, 46 – 61.
- Mirjalili, S., Gandomi, A.H., Mirjalili, S.Z., Saremi S., Faris, H., Mirjalili, S.M., (2017). Salp Swarm Algorithm: A bio-inspired optimizer for engineering design problems, *Adv. Eng. Softw.* 114, 163 – 191.
- Yang, X-S., (2011). Bat algorithm for multi-objective optimization, *International Journal of Bio-Inspired Computation*, vol:3, DOI: <https://doi.org/10.1504/IJBIC.2011.042259>.
- Rao, R., (2016). Jaya: A simple and new optimization algorithm for solving constrained and unconstrained optimization problems. *International Journal of Industrial Engineering Computations*, 7(1), 19-34.

## SOLUTION OF THE STEP-CONE PULLEY PROBLEM WITH RECENT OPTIMIZATION ALGORITHMS

**Cemil KÖZKURT**

*Department of Transportation Engineering, Faculty of Engineering and Natural Sciences,  
Bandırma Onyedi Eylül University, 10200 Bandırma, Balıkesir/TURKEY.*

*ORCID: 0000-0003-1407-9867*

### Abstract

Today's mechanical engineers work to design machine parts with optimum dimensions, weights and mechanical properties. Graded cone pulleys are machine parts of the type of transmission element that provide rotation at different rates through belts and pulleys. The purpose of use of stepped cone pulleys is to convert low speed to high speed or to increase torque by converting high speed to low speed. Optimization of parameters such as pulley diameter at each stage of stepped pulleys, pulley width forming the contact channel of the belt is an engineering optimization problem. State-of-the-art methods are used for the optimization of these and similar mechanisms. In this study, the optimization problem is solved by applying current optimization algorithms on the 4-steps pulley problem. The main objective of the problem is to minimize the weight of the four-step cone pulley. A total of 5 variables, four of which are step diameters, and one is belt groove thickness, were used in the optimization. This problem includes 11 nonlinear constraints to ensure the transmission power is at 0.75 hp. In experimental studies, recently used five different optimization algorithms were used, namely Particle Swarm Optimization (PSO), Forensic-based Investigation (FBI), Sine Cosine Algorithm (SCA), Coyote Optimization Algorithm (CO) and Atom Search Optimization (ASO). In the solution of the problem, the number of iterations for each algorithm was determined as 50, 100 and 200, and the numbers of population was handled in 10, 25 and 50. It has been observed that the PSO algorithm is superior to the others and that the CO algorithm can solve near same times with PSO at higher iteration numbers.

**Keywords:** Optimization Algorithms, Metaheuristics, Mechanical Design Optimization.

### 1. Introduction

Today's mechanical engineers work to design machine parts with optimum dimensions, weights and mechanical properties. Graded cone pulleys are machine parts of the type of transmission element that provide rotation at different rates through belts and pulleys. The purpose of use of stepped cone pulleys is to convert low speed to high speed or to increase torque by converting high speed to low speed. Optimization of parameters such as pulley diameter at each step of stepped pulleys, pulley width forming the contact channel of the belt is an engineering optimization problem. State-of-the-art methods are used for the optimization of these and similar mechanisms.

In this study, the optimization problem is solved by applying current optimization algorithms on the four-steps pulley problem. The main objective of the problem is to minimize the weight of the four-steps cone pulley. A total of 5 variables, four of which are step diameters, and one is cone thickness, were used in the optimization. This problem includes 11 non-linear constraints to ensure the transmission power is at 0.75 hp. In experimental studies, five different optimization algorithms were used, namely Particle Swarm Optimization (PSO), Forensic-based Investigation (FBI), Sine Cosine Algorithm (SCA), Coyote Optimization Algorithm (CO) and Atom Search Optimization (ASO). In the solution of the problem, the

number of iterations for each algorithm was determined as 50, 100 and 200, and the number of populations was handled in four different ways as 10, 25 and 50.

This manuscript is organized as follows: Section 2 presents the step-cone pulley optimization problem. Section 3 presents used recent algorithms. Section 4 presents the main numerical results and discussion. Finally, Section 5 draws the conclusions.

## 2. Optimization Problem

The basic goal of the step-cone pulley issue is to reduce the weight of four step-cone pulleys by employing five variables, four of which are the diameters of each pulley step and one of which is the pulley's width. There are eleven non-linear restrictions in this problem that must be met in order for the transmit power to be 0.75 hp [1].

The four step-cone pulley problem must be designed for minimum weight. The problem includes five variables, the diameters of each step  $d_i (i = 1, \dots, 4)$ , and the width of the pulley  $\omega$ . Eleven constraints are considered, three equality constraints and eight inequality constraints. The step pulley transmitted at least 0.75 hp, with an input speed of 350 rpm and output speeds of 750, 450, 250 and 150 rpm [2].

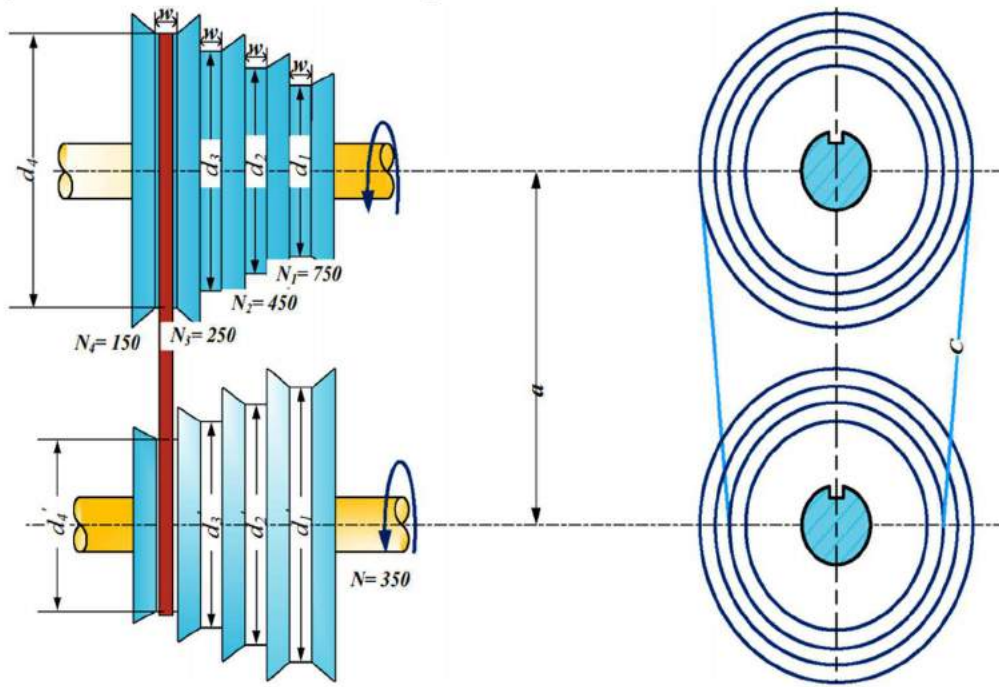


Figure 1. Schematic view of the step-cone pulley.

The mathematical formulation of this problem can be defined as follows.

**Minimize:**

$$f(\bar{x}) = \rho\omega \left[ d_1^2 \left\{ 1 + \left( \frac{N_1}{N} \right)^2 \right\} + d_2^2 \left\{ 1 + \left( \frac{N_2}{N} \right)^2 \right\} + d_3^2 \left\{ 1 + \left( \frac{N_3}{N} \right)^2 \right\} + d_4^2 \left\{ 1 + \left( \frac{N_4}{N} \right)^2 \right\} \right] \quad (0.1)$$

**subject to:**

$$\begin{aligned}
h_1(\bar{x}) &= C_1 - C_2 = 0, \\
h_2(\bar{x}) &= C_1 - C_3 = 0, \\
h_3(\bar{x}) &= C_1 - C_4 = 0, \\
g_{i=1,2,3,4}(\bar{x}) &= -R_i \leq 2, \\
g_{i=5,6,7,8}(\bar{x}) &= (0.75 \times 745.6998) - P_i \leq 0
\end{aligned} \tag{0.2}$$

where,  $C_i$  indicates the length of the belt to obtain speed  $N_i$  and is given by

$$C_i = \frac{\pi d_i}{2} \left( 1 + \frac{N_i}{N} \right) + \frac{\left( \frac{N_i}{N} - 1 \right)^2}{4a} + 2a, i = (1, 2, 3, 4), \tag{0.3}$$

$R_i$  is the tension ratio and is given by

$$R_i = \exp \left( \mu \left\{ \pi - 2 \sin^{-1} \left\{ \left( \frac{N_i}{N} - 1 \right) \frac{d_i}{2a} \right\} \right\} \right), \quad i = (1, 2, 3, 4) \tag{0.4}$$

$P_i$  is the power transmitted at each step

$$P_i = st\omega(1 - R_i) \frac{\pi d_i N_i}{60}, \quad i = (1, 2, 3, 4) \tag{0.5}$$

### 3. Optimization Algorithms

The recent popular meta-heuristic optimization algorithms used in the solution of the Step-cone Pulley problem are as follows.

#### 3.1. Particle Swarm Optimization (PSO)

PSO is a method for optimizing continuous nonlinear functions, as reported by Kennedy and Eberhart [3]. The PSO was discovered through simulation of a simplified social model. Artificial life and evolutionary computation are the two fundamental methodological components that PSO draws on. PSO is based on a straightforward notion, and paradigms can be implemented in a few lines of code. It simply uses elementary mathematical operations and is computationally light in terms of memory and performance.

#### 3.2. Forensic-based Investigation (FBI)

Chou and Nguyen [4] introduced FBI as a way to find global solutions for continuous nonlinear functions with minimal computing effort and high accuracy. The FBI is inspired by police officers' suspect investigation–location–pursuit procedure. Investigators examine and evaluate evidence acquired in a search space to identify and locate a suspect, on the basis of which police agents may make arrests. Throughout the investigation–location–pursuit phase, all investigators and police operatives must work closely with one another and follow the orders of headquarters. Finding and apprehending the suspect is the process's outcome.



### 3.3. Sine Cosine Algorithm (SCA)

For handling optimization problems, Mirjalili [5] introduced SCA, an unique optimization originated to population algorithm. Using a mathematical model based on sine and cosine functions, the SCA generates many initial random candidate solutions and needs them to fluctuate outwards or towards the optimal solution. During optimization, the method may efficiently explore different regions of a search space, avoid local optima, converge towards the global optimum, and exploit promising regions of a search space.

### 3.4. Coyote Optimization Algorithm (COA)

Pierezan and D-S Coelho [6] introduce the COA, a population-based meta-heuristic for optimization inspired by canis latrans species. It contributes a new algorithmic structure and mechanisms to balance discovery and usage. COA is proposed for global optimization and a population-based algorithm inspired on the Canis latrans species classified as both swarm intelligence and evolutionary heuristic. COA provides new mechanisms for balancing the exploration and exploitation in the optimization process.

### 3.5. Atom Search Optimization (ASO)

Zhao et.al. [7] proposed a novel physics inspired algorithm with swarm-inspired characteristics for global optimization. The algorithm, named ASO, is inspired by basic molecular dynamics and is also a population-based heuristic algorithm. To create an effective search mechanism for global optimization issues, ASO simulates atomic motion controlled by interaction and constraint forces.

## 4. Experimental Results

There are five heuristic optimization algorithms used in experimental studies for the solution of the stepped cone-pulley optimization problem, namely Particle Swarm Optimization (PSO), Forensic-based Investigation (FBI), Sine Cosine Algorithm (SCA), Coyote Optimization Algorithm (CO), and Atom Search Optimization (ASO). Performance comparisons of the optimization algorithms used in this study are given in Tables 1, 2 and 3. The parameters measured in these tables are the mean, standard deviation, minimum and maximum values of the objective function. It has also been categorized according to three different population sizes, 10, 25, and 50.

**Table 1.** Solution values when the number of iterations is 50.

P	Stats	PSO	FBI	SCA	CO	ASO
10	Min	<b>8,279E+00</b>	8,366E+00	1,239E+01	1,003E+01	1,418E+01
	Max	2,199E+01	1,017E+01	3,699E+03	3,092E+04	1,968E+04
	Mean	1,043E+01	8,784E+00	1,315E+03	1,040E+04	2,449E+03
	Std. dev.	4,239E+00	5,215E-01	1,495E+03	9,369E+03	6,132E+03
25	Min	<b>8,207E+00</b>	8,262E+00	1,088E+01	8,424E+01	1,184E+01
	Max	8,795E+00	8,752E+00	1,628E+03	2,387E+04	1,154E+03
	Mean	8,551E+00	8,433E+00	3,925E+02	1,066E+04	1,500E+02
	Std. dev.	2,882E-01	1,474E-01	5,626E+02	7,296E+03	3,565E+02
50	Min	<b>8,203E+00</b>	8,256E+00	1,045E+01	7,608E+01	1,250E+01
	Max	8,776E+00	8,407E+00	1,728E+02	5,233E+04	1,309E+02
	Mean	8,605E+00	8,328E+00	8,378E+01	9,605E+03	2,666E+01

<i>Std. dev.</i>	2,700E-01	4,963E-02	7,136E+01	1,614E+04	3,668E+01
------------------	-----------	-----------	-----------	-----------	-----------

**Table 2.** Solution values when the number of iterations is 100.

P	Stats	PSO	FBI	SCA	CO	ASO
10	<i>Min</i>	<b>8,189E+00</b>	8,223E+00	1,349E+01	3,199E+02	1,040E+01
	<i>Max</i>	1,256E+01	8,718E+00	9,329E+02	1,888E+04	2,648E+03
	<i>Mean</i>	9,671E+00	8,368E+00	3,457E+02	8,308E+03	2,866E+02
	<i>Std. dev.</i>	1,855E+00	1,443E-01	3,813E+02	7,030E+03	8,304E+02
25	<i>Min</i>	<b>8,189E+00</b>	8,199E+00	9,989E+00	2,794E+01	1,228E+01
	<i>Max</i>	8,769E+00	8,379E+00	1,458E+02	3,566E+04	2,353E+01
	<i>Mean</i>	8,537E+00	8,235E+00	3,532E+01	1,060E+04	1,506E+01
	<i>Std. dev.</i>	2,994E-01	5,347E-02	4,183E+01	1,163E+04	3,262E+00
50	<i>Min</i>	8,723E+00	<b>8,197E+00</b>	1,197E+01	1,309E+01	1,127E+01
	<i>Max</i>	8,769E+00	8,266E+00	2,109E+01	4,266E+04	1,448E+01
	<i>Mean</i>	8,764E+00	8,222E+00	1,420E+01	1,436E+04	1,305E+01
	<i>Std. dev.</i>	1,445E-02	1,995E-02	2,739E+00	1,487E+04	1,125E+00

**Table 3.** Solution values when the number of iterations is 200.

P	Stats	PSO	FBI	SCA	CO	ASO
10	<i>Min</i>	8,769E+00	<b>8,193E+00</b>	1,063E+01	1,229E+01	1,061E+01
	<i>Max</i>	1,822E+01	8,303E+00	1,111E+03	6,804E+02	9,043E+01
	<i>Mean</i>	1,046E+01	8,216E+00	2,851E+02	8,495E+01	2,078E+01
	<i>Std. dev.</i>	3,147E+00	3,205E-02	3,918E+02	2,093E+02	2,454E+01
25	<i>Min</i>	<b>8,189E+00</b>	<b>8,189E+00</b>	1,044E+01	1,154E+01	1,001E+01
	<i>Max</i>	8,769E+00	8,209E+00	2,512E+02	1,739E+04	1,427E+01
	<i>Mean</i>	8,653E+00	8,197E+00	4,291E+01	3,251E+03	1,187E+01
	<i>Std. dev.</i>	2,446E-01	8,349E-03	7,497E+01	6,171E+03	1,355E+00
50	<i>Min</i>	<b>8,189E+00</b>	<b>8,189E+00</b>	1,118E+01	1,354E+01	1,013E+01
	<i>Max</i>	8,769E+00	8,196E+00	3,207E+01	1,437E+03	1,257E+01
	<i>Mean</i>	8,595E+00	8,191E+00	1,501E+01	2,388E+02	1,130E+01
	<i>Std. dev.</i>	2,802E-01	2,294E-03	6,177E+00	4,639E+02	7,528E-01

When the statistical results given in the tables above are examined, it is seen that the PSO algorithm is generally more successful than the others. If the population number is determined as 25 or 50, it is seen that the PSO and FBI methods produce very close values. The lowest score in all experimental studies belongs to PSO and FBI algorithms. When the problem is evaluated in general, it is thought that it is more appropriate to specify the population number of optimization algorithms as 25 or 50.

The convergence graphs of the optimization algorithms in different iterations depending on the population number are shown in Figure 2 to Figure 10.

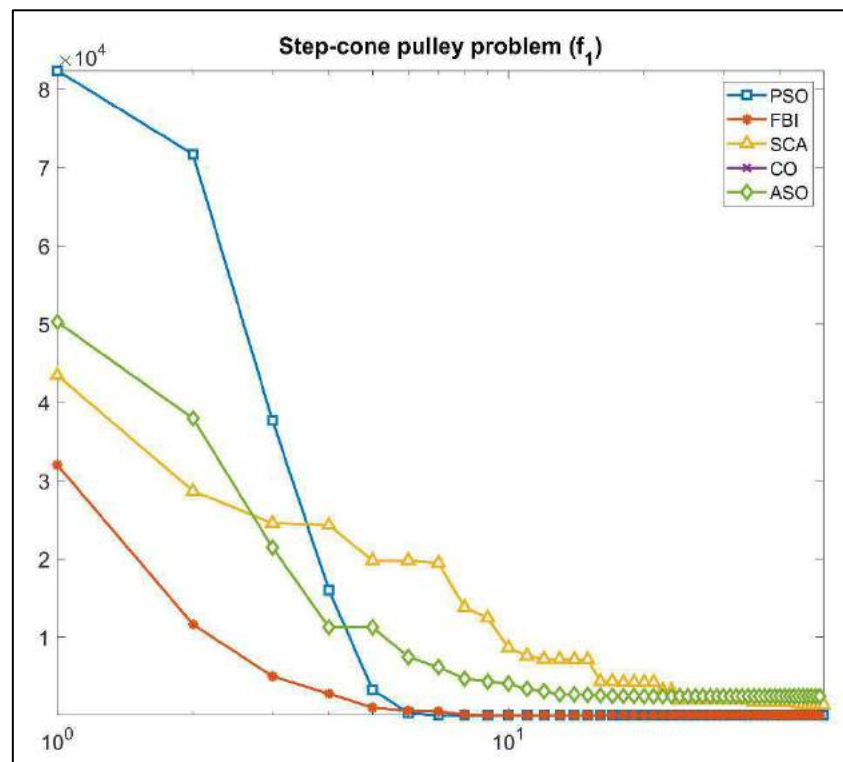
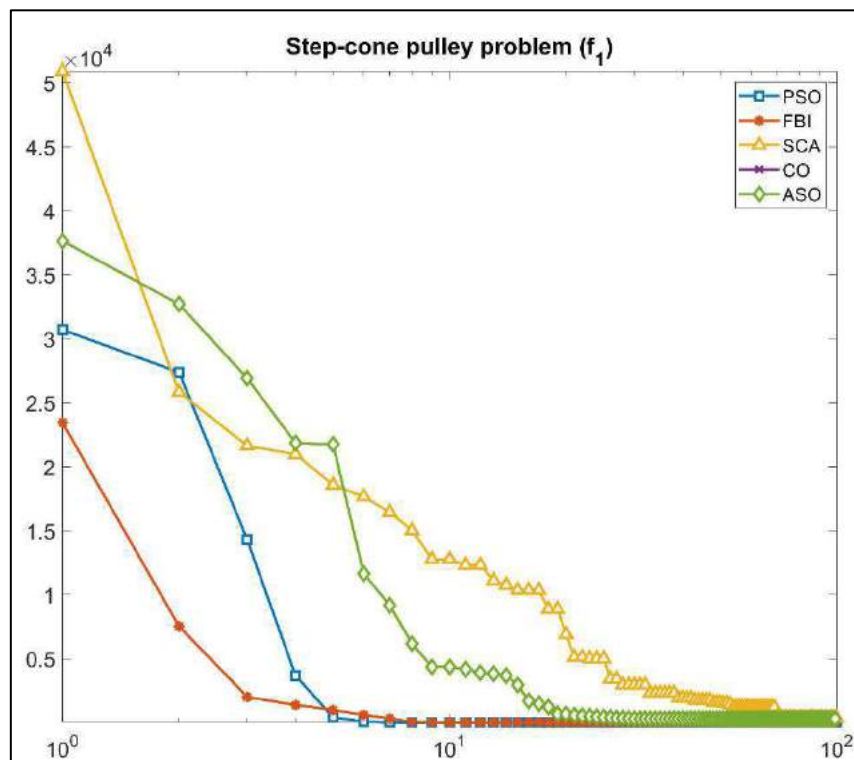
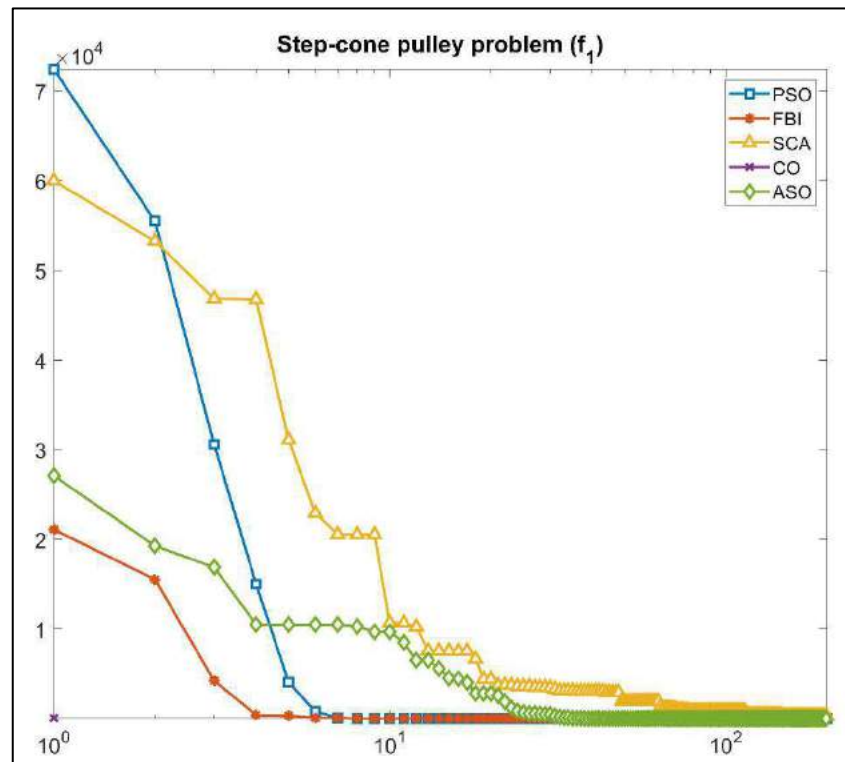
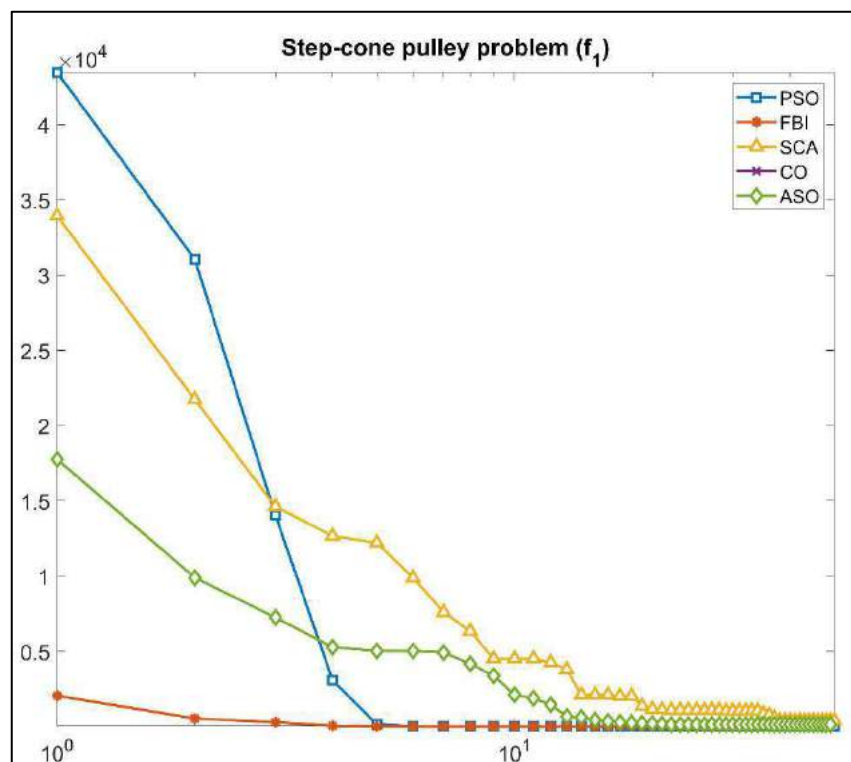


Figure 2. Population=10, Iteration=50



**Figure 3.** Population=10, Iteration=100**Figure 4.** Population=10, Iteration=200.**Figure 5.** Population=25, Iteration=50.

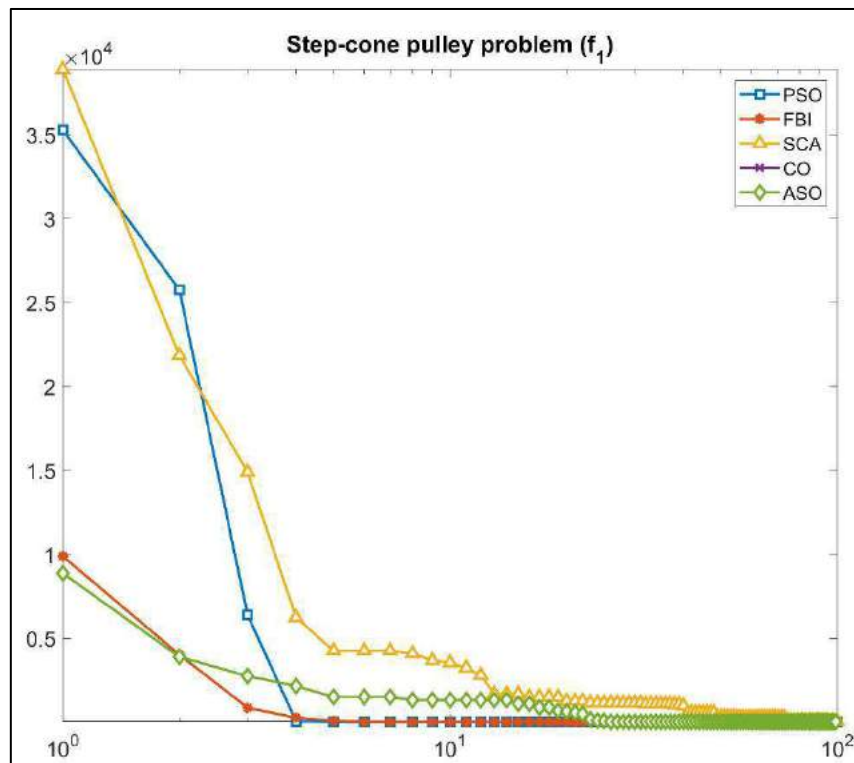


Figure 6. Population=25, Iteration=100.

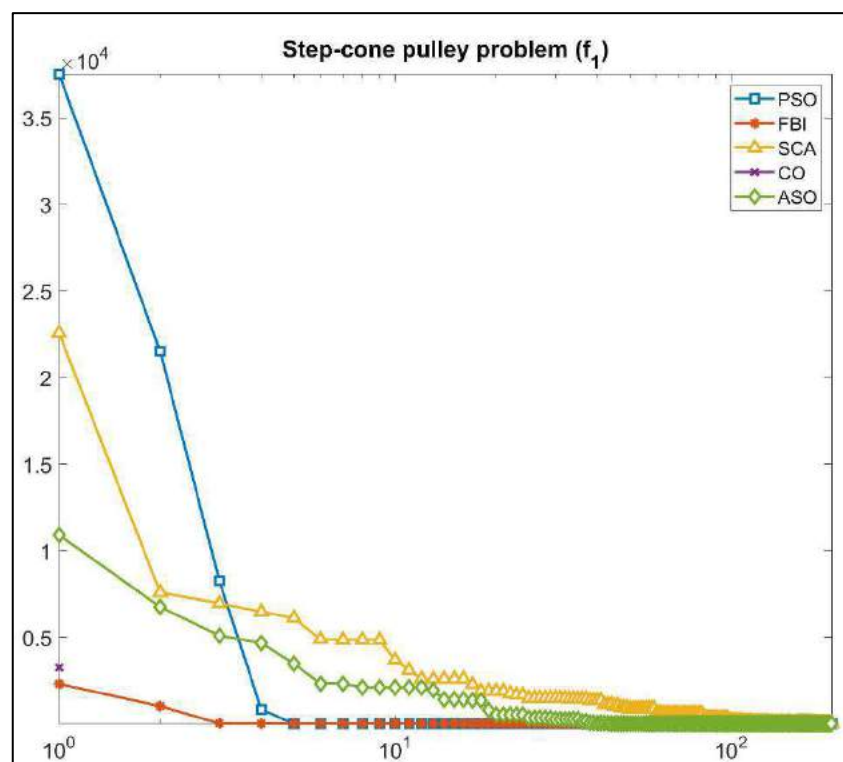


Figure 7. Population=25, Iteration=200.

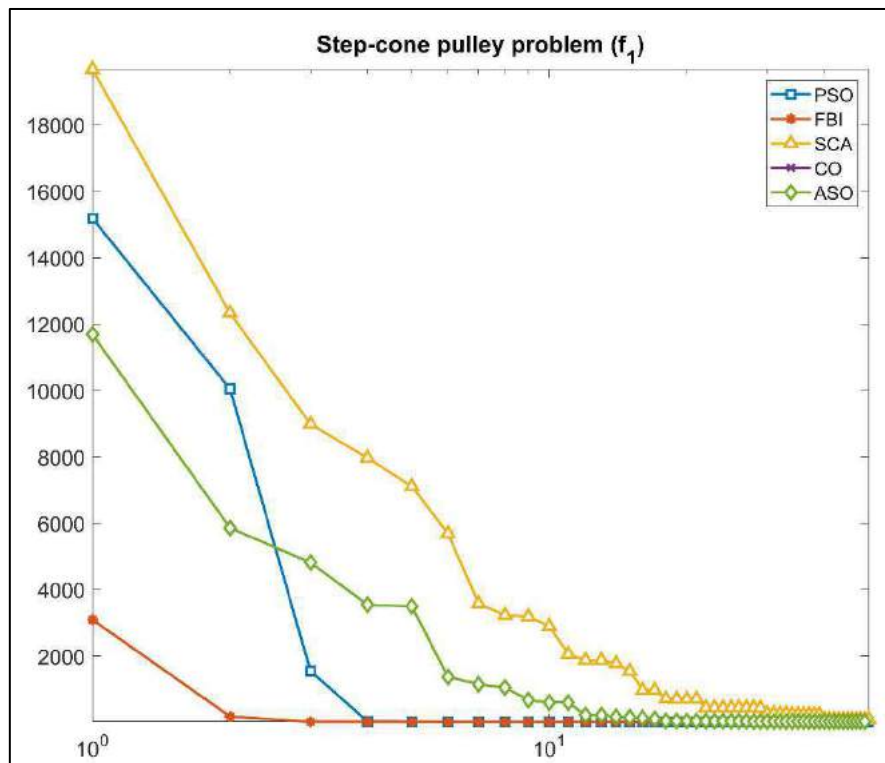


Figure 8. Population=50, Iteration=50.

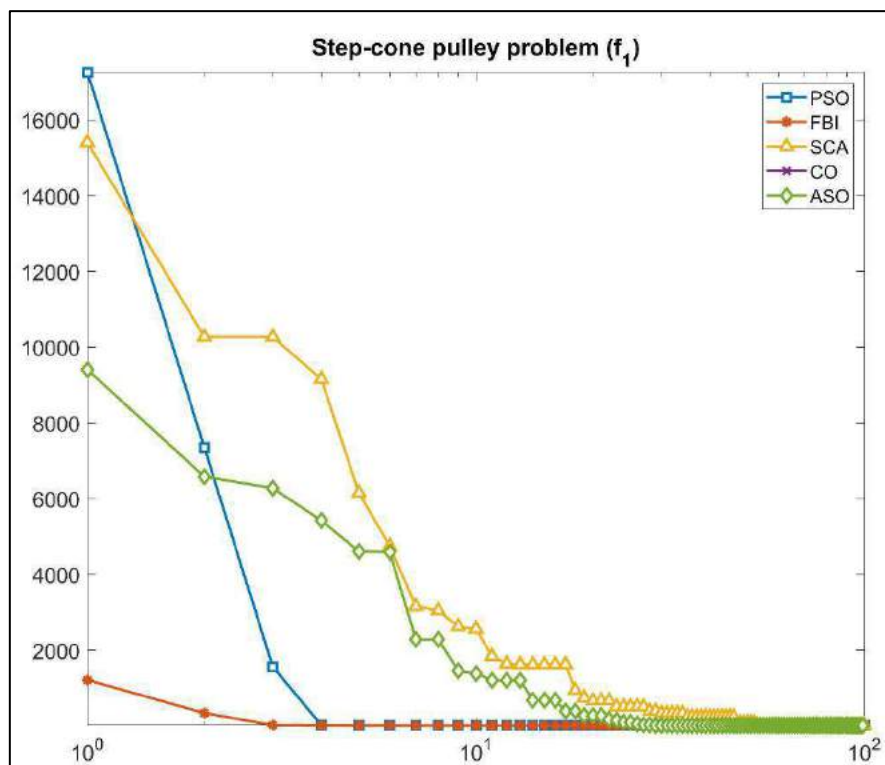


Figure 9. Population=50, Iteration=100.



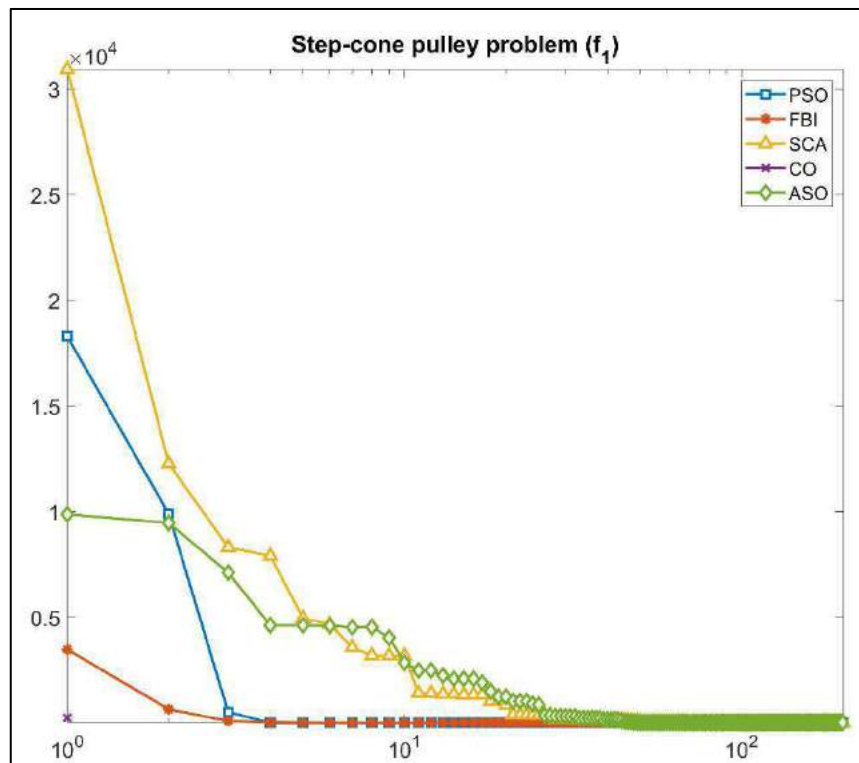


Figure 10. Population=50, Iteration=200.

## 5. Conclusions

Weight minimization of a four steps cone pulley, which is a machine transmission element, was carried out by considering five variables. Current heuristic algorithms are used to solve the step-cone pulley optimization problem. According to the results obtained, it is seen that the PSO algorithm is generally more successful than the others. If the population number is determined as 25 or 50, it is seen that the PSO and FBI methods produce very close values. The lowest score in all experimental studies belongs to PSO and FBI algorithms.

## References

- [1]. Kumar, A., Wu, G., Ali, M. Z., Mallipeddi, R., Suganthan, P. N., & Das, S. (2020). A test-suite of non-convex constrained optimization problems from the real-world and some baseline results. *Swarm and Evolutionary Computation*, 56, 100693. <https://doi.org/10.1016/j.swevo.2020.100693>
- [2]. Yildiz, A.R., Abderazek, H. & Mirjalili, S. A Comparative Study of Recent Non-traditional Methods for Mechanical Design Optimization. *Arch Computat Methods Eng* 27, 1031–1048 (2020). <https://doi.org/10.1007/s11831-019-09343-x>
- [3]. Kennedy, J., & Eberhart, R. (n.d.). Particle swarm optimization. *Proceedings of ICNN'95 - International Conference on Neural Networks*. <https://doi.org/10.1109/icnn.1995.488968>
- [4]. Chou, J.-S., & Nguyen, N.-M. (2020). FBI inspired meta-optimization. *Applied Soft Computing*, 106339. <https://doi.org/10.1016/j.asoc.2020.106339>
- [5]. Mirjalili, S. (2016). SCA: A Sine Cosine Algorithm for solving optimization problems. *Knowledge-Based Systems*, 96, 120–133. <https://doi.org/10.1016/j.knosys.2015.12.022>

- [6]. Pierson, J., & Dos Santos Coelho, L. (2018). Coyote Optimization Algorithm: A New Metaheuristic for Global Optimization Problems. 2018 IEEE Congress on Evolutionary Computation (CEC). <https://doi.org/10.1109/cec.2018.8477769>
- [7]. Zhao, W., Wang, L., & Zhang, Z. (2018). Atom search optimization and its application to solve a hydrogeologic parameter estimation problem. Knowledge-Based Systems. <https://doi.org/10.1016/j.knosys.2018.08.030>

## ANT COLONY OPTIMIZATION ALGORITHM FOR SOLVING U-SHAPED DISASSEMBLY LINE BALANCING PROBLEM WITH MULTIPLE OBJECTIVES

**Pengfei Yao**

*Department of Mechanical and Industrial Engineering, Northeastern University Boston, MA, 02115, USA.*

*ORCID No: <https://orcid.org/0000-0003-3620-2491>*

**Surendra M. Gupta**

*Department of Mechanical and Industrial Engineering, Northeastern University Boston, MA, 02115, USA.*

*ORCID No: <https://orcid.org/0000-0002-6194-2857>*

### Abstract

Economic development and manufacturing productivity rely on efficient utilization of resources. Renewal of technology and rapid manufacturing directly causes products to become end-of-life (EOL) products early in their life cycles. A higher stage of environmental protection consciousness of individuals and governments together encourage green manufacturing and remanufacturing development. Product recovery is one of the most efficient processes of dealing with EOL products. Remanufacturing is one of the elements of product recovery. Disassembly is the first step of remanufacturing and its success is an important step for creating profit. EOL products are processed on a disassembly line. Therefore, in order to improve efficiency, disassembly line balancing is crucial. U-shaped layout has many advantages compared to the traditional straight-line disassembly line. Selected operators or machines can work on both sides of the U-shaped line and thus increase the efficiency of the line. Multiple objectives need to be addressed in the disassembly line balancing problem (DLBP) since a single economic objective is not enough in a real-world environment. In this paper, several objectives such as number of workstations, smoothness index, hazardous index and demand values are considered. Due to the NP-hard characteristic of DLBP, exact methods and mathematical programming are not suitable approaches to solve practical DLBPs. Thus, meta-heuristic algorithms are better suited for solving the DLBP. For this reason, in this paper, ant colony optimization (ACO) algorithm, which is a probabilistic swarm-based meta-heuristic algorithm, is used. Since four objectives are considered, pareto front is used to classify different solutions. The performance of U-shaped disassembly line is compared to that of the straight-line disassembly line. The functionality of ACO is compared to the functionality of several other algorithms. Results show that the U-shaped layout indeed has higher efficiency compared to straight line layout and the performance of ACO is superior to other algorithms.

**Keywords:** Remanufacturing, Disassembly Line Balancing Problem, U-Shaped Disassembly line, Ant Colony Optimization (ACO).

### INTRODUCTION

The rate at which products renew has accelerated during the past 10 years. Two main reasons of this acceleration are economic expansion and technological innovation. An increasing number of frequently introduced products in the market causes products to enter the stage of End-of-life (EOL) early. The main ways of dealing with EOL products are reusing, remanufacturing, recycling and landfilling. The societal pressure of dealing with EOL products due to the awareness of environmental consciousness of individuals have propelled the growth of green manufacturing and remanufacturing (Gungor and Gupta, 1999). Disassembly, which is the process of physically separating EOL products into subassemblies/parts, is the first and most crucial step of product recovery (McGovern and Gupta, 2011). Disassembly is not the reverse of assembly and because of uncertain conditions of EOL

products, is much more complicated than assembly (Wang et al., 2021). In assembly, all parts should be assembled, but in disassembly, partial disassembly and complete disassembly are possible. Subassemblies or parts are either sent for remanufacturing or are sold to suppliers (Goksoy Kalaycilar et al., 2021). EOL products are processed on a linked disassembly line. The disassembly line contains workstations, transporting belts and other auxiliary equipment. Operators or machines are set into workstations to accomplish the tasks accordingly. In order to better achieve preset objectives, disassembly line balancing is important. Gungor and Gupta (1999) first defined the concept of disassembly line balancing problem (DLBP). This problem has received a great deal of attention and development in the last two decades. To further improve the efficiency of DLBP, the choice of disassembly line layout is essential. There are four main types of disassembly lines configurations available, namely, straight-line, U-shaped line, parallel line and two-sided line. Compared to the traditional straight-line, U-shaped line has many more advantages due to its special operation scheme and line type. Multiple objectives are considered in this paper which are: minimize the number of workstations, minimize the total of idle times, remove the hazardous parts early and remove the highly demanded parts early. In this paper, ant colony optimization (ACO) algorithm is used to help find a near-optimal solution to the problem. The performance of ACO algorithm is compared with the performance of other methodologies to solve the DLBP.

The rest of the paper is structured as follows: The next section presents the literature review. The problem definition and the mathematical formulation are given in the following. The subsequent section details a case study and computational results. Conclusion is given in the final section.

## LITERATURE REVIEW

As mentioned before, in this paper, a U-shaped disassembly line is considered to process the EOL products. Compared to a straight-line, U-shaped disassembly line is not gained as much attention (Ozceylan et al., 2019). Agrawal and Tiwari (2008) first proposed a collaborative ant colony algorithm to solve a U-shaped disassembly line balancing problem. Avikal and Mishra (2012) and Avikal et al. (2013) studied two different heuristic methods on U-shaped layout. Their results showed that a U-shaped disassembly line can improve working efficiency. Zhang et al. (2018) proposed a multi-objective ant colony genetic algorithm to help find near-optimal solutions on U-shaped disassembly line and they collaborated operation time and disassembly cost to create high-quality initial solutions. With the consideration of stochastic processing times, Zhang et al. (2018) used hybrid fish swarm algorithm on U-shaped disassembly line. Sequence-dependent DLBP takes task-order relationship into account. Li et al. (2019) modeled sequence dependent DLBP (SDDLBP) mathematically and developed an iterated local search method on a U-shaped line. Wang et al. (2020) introduced a flower pollination algorithm on a U-shaped layout and considered partial destructive mode. Wang et al. (2021) proposed a meta-heuristic approach on U-shaped line where multi-criterion decision making (MCDM) and variable neighborhood search (VNS) methods are considered to help enhance searching ability. Li and Janardhanan (2021) proposed cuckoo search algorithm on partial U-shaped disassembly line. Yao and Gupta (2021) considered multi-objective U-shaped DLBP with a novel small world optimization algorithm (SWOA). Yao and Gupta (2021) first tested cat swarm optimization (CSO) on a U-shaped line with the consideration of multiple objectives. Most recently, Qin et al. (2021) designed a discrete migrating birds optimization algorithm on U-shaped layout. In this paper, the advantages of U-shaped disassembly are shown by comparing it with a straight-line counterpart.

McGovern and Gupta (2007) mathematically proved that DLBP is an NP-hard problem which means that for large-scale DLBP, heuristic and meta-heuristic approaches are more practical for finding near-optimal solutions in reasonable computational time. Genetic algorithm, swarm-based algorithm, tabu search, simulated annealing algorithm and other local or global searching algorithms have been proposed in disassembly line balancing. ACO is an efficient searching algorithm with high speed



where its artificial ant system can provide a fast, near-optimal solution to the multiple objective DLBP (McGovern and Gupta, 2006).

Objectives are evaluated performances of designed disassembly line based on precedence relationships and cycle time constraints. Different objective values can be used to compare obtained solutions. In the given computational time, ACO may find multiple near-optimal solutions and therefore, pareto front is introduced to classify different solutions according to the objectives. In this paper, we consider four objectives, namely, minimize total number of workstations, minimize idle times, remove hazardous parts early and remove highly demanded parts early. The first two objectives are the consideration of workstations and are widely used in DLBP. In real world disassembly cases, hazardous parts may be harmful for individuals and equipment. In order to minimize this effect, the third objective is worth considering. Also, economic profit is one of the most essential points of disassembly and thus, removal of highly demanded parts early can make the cycle more efficient.

## PROBLEM DEFINITION

Disassembly line balancing aims to systematically separate EOL products into its subassemblies and parts. A disassembly task is disassembling a subassembly or part of product. Tasks should be done in different workstations and the sequence of disassembly obeys two constraints: cycle time constraint and precedence relationship constraint. Cycle time is predetermined, and its value is the same for every workstation. Precedence relationship introduces ordering among tasks which should be strictly followed. AND/OR graph is widely used in DLBP to describe precedence relationship. In this paper also, AND/OR graphs will represent the relationships among tasks.

## Notation

Indices and parameters:

$i, j$  index of tasks

$m$  index of workstations

$N$  Set of tasks

$M$  Set of workstations

$F$  Objective functions

$CT$  Cycle time

$t_i$  Disassembly time of task  $i$

$h_i$  Hazardous index of task  $i$ , binary variable, 1, if task  $i$  is hazardous; 0, otherwise

$d_i$  Demand value of task  $i$

$T_m$  Total task processing times of workstation  $m$

Decision variables:

$x_{im}$  binary variable, 1, if task  $i$  is assigned at the front side of workstation  $m$ ; 0, task  $i$  is not assigned at the front side of workstation  $m$ .

$y_{im}$  binary variable, 1, if task  $i$  is assigned at the back side of workstation  $m$ ; 0, task  $i$  is not assigned at the back side of workstation  $m$ .

$p_i$  position number of task  $i$  in disassembly sequence

$NW_m$  binary variable, 1 if workstation  $m$  is opened; 0, otherwise.

## Assumption

Before operating disassembly line balancing problem, several assumptions are stated as follows:

- (1) One task can only be assigned to one workstation.
- (2) The EOL products are only of one type.
- (3) Total task processing times of each workstation should be less than or equal to the cycle time.
- (4) Order of tasks should strictly follow the precedence relationship.

(5) Sequence-dependent relationship is not considered in this paper.

### Model formulation

$$\text{Min } f_1 = \sum_{m=1}^M NW_m \quad (1)$$

$$\text{Min } f_2 = \sum_{m=1}^M (CT - T_m)^2 \quad (2)$$

$$\text{Min } f_3 = \sum_{i=1}^N (s_i * h_i) \quad (3)$$

$$\text{Min } f_4 = \sum_{j=1}^N (s_j * d_j) \quad (4)$$

Equation (1) represents the first objective which aims to minimize the total number of workstations. Equation (2) represents minimization of total idle time. Equation (3) is minimization of the hazardous tasks' performance and equation (4) summarizes demand values of all tasks.

### Constraints

In this paper, there are two main constraints which are cycle time constraint and precedence relationship constraint. In different disassembly line types, the representation of precedence relationships are not the same. That means in U-shaped disassembly line, two directions are considered in disassembly processes. Corresponding constraints are shown below:

$$\sum_{m=1}^M (x_{im} + y_{im}) = 1 \quad \forall i, m \quad (5)$$

$$\sum_{j=1}^N (x_{jm} + y_{jm}) \geq 1 \quad \forall j, m \quad (6)$$

$$CT \geq T_m \quad \forall m \quad (7)$$

$$x_{im}, y_{im}, x_{jm}, y_{jm} \in \{0, 1\} \quad \forall i, j, m \quad (8)$$

Equation (5) represents one task should be assigned to only one side of only one workstation. Equation (6) means there can be one or more tasks disassembling in one workstation. Equation (7) ensures that cycle time constraint is strictly followed. Equation (8) restricts the values of the decision variables.

### RESULTS

The proposed ACO was coded in MATLAB and was tested on Apple M1. Product information and precedence relationships were taken from (McGovern and Gupta, 2006). Cycle time was set to 40s for each workstation. ACO was separately run 20 times on U-shaped disassembly line and straight-line disassembly line. Table 1 introduces accordingly information of tasks. From Table 1, task 7 is the only hazardous task and four of ten tasks (2, 6, 7, 9) have demand values.

**Table1.** Case information

Task	Disassembly time	Hazardous Index	Demand Value
1	14	0	0
2	10	0	500
3	12	0	0
4	17	0	0
5	23	0	0
6	14	0	750
7	19	1	295
8	36	0	0
9	14	0	360
10	10	0	0

Table 2 lists part results of ACO on U-shaped disassembly line and straight-line disassembly line. For each line type, four non-dominated solutions are listed in Table 2. Task sequence of each solution is listed on the last column. From Table 2, all of these solutions found the best value of  $f_1$  which is 5. The minimum values found of  $f_2$  on straight-line disassembly line and U-shaped line are 211 and 207,

respectively. The first solution of straight-line and the first solution of U-shaped line together found the best value of  $f_3$ , but their task sequences are different. The average values based on these 20 separate computations showed that U-shaped layout found lower values than straight-line layout.

**Table 2.** Results of ACO one two types of line

Line type	$f_1$	$f_2$	$f_3$	$f_4$	Task sequence
Straight-line	5	434	3	8325	5,6,7,9,1,4,10,8,2,3
	5	282	5	7445	6,9,5,1,7,4,8,10,2,3
	5	274	5	9605	6,1,5,10,7,4,8,9,2,3
	5	211	4	10810	5,10,6,7,1,4,8,9,2,3
U-shaped	5	259	3	10265	5,6,7,4,10,8,1,9,3,2
	5	207	5	8915	5,6,4,9,7,8,1,10,2,3
	5	207	4	8980	5,6,4,7,9,8,1,10,2,3
	5	219	5	8585	9,4,6,5,7,1,8,10,2,3

The performance of ACO was compared with genetic algorithm (GA), improved ant colony optimization (IACO), hybrid group neighborhood search algorithm (HGNS), small world optimization algorithm (SWOA) and cat swarm optimization (CSO). Part data of this case was taken from (Zhang et al., 2018; Zhu et al., 2014; Zhu et al., 2020; Yao and Gupta, 2021; Yao and Gupta, 2021). Table 3 summarizes results of operating different algorithms on disassembly line with considering the first two objectives as primary goals.

**Table 3.** Performance of algorithms

Objective	GA	ACO	IACO	HGNS	IABC	SWOA	CSO	SWOA(U)	CSO(U)	ACO(U)
$f_1$	5	5	5	5	5	5	5	5	5	5
$f_2$	211	211	211	219	211	211	211	<b>207</b>	<b>207</b>	<b>207</b>
$f_3$	4	4	4	4	4	4	5	4	5	5
$f_4$	9730	10090	9730	7510	9730	9480	8880	8980	9695	8915

From Table 3, the proposed ACO has the ability finding the best values of  $f_1$  and  $f_2$  which is proved to be suitable for solving DLBP. On U-shaped layout, ACO can find the best values on minimization of workstations and idle time, also, ACO has a better performance on minimizing demand values.

## CONCLUSION

This paper proposed a meta-heuristic algorithm (ACO) on U-shaped disassembly line balancing problem. DLBP is full of interesting and challenging areas for researchers. More research on U-shaped, two-sided, and parallel disassembly lines can be conducted in the future. Furthermore, new optimization algorithm and combination methods can be proposed for the DLBP. Special situation of DLBP like partial disassembly and sequence-dependent disassembly needs more attention.

## REFERENCES

1. Avikal, S., Jain, R. and Mishra, P., 2013. A heuristic for U-shaped disassembly line balancing problems. *MIT International Journal of Mechanical Engineering*, 3(1), pp.51-56.
2. Avikal, S. and Mishra, P.K., 2012. A new U-shaped heuristic for disassembly line balancing problems. *Int J Sci*, 1(1), pp.21-27.
3. Agrawal, S. and Tiwari, M.K., 2008. A collaborative ant colony algorithm to stochastic mixed-model U-shaped disassembly line balancing and sequencing problem. *International journal of production research*, 46(6), pp.1405-1429.
4. Gungor, A. and Gupta, S.M., 1999. Disassembly line balancing. *Proceedings of the 1999 Annual Meeting of the Northeast Decision Sciences Institute*, Newport, Rhode Island, March 24-26, 193-195.

5. Gungor, A. and Gupta, S.M., 1999. Issues in environmentally conscious manufacturing and product recovery: a survey. *Computers & Industrial Engineering*, 36(4), pp.811-853.
6. Goksoy Kalaycilar, E., Batun, S. and Azizoglu, M., 2021. A stochastic programming approach for the disassembly line balancing with hazardous task failures. *International Journal of Production Research*, pp.1-26.
7. Li, Z. and Janardhanan, M.N., 2021. Modelling and solving profit-oriented U-shaped partial disassembly line balancing problem. *Expert Systems with Applications*, p.115431.
8. Li, Z., Kucukkoc, I. and Zhang, Z., 2019. Iterated local search method and mathematical model for sequence-dependent U-shaped disassembly line balancing problem. *Computers & Industrial Engineering*, 137, p.106056.
9. McGovern, S.M. and Gupta, S.M., 2006. Ant colony optimization for disassembly sequencing with multiple objectives. *The International Journal of Advanced Manufacturing Technology*, 30(5-6), pp.481-496.
10. McGovern, S.M. and Gupta, S.M., 2007. Combinatorial optimization analysis of the unary NP-complete disassembly line balancing problem. *International Journal of Production Research*, 45(18-19), pp.4485-4511.
11. McGovern, S.M. and Gupta, S.M., 2011. *Disassembly Line: Balancing and Modeling*. McGraw-Hill Education.
12. Özceylan, E., Kalayci, C.B., Güngör, A. and Gupta, S.M., 2019. Disassembly line balancing problem: a review of the state of the art and future directions. *International Journal of Production Research*, 57(15-16), pp.4805-4827.
13. Qin, G., Guo, X., Liu, S., Qi, L., Zhao, J., Zhao, Z. and Tang, Y., 2021, June. Multi-objective Discrete Migrating Birds Optimizer Solving Multiple-product Partial U-shaped Disassembly Line Balancing Problem. In *2021 29th Mediterranean Conference on Control and Automation (MED)*(pp. 59-64). IEEE.
14. Wang, K., Gao, L. and Li, X., 2020. A multi-objective algorithm for U-shaped disassembly line balancing with partial destructive mode. *Neural Computing and Applications*, pp.1-22.
15. Wang, K., Li, X., Gao, L., Li, P. and Gupta, S.M., 2021. A genetic simulated annealing algorithm for parallel partial disassembly line balancing problem. *Applied Soft Computing*, 107, p.107404.
16. Wang, Y., Xie, Y., Ren, Y. and Zhang, C., 2021, February. A MCDM-Based Meta-Heuristic Approach for U-shaped Disassembly Line Balancing Problem. In *Journal of Physics: Conference Series* (Vol. 1828, No. 1, p. 012159). IOP Publishing.
17. Yao, P. and Gupta, S. M., 2021. Cat Swarm Optimization Algorithm for Solving Multi-Objective U-Shaped Disassembly Line Balancing Problem. *Proceedings of the International Conference on Remanufacturing*, March 24-25, pp. 222-230.
18. Yao, P. and Gupta, S. M., 2021. Small World Optimization Algorithm for Solving Multi-Objective U-Shaped Disassembly Line Balancing Problem, *Proceedings of the 2021 Annual Meeting of the Northeast Decision Sciences Institute*, Virtual, March 26-27, 659-668.
19. Zhang, Z.Q., Wang, K.P., Li, L.K. and Mao, L., 2018. Multi-objective optimization for U-shaped disassembly line balancing problem with stochastic operation times. *Computer Integrated Manufacturing Systems*, 24(1), pp.89-100.
20. Zhang, Z., Wang, K., Zhu, L. and Cheng, W., 2018. Pareto Hybrid Ant Colony and Genetic Algorithm for Multi-Objective U-Shaped Disassembly Line Balancing Problem. *Journal of Southwest Jiaotong University*, 53(3), pp.628-637.
21. Zhu, X., Zhang, Z. and Hu, J., 2014. An ant colony optimization algorithm for multi-objective disassembly line balancing problem. *Zhongguo Jixie China Mechanical Engineering*, 25(8), pp.1075-1079.
22. Zhu, L., Zhang, Z. and Guan, C., 2020. Multi-objective partial parallel disassembly line balancing problem using hybrid group neighbourhood search algorithm. *Journal of Manufacturing Systems*, 56, pp.252-269.





# PERIODIC SOLUTIONS OF VOLTERRA INTEGRO-DIFFERENTIAL EQUATIONS WHICH HAVE THE RETARDED ARGUMENT WITH BOUNDARY CONDITIONS OF GAMMA FUNCTIONS

**Raad N. Butris & Sahla B. Abdi**

*University of Duhok, College of Basic Education, Department of Mathematics,  
Kurdistan Region, Iraq.*

## Abstract

In this paper, we investigate the existence, uniqueness and stability periodic solutions of new Volterra integro-differential equations which have the retarded argument with boundary conditions of Gamma functions by using the numerical- analytic method that has been used to the study of a periodic solutions of nonlinear ordinary differential equations that were introduced by Samiolenko. Theorems on existence, uniqueness and stability periodic solutions which are established under some necessary and sufficient conditions on closed and bounded domains (compact spaces).

**Keywords:** Numerical-analytic methods, existence, uniqueness and stability periodic solutions, Volterra integro-differential equations, boundary conditions of Gamma functions.

## I. Introduction.

The theory of integro- differential equations has been of great interest for many years. It plays an important role in different subjects, such as physics, biology, chemistry, etc, and the study the solutions for non-linear system of integro- differential equations is very important branch in the integro- differential equations theory [1,2,4,6,8,10]. Many results about the existence, uniqueness and stability of the solutions for system of non-linear integro-differential equations have been obtained by the numerical analytic methods that were proposed by Samoilenko [12,13] which had been later applied in many studies [3,5,7,9,11,14].

In this paper, we investigate the existence, uniqueness and stability periodic solutions of Volterra integro-differential equations have retarded argument with boundary conditions of Gamma functions. In particular the following problems: -

$$\left. \begin{aligned} \frac{dx}{dt} &= Ax + f(t) + n(t, x(t), x(t-h), y(t), y(t-h), v) \\ E_1 x(0) + F_1 x(T) &= \Delta_1(t, \alpha), \quad \det F_1 \neq 0 \\ \frac{dy}{dt} &= By + g(t) + m(t, x(t), x(t-h), y(t), y(t-h), u) \\ E_2 y(0) + F_2 y(T) &= \Delta_2(t, \beta), \quad \det F_2 \neq 0 \end{aligned} \right\} \quad (1)$$

where

$$\Delta_1(t, \alpha) = \frac{t^{\alpha-1} e^{-t}}{\Gamma(\alpha+1)}, \quad \Delta_2(t, \beta) = \frac{t^{\beta-1} e^{-t}}{\Gamma(\beta+1)}$$

$$T < \left[ \frac{\Gamma(\alpha+1)}{(\alpha+1)} \right]^{\frac{1}{\alpha}} < \left[ \frac{\Gamma(\beta+1)}{(\beta+1)} \right]^{\frac{1}{\beta}}$$

$$f(t) = f_1(t) + t^\beta f_2(t), \quad \beta = 1 - \alpha, \quad 0 < \alpha < 1$$

$$g(t) = g_1(t) + t^\beta g_2(t), \quad \beta = 1 - \alpha$$

where

$$v(t) = \int_{-\infty}^t \frac{F(t, s)}{(t-s)^\alpha} \mathfrak{X}(s, x(s), x(s-h), y(s), y(s-h)) ds$$

and

$$u(t) = \int_{-\infty}^t \frac{G(t, s)}{(t-s)^\alpha} \mu(s, x(s), x(s-h), y(s), y(s-h)) ds$$

where  $E_1 = (E_{1ij})$ ,  $E_2 = (E_{2ij})$ ,  $F_1 = (F_{1ij})$ , and  $F_2 = (F_{2ij})$  are  $(n \times n)$  positive constant matrices and  $\mathfrak{X}_1(t, \alpha)$  and  $\mathfrak{X}_2(t, \beta)$  are said to be Gamma functions. Also, the vector function  $F(t, s)$  and  $G(t, s)$  are continuous in the  $t, s$  and periodic in  $t$  of period  $T$ .

The vector functions  $n(t, x, y, z, w, v)$  and  $m(t, x, y, z, w, u)$  is defined and continuous on the domains: -

$$\left. \begin{aligned} (t, x, y, z, w, v) &\in R^1 \times D \times D_1 \times D_2 \times D_3 \times D_v \\ (t, x, y, z, w, u) &\in R^1 \times D \times D_1 \times D_2 \times D_3 \times D_u \end{aligned} \right\} \quad (2)$$

and periodic in  $t$  of periodic  $T$ , where  $D, D_1, D_2, D_3$  are closed and bounded domains subsets of Euclidean space  $R^n$  and  $D_v, D_u$  are bounded domains subset of the Euclidean space  $R^m$ .

Suppose that the vector functions  $n(t, x, y, z, w, v)$  and  $m(t, x, y, z, w, u)$  satisfy the following in inequalities:-

$$\begin{aligned} &\|n(t, x_1, y_1, z_1, w_1, v_1) - n(t, x_2, y_2, z_2, w_2, v_2)\| \\ &\leq K_1 \|x_1 - x_2\| + K_2 \|y_1 - y_2\| + K_3 \|z_1 - z_2\| + K_4 \|w_1 - w_2\| \\ &\quad + K_5 \|v_1 - v_2\| \quad (3) \end{aligned}$$

$$\begin{aligned} &\|m(t, x_1, y_1, z_1, w_1, u_1) - m(t, x_2, y_2, z_2, w_2, u_2)\| \leq L_1 \|x_1 - x_2\| + \\ &L_2 \|y_1 - y_2\| + L_3 \|z_1 - z_2\| + L_4 \|w_1 - w_2\| + L_5 \|u_1 - \\ &u_2\| \quad (4) \end{aligned}$$

$$\begin{aligned} &\|\mathfrak{X}(t, x_1, y_1, z_1, w_1) - \mathfrak{X}(t, x_2, y_2, z_2, w_2)\| \\ &\leq Q_1 \|x_1 - x_2\| + Q_2 \|y_1 - y_2\| + Q_3 \|z_1 - z_2\| \\ &\quad + Q_4 \|w_1 - w_2\| \quad (5) \end{aligned}$$

$$\begin{aligned} &\|\mu(t, x_1, y_1, z_1, w_1) - \mu(t, x_2, y_2, z_2, w_2)\| \\ &\leq J_1 \|x_1 - x_2\| + J_2 \|y_1 - y_2\| + J_3 \|z_1 - z_2\| \\ &\quad + J_4 \|w_1 - w_2\| \quad (6) \end{aligned}$$

$$\|F(t, s)\| \leq \delta_1 e^{-\lambda_1(t-s)} \quad (7)$$

$$\|G(t, s)\| \leq \delta_2 e^{-\lambda_2(t-s)} \quad (8)$$

$$\begin{aligned} \|f(t)\| &= \|f_1(t) + t^\beta f_2(t)\| \leq \|f_1(t)\| + \|t\|^\beta \|f_2(t)\| \\ &\leq M_1 + T^\beta M_2 \end{aligned} \quad (9)$$

where

$$\|f_1(t)\| \leq M_1, \|f_2(t)\| \leq M_2, \quad t \in [0, T] \text{ and}$$

$$\begin{aligned} \|g(t)\| &= \|g_1(t) + t^\beta g_2(t)\| \leq \|g_1(t)\| + \|t\|^\beta \|g_2(t)\| \\ &\leq N_1 + T^\beta N_2 \end{aligned} \quad (10)$$

and

$$\|g_1(t)\| \leq N_1, \|g_2(t)\| \leq N_2, \quad t \in [0, T] \text{ and}$$

$$\left. \begin{aligned} \|n(t, x, y, z, w, v)\| &\leq M \\ \|m(t, x, y, z, w, u)\| &\leq N \end{aligned} \right\} \quad (11)$$

$$\left. \begin{aligned} \|\mathfrak{X}(t, x, y, z, w)\| &\leq M_3 \\ \|\mu(t, x, y, z, w)\| &\leq N_3 \end{aligned} \right\} \quad (12)$$

for all  $t \in R^1, x, x_1, x_2 \in D, y, y_1, y_2 \in D_1, z, z_1, z_2 \in D_2, w, w_1, w_2 \in D_3$  and  $v, v_1, v_2 \in D_v$  and  $u, u_1, u_2 \in D_u$ .

Also

$M_1, M_2, M_3, N, N_1, N_2, N_3, K_1, K_2, K_3, K_4, K_5, L_1, L_2, L_3, L_4, L_5, Q_1, Q_2, Q_3, Q_4, J_1, J_2, J_3$  and  $J_4$  are non-negative constants.

Suppose that  $A = [A_{ij}]$  and  $B = [B_{ij}]$  are  $(n \times n)$  positive matrices and satisfy the following inequalities:-

$$\|e^{A(t-s)}\| \leq \delta_3 \quad (13)$$

$$\|e^{B(t-s)}\| \leq \delta_4 \quad (14)$$

where  $\delta_1, \delta_2, \delta_3$  and  $\delta_4$  are positive constants.

Now, we define the non-empty sets as follows: -

$$\left. \begin{aligned} D_\rho &= D - \left( \delta_3 \left[ \frac{T}{2} (M_1 + T^\beta M_2) + M \right] + z_1 \right) \\ D_\rho^* &= D_1 - \left( \delta_3 \left[ \frac{T-h}{2} (M_1 + T^\beta M_2) + M \right] + z_2 \right) \\ D_\sigma &= D_2 - \left( \delta_4 \left[ \frac{T}{2} (N_1 + T^\beta N_2) + N \right] + z_3 \right) \\ D_\sigma^* &= D_3 - \left( \delta_4 \left[ \frac{T-h}{2} (N_1 + T^\beta N_2) + N \right] + z_4 \right) \end{aligned} \right\} \quad (15)$$

where

$$z_1 = \left\| \frac{\mathbb{X}_1(T, \alpha)}{F_1} - \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 \right\|$$

$$z_2 = \left\| \frac{\mathbb{X}_2(T, \beta)}{F_2} - \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 \right\|$$

$$z_3 = \left\| \frac{\mathbb{X}_1((T-h), \alpha)}{F_1} - \left( \frac{E_1}{F_1} + e^{A(T-h)} \right) x_0 \right\|$$

$$z_4 = \left\| \frac{\mathbb{X}_2((T-h), \beta)}{F_2} - \left( \frac{E_2}{F_2} + e^{B(T-h)} \right) y_0 \right\|$$

Furthermore, we suppose that the largest eigen-value of the matrix

$$Q = \begin{pmatrix} \frac{T}{2} R_1 & \frac{T}{2} R_2 & \frac{T}{2} R_3 & \frac{T}{2} R_4 \\ \frac{T}{2} G_1 & \frac{T}{2} G_2 & \frac{T}{2} G_3 & \frac{T}{2} G_4 \\ (\frac{T-h}{2}) R_1 & (\frac{T-h}{2}) R_2 & (\frac{T-h}{2}) R_3 & (\frac{T-h}{2}) R_4 \\ (\frac{T-h}{2}) G_1 & (\frac{T-h}{2}) G_2 & (\frac{T-h}{2}) G_3 & (\frac{T-h}{2}) G_4 \end{pmatrix} \text{ does not exceed unity. That is}$$

$$\lambda_{\max}(Q) = \frac{\psi_1 + \sqrt{\psi_1^2 - 4\psi_2}}{2} < 1 \quad (16)$$

$$\text{where } \psi_1 = \frac{T}{2} R_1 + \frac{T}{2} G_2 + \frac{T-h}{2} R_3 + \frac{T-h}{2} G_4$$

$$\begin{aligned} \psi_2 = & \frac{T}{2} R_1 \left( \frac{T-h}{2} \right) G_4 + \frac{T^2}{4} R_1 G_2 + \frac{T}{2} G_2 \left( \frac{T-h}{2} \right) R_3 + \frac{(T-h)^2}{4} R_3 G_4 + \frac{(T-h)^2}{4} G_3 R_4 + \\ & \left( \frac{T-h}{2} \right) R_2 \frac{T}{2} G_3 - \frac{T}{2} G_1 \left( \frac{T-h}{2} \right) R_2 - \left( \frac{T-h}{2} \right) G_1 \frac{T}{2} R_4, \end{aligned}$$

$$R_1 = \delta_3 K_1 + \delta_3 K_5 Q_1 \frac{\delta_1}{2\lambda_1 T^\alpha}, R_2 = \delta_3 K_2 + \delta_3 K_5 Q_2 \frac{\delta_1}{2\lambda_1 T^\alpha}$$

$$R_3 = \delta_3 K_3 + \delta_3 K_5 Q_3 \frac{\delta_1}{2\lambda_1 T^\alpha}, R_4 = \delta_3 K_4 + \delta_3 K_5 Q_4 \frac{\delta_1}{2\lambda_1 T^\alpha}$$

$$G_1 = \delta_4 L_1 + \delta_4 L_5 J_1 \frac{\delta_2}{2\lambda_2 T^\alpha}, G_2 = \delta_4 L_2 + \delta_4 L_5 J_2 \frac{\delta_2}{2\lambda_2 T^\alpha}$$

$$G_3 = \delta_4 L_3 + \delta_4 L_5 J_3 \frac{\delta_2}{2\lambda_2 T^\alpha}, G_4 = \delta_4 L_4 + \delta_4 L_5 J_4 \frac{\delta_2}{2\lambda_2 T^\alpha}$$

We define the sequence of functions  $\{x_i(t, x_0, y_0)\}_{i=0}^\infty, \{y_i(t, x_0, y_0)\}_{i=0}^\infty$  on the domains (2) by the following: -

$$\begin{aligned} x_{i+1}(t, x_0, y_0) &= x_0 e^{At} + \int_0^t e^{A(t-s)} [f(s) \\ &+ n(s, x_i(s, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), v_i))] - \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\ &+ n(s, x_i(s, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), v_i) ds] ds + \delta_3 \frac{t}{T} \left[ \frac{\mathbb{X}_1(T, \alpha)}{F_1} \right. \\ &\left. - \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 \right] \quad (17) \end{aligned}$$

and

$$\begin{aligned} y_{i+1}(t) &= y_0 e^{Bt} + \int_0^t e^{B(t-s)} [g(s) \\ &+ m(s, x_i(s, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), u_i))] - \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\ &+ m(s, x_i(s, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), u_i) ds] ds + \delta_4 \frac{t}{T} \left[ \frac{\mathbb{X}_2(T, \beta)}{F_2} - \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 \right] \quad (18) \end{aligned}$$

with  $x_0(t, x_0, y_0) = x_0 e^{At}$ ,  $y_0(t, x_0, y_0) = y_0 e^{Bt}$ , for all  $i = 0, 1, 2, \dots$

where



$$v_i = \int_{-\infty}^s \frac{F(s, \tau)}{(s - \tau)^\alpha} \mathfrak{X}(\tau, x_i(\tau, x_0, y_0), x_i((\tau - h), x_0, y_0), y_i(\tau, x_0, y_0), y_i((\tau - h), x_0, y_0)) d\tau$$

$$u_i = \int_{-\infty}^s \frac{G(s, \tau)}{(s - \tau)^\alpha} \mu(\tau, x_i(\tau, x_0, y_0), x_i((\tau - h), x_0, y_0), y_i(\tau, x_0, y_0), y_i((\tau - h), x_0, y_0)) d\tau$$

**Lemma 1.** Suppose that the vector functions  $n(t, x, y, z, w, v)$  and  $m(t, x, y, z, w, u)$  be vectors are defined in the interval  $[0, T]$ , then the following inequality hold: -

$$\left( \begin{array}{l} \|F_1(t, x_0, y_0)\| \\ \|F_2(t, x_0, y_0)\| \end{array} \right) \leq \left( \begin{array}{l} \delta_3 [\alpha(t) [(M_1 + T^\beta M_2) + M] + z_1] \\ \delta_4 [\alpha(t) [(N_1 + T^\beta N_2) + N] + z_2] \end{array} \right) \quad (19)$$

for  $0 \leq t \leq T$ , and  $\alpha(t) \leq \frac{T}{2}$

where  $\alpha(t) = 2t(1 - \frac{t}{T})$  for all  $t \in [0, T]$ ,

$$\begin{aligned} F_1(t, x_0, y_0) &= x_0 e^{At} + \int_0^t e^{A(t-s)} [f(s) \\ &\quad + n(s, x(s, x_0, y_0), x((s - h), x_0, y_0), y(s, x_0, y_0), y((s - h), x_0, y_0), v)] - \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\ &\quad + n(s, x(s, x_0, y_0), x((s - h), x_0, y_0), y(s, x_0, y_0), y((s - h), x_0, y_0), v) ds] ds + \delta_3 \frac{t}{T} \left[ \frac{\mathfrak{X}_1(T, \alpha)}{F_1} - \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 \right] \end{aligned}$$

$$\begin{aligned} F_2(t, x_0, y_0) &= y_0 e^{Bt} + \int_0^t e^{B(t-s)} [g(s) \\ &\quad + m(s, x(s, x_0, y_0), x((s - h), x_0, y_0), y(s, x_0, y_0), y((s - h), x_0, y_0), u)] - \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\ &\quad + m(s, x(s, x_0, y_0), x((s - h), x_0, y_0), y(s, x_0, y_0), y((s - h), x_0, y_0), u) ds] ds + \delta_4 \frac{t}{T} \left[ \frac{\mathfrak{X}_2(T, \beta)}{F_2} - \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 \right] \end{aligned}$$

where

$$v = \int_{-\infty}^s \frac{F(s, \tau)}{(s - \tau)^\alpha} \mathfrak{X}(\tau, x(\tau, x_0, y_0), x((\tau - h), x_0, y_0), y(\tau, x_0, y_0), y((\tau - h), x_0, y_0)) d\tau$$

$$u = \int_{-\infty}^s \frac{G(s, \tau)}{(s - \tau)^\alpha} \mu(\tau, x(\tau, x_0, y_0), x((\tau - h), x_0, y_0), y(\tau, x_0, y_0), y((\tau - h), x_0, y_0)) d\tau$$

**Proof:** Taking

$$\begin{aligned} \|F_1(t, x_0, y_0)\| &\leq \left(1 - \frac{t}{T}\right) \int_0^t \|e^{A(t-s)}\| \|f(s)\| \\ &\quad + \|n(s, x(s, x_0, y_0), x((s - h), x_0, y_0), y(s, x_0, y_0), y((s - h), x_0, y_0), v) ds\| ds \\ &\quad + \frac{t}{T} \int_t^T \|e^{A(t-s)}\| \|f(s)\| \\ &\quad + \|n(s, x(s, x_0, y_0), x((s - h), x_0, y_0), y(s, x_0, y_0), y((s - h), x_0, y_0), v) ds\| ds + \delta_3 \left\| \frac{\mathbb{X}_1(T, \alpha)}{F_1} - \left(\frac{E_1}{F_1} + e^{AT}\right) x_0 \right\| \end{aligned}$$

So

$$\|F_1(t, x_0, y_0)\| \leq \delta_3 [\alpha(t) [(M_1 + T^\beta M_2) + M] + z_1] \quad (20)$$

Similarly

$$\|F_2(t, x_0, y_0)\| \leq \delta_4 [\alpha(t) [(N_1 + T^\beta N_2) + N] + z_2] \quad (21)$$

From (20) and (21) we conclude that the inequality (19) .

**Lemma 2.** Suppose that the vector functions  $n(t, x, y, z, w, v)$  and  $m(t, x, y, z, w, u)$  be vectors are defined in the interval  $[0, T]$ , then the following inequality hold: -

$$\left( \|F_3((t - h), x_0, y_0)\| \right) \leq \left( \delta_3 [\alpha(t - h) [(M_1 + T^\beta M_2) + M] + z_3] \right) \quad (22)$$

$$\left( \|F_4((t - h), x_0, y_0)\| \right) \leq \left( \delta_4 [\alpha(t - h) [(N_1 + T^\beta N_2) + N] + z_4] \right)$$

for  $0 \leq t \leq T$ , and  $\alpha(t - h) \leq \frac{T-h}{2}$

where  $\alpha(t - h) = 2(t - h)(1 - \frac{t-h}{T})$  for all  $t \in [0, T]$ ,

$$\begin{aligned}
F_3((t-h), x_0, y_0) &= x_0 e^{At} + \int_0^{t-h} e^{A(t-s)} [f(s) \\
&+ n(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), v))] - \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\
&+ n(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), v) ds] ds + \delta_3 \frac{t-h}{T} \left[ \frac{\mathbb{X}_1((T-h), \alpha)}{F_1} \right. \\
&\left. - \left( \frac{E_1}{F_1} + e^{A(T-h)} \right) x_0 \right]
\end{aligned}$$

$$\begin{aligned}
F_4((t-h), x_0, y_0) &= y_0 e^{Bt} + \int_0^{t-h} e^{B(t-s)} [g(s) \\
&+ m(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), u))] - \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\
&+ m(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), u) ds] ds + \delta_4 \frac{t-h}{T} \left[ \frac{\mathbb{X}_2((T-h), \beta)}{F_2} \right. \\
&\left. - \left( \frac{E_2}{F_2} + e^{B(T-h)} \right) y_0 \right]
\end{aligned}$$

**Proof:** By the same proof of lemma1., we have

$$\|F_3((t-h), x_0, y_0)\| \leq \delta_3 \left[ \frac{(T-h)}{2} [(M_1 + T^\beta M_2) + M] + z_3 \right] \quad (23)$$

Also,

$$\|F_4((t-h), x_0, y_0)\| \leq \delta_4 \left[ \frac{(T-h)}{2} [(N_1 + T^\beta N_2) + N] + z_4 \right] \quad (24)$$

From (23) and (24) we conclude that the inequality (22) .

## II. Approximation periodic solution of (1).

In this section, we investigate the approximation of periodic solutions for (1) will be introduced by the following theorem: -

**Theorem 1.** If the system (1) satisfy inequalities from (3) to (12) and satisfy the conditions (15) and (16), then there exists a sequence of functions (17) and (18), which are periodic in  $t$  of periodic  $T$ , convergent uniformly on the domain: -

$$(t, x_0, y_0) \in [0, T] \times D_\rho \times D_\sigma \quad (25)$$

to the limit functions  $x(t, x_0, y_0)$  and  $y(t, x_0, y_0)$  define in the domain (2) which is periodic in  $t$  of periodic  $T$  and satisfy the system of integral equations: -

$$\begin{aligned} x(t, x_0, y_0) = & x_0 e^{At} + \int_0^t e^{A(t-s)} [f(s) \\ & + n(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), v))] - \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\ & + n(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), v) ds] ds + \delta_3 \frac{t}{T} \left[ \frac{\tilde{X}_1(T, \alpha)}{F_1} \right. \\ & \left. - \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 \right] \end{aligned} \quad (26)$$

and

$$\begin{aligned} y(t, x_0, y_0) = & y_0 e^{Bt} + \int_0^t e^{B(t-s)} [g(s) \\ & + m(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), u))] - \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\ & + m(s, x(s, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), u) ds] ds + \delta_4 \frac{t}{T} \left[ \frac{\tilde{X}_2(T, \beta)}{F_2} \right. \\ & \left. - \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 \right] \end{aligned} \quad (27)$$

which are unique solutions on the domain (2), provided that

$$\begin{pmatrix} \|x_i(t, x_0, y_0) - x_0\| \\ \|y_i(t, x_0, y_0) - y_0\| \\ \|x_i((t-h), x_0, y_0) - x_0\| \\ \|y_i((t-h), x_0, y_0) - y_0\| \end{pmatrix} \leq \begin{pmatrix} \delta_3 \left[ \frac{T}{2} [(M_1 + T^\beta M_2) + M] + z_1 \right] \\ \delta_4 \left[ \frac{T}{2} [(N_1 + T^\beta N_2) + N] + z_3 \right] \\ \delta_3 \left[ \frac{T-h}{2} [(M_1 + T^\beta M_2) + M] + z_2 \right] \\ \delta_4 \left[ \frac{T-h}{2} [(N_1 + T^\beta N_2) + N] + z_4 \right] \end{pmatrix} \quad (28)$$

and

$$\begin{pmatrix} \|x(t, x_0, y_0) - x_i(t, x_0, y_0)\| \\ \|y(t, x_0, y_0) - y_i(t, x_0, y_0)\| \\ \|x((t-h), x_0, y_0) - x_i((t-h), x_0, y_0)\| \\ \|y((t-h), x_0, y_0) - y_i((t-h), x_0, y_0)\| \end{pmatrix} \leq Q^i(E - Q)^{-1}\lambda \quad (29)$$

$$\text{where } \lambda = \begin{pmatrix} \delta_3 \left[ \frac{T}{2} [(M_1 + T^\beta M_2) + M] + z_1 \right] \\ \delta_4 \left[ \frac{T}{2} [(N_1 + T^\beta N_2) + N] + z_2 \right] \\ \delta_3 \left[ \frac{T-h}{2} [(M_1 + T^\beta M_2) + M] + z_3 \right] \\ \delta_4 \left[ \frac{T-h}{2} [(N_1 + T^\beta N_2) + N] + z_4 \right] \end{pmatrix}$$

for all  $t \in [0, T]$  and  $x_0 \in D_\rho, y_0 \in D_\sigma$ , where  $E$  is identity matrix.

**Proof.**

By mathematical induction, we can prove that

$$\begin{aligned} \|x_i(t, x_0, y_0) - x_0\| &\leq \delta_3 \left[ \frac{T}{2} [(M_1 + T^\beta M_2) + M] + z_1 \right] \\ \|y_i(t, x_0, y_0) - y_0\| &\leq \delta_4 \left[ \frac{T}{2} [(N_1 + T^\beta N_2) + N] + z_2 \right] \end{aligned} \quad (30)$$

Therefore  $x_i(t) \in D, y_i(t) \in D_1, t \in [0, T], x_0 \in D_\rho, y_0 \in D_\sigma, i = 1, 2, \dots$

Also, by using sequence of functions (17) and lemma 2, we have



$$\left. \begin{aligned} \|x_i((t-h), x_0, y_0) - x_0\| &\leq \delta_3 \left[ \frac{(T-h)}{2} [(M_1 + T^\beta M_2) + M] + z_3 \right] \\ \|y_i((t-h), x_0, y_0) - y_0\| &\leq \delta_4 \left[ \frac{(T-h)}{2} [(N_1 + T^\beta N_2) + N] + z_4 \right] \end{aligned} \right\} \quad (31)$$

Therefore  $x_i((t-h), x_0, y_0) \in D_1, y_i((t-h), x_0, y_0) \in D_3, t \in [0, T], x_0 \in D_\sigma^*, y_0 \in D_\rho^*, i = 1, 2, \dots$

Rewriting the inequalities (30) and (31) by vector form, then we have (28).

Next, we shall prove that the sequence of functions (17) and (18) convergent uniformly on the domain (2).

We start by finding a calculation for

$$\begin{aligned} x_i(t, x_0, y_0) &= x_0 e^{At} + \int_0^t e^{A(t-s)} [f(s) \\ &\quad + n(s, x_{i-1}(s, x_0, y_0), x_{i-1}((s-h), x_0, y_0), y_{i-1}(s, x_0, y_0), y_{i-1}((s-h), x_0, y_0), v_{i-1})) \\ &\quad - \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\ &\quad + n(s, x_{i-1}(s, x_0, y_0), x_{i-1}((s-h), x_0, y_0), y_{i-1}(s, x_0, y_0), y_{i-1}((s-h), x_0, y_0), v_{i-1})) ds] ds \\ &\quad + \delta_3 \frac{t}{T} \left[ \frac{\mathfrak{X}_1(T, \alpha)}{F_1} - \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 \right] \end{aligned} \quad (32)$$

and

$$\begin{aligned} y_i(t) &= y_0 e^{Bt} + \int_0^t e^{B(t-s)} [g(s) \\ &\quad + m(s, x_{i-1}(s, x_0, y_0), x_{i-1}((s-h), x_0, y_0), y_{i-1}(s, x_0, y_0), y_{i-1}((s-h), x_0, y_0), u_{i-1})) \\ &\quad - \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\ &\quad + m(s, x_{i-1}(s, x_0, y_0), x_{i-1}((s-h), x_0, y_0), y_{i-1}(s, x_0, y_0), y_{i-1}((s-h), x_0, y_0), u_{i-1})) ds] ds \\ &\quad + \delta_4 \frac{t}{T} \left[ \frac{\mathfrak{X}_2(T, \beta)}{F_2} - \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 \right] \end{aligned} \quad (33)$$

where

$$v_{i-1} = \int_{-\infty}^s \frac{F(s, \tau)}{(s-\tau)^\alpha} \mathfrak{X}(\tau, x_{i-1}(\tau, x_0, y_0), x_{i-1}((\tau-h), x_0, y_0), y_{i-1}(\tau, x_0, y_0), y_{i-1}((\tau-h), x_0, y_0)) d\tau$$

$$u_{i-1} = \int_{-\infty}^s \frac{G(s, \tau)}{(s - \tau)^\alpha} \mu(\tau, x_{i-1}(\tau, x_0, y_0), x_{i-1}((\tau - h), x_0, y_0), y_{i-1}(\tau, x_0, y_0), y_{i-1}((\tau - h), x_0, y_0)) d\tau$$

Now, finding the different between (17) and (32), we get

$$\begin{aligned} & \|x_{i+1}(t, x_0, y_0) - x_i(t, x_0, y_0)\| \\ & \leq \alpha(t)R_1 \|x_i(t, x_0, y_0) - x_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t)R_2 \|x_i((t - h), x_0, y_0) - x_{i-1}((t - h), x_0, y_0)\| \\ & + \alpha(t)R_3 \|y_i(t, x_0, y_0) - y_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t)R_4 \|y_i((t - h), x_0, y_0) - y_{i-1}((t - h), x_0, y_0)\| \end{aligned} \quad (34)$$

Similarly, the different between the sequence of functions (18) and (33), we obtain that:-

$$\begin{aligned} & \|y_{i+1}(t, x_0, y_0) - y_i(t, x_0, y_0)\| \\ & \leq \alpha(t)G_1 \|x_i(t, x_0, y_0) - x_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t)G_2 \|x_i((t - h), x_0, y_0) - x_{i-1}((t - h), x_0, y_0)\| \\ & + \alpha(t)G_3 \|y_i(t, x_0, y_0) - y_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t)G_4 \|y_i((t - h), x_0, y_0) - y_{i-1}((t - h), x_0, y_0)\| \end{aligned} \quad (35)$$

Also, by the same way above, we obtain that

$$\begin{aligned} & \|x_{i+1}((t - h), x_0, y_0) - x_i((t - h), x_0, y_0)\| \\ & \leq \alpha(t - h)R_1 \|x_i(t, x_0, y_0) - x_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t - h)R_2 \|x_i((t - h), x_0, y_0) - x_{i-1}((t - h), x_0, y_0)\| \\ & + \alpha(t - h)R_3 \|y_i(t, x_0, y_0) - y_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t - h)R_4 \|y_i((t - h), x_0, y_0) - y_{i-1}((t - h), x_0, y_0)\| \end{aligned} \quad (36)$$

Also

$$\begin{aligned} & \|y_{i+1}((t - h), x_0, y_0) - y_i((t - h), x_0, y_0)\| \\ & \leq \alpha(t - h)G_1 \|x_i(t, x_0, y_0) - x_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t - h)G_2 \|x_i((t - h), x_0, y_0) - x_{i-1}((t - h), x_0, y_0)\| \\ & + \alpha(t - h)G_3 \|y_i(t, x_0, y_0) - y_{i-1}(t, x_0, y_0)\| \\ & + \alpha(t - h)G_4 \|y_i((t - h), x_0, y_0) - y_{i-1}((t - h), x_0, y_0)\| \end{aligned} \quad (37)$$

Rewriting inequalities (34), (35), (36) and (37) for all  $p$  in  $a$  vector form, we have:-

$$\begin{pmatrix} \|x_{i+p}(t, x_0, y_0) - x_i(t, x_0, y_0)\| \\ \|y_{i+p}(t, x_0, y_0) - y_i(t, x_0, y_0)\| \\ \|x_{i+p}((t-h), x_0, y_0) - x_i((t-h), x_0, y_0)\| \\ \|y_{i+p}((t-h), x_0, y_0) - y_i((t-h), x_0, y_0)\| \end{pmatrix} \leq Q^i(E + Q + \dots + Q^{p-1})\lambda \quad (38)$$

for all  $t \in [0, T]$ ,  $x_0 \in D_\rho$  and  $y_0 \in D_\sigma$ .

Since  $\frac{\psi_1 + \sqrt{\psi_1^2 - 4\psi_2}}{2} < 1$  and  $\lim_{i \rightarrow \infty} \Lambda^i = 0$ , so that the right side of (38) tend to zero. Hence the sequence of functions  $\begin{pmatrix} x(t, x_0, y_0) \\ y(t, x_0, y_0) \end{pmatrix}$  is convergent uniformly on the domain (25) to the limit function  $\begin{pmatrix} x(t, x_0, y_0) \\ y(t, x_0, y_0) \end{pmatrix}$  is define on the same domain.

Let

$$\lim_{i \rightarrow \infty} \begin{pmatrix} x_i(t, x_0, y_0) \\ y_i(t, x_0, y_0) \end{pmatrix} = \begin{pmatrix} x(t, x_0, y_0) \\ y(t, x_0, y_0) \end{pmatrix} \quad (39)$$

**Theorem 2 .** Let system (1) satisfied all inequalities and conditions of theorem 1, suppose that  $\begin{pmatrix} x(t, x_0, y_0) \\ y(t, x_0, y_0) \end{pmatrix}$  is a unique solution of (1).

**Proof.** Assume that  $\begin{pmatrix} \hat{x}(t, x_0, y_0) \\ \hat{y}(t, x_0, y_0) \end{pmatrix}$  be other solutions of (1).

where

$$\begin{aligned} \hat{x}(t, x_0, y_0) = & x_0 e^{At} + \int_0^t e^{A(t-s)} [f(s) \\ & + n(s, \hat{x}(s, x_0, y_0), \hat{x}((s-h), x_0, y_0), \hat{y}(s, x_0, y_0), \hat{y}((s-h), x_0, y_0), \hat{v})) - \frac{1}{T} \int_0^t e^{A(t-s)} [f(s) \\ & + n(s, \hat{x}(s, x_0, y_0), \hat{x}((s-h), x_0, y_0), \hat{y}(s, x_0, y_0), \hat{y}((s-h), x_0, y_0), \hat{v})) ds] ds + \delta_3 \frac{t}{T} [\frac{\mathbf{X}_1(T, \alpha)}{F_1} \\ & - (\frac{E_1}{F_1} + e^{AT}) x_0] \end{aligned} \quad (40)$$

and

$$\begin{aligned}
\hat{y}(t, x_0, y_0) = & y_0 e^{Bt} + \int_0^t e^{B(t-s)} [g(s) \\
& + m(s, \hat{x}(s, x_0, y_0), \hat{x}((s-h), x_0, y_0), \hat{y}(s, x_0, y_0), \hat{y}((s-h), x_0, y_0), \hat{u})) - \frac{1}{T} \int_0^t e^{B(t-s)} [g(s) \\
& + m(s, \hat{x}(s, x_0, y_0), \hat{x}((s-h), x_0, y_0), \hat{y}(s, x_0, y_0), \hat{y}((s-h), x_0, y_0), \hat{u})) ds] ds + \delta_4 \frac{t}{T} [\frac{\mathbf{X}_2(T, \beta)}{F_2} \\
& - (\frac{E_2}{F_2} + e^{BT}) y_0] \quad (41)
\end{aligned}$$

where

$$\hat{v} = \int_{-\infty}^s \frac{F(s-\tau)}{(s-\tau)^\alpha} \mathbf{X}(\tau, \hat{x}(\tau, x_0, y_0), \hat{x}((\tau-h), x_0, y_0), \hat{y}(\tau, x_0, y_0), \hat{y}((\tau-h), x_0, y_0)) d\tau$$

$$\hat{u} = \int_{-\infty}^s \frac{G(s-\tau)}{(s-\tau)^\alpha} \mu(\tau, \hat{x}(\tau, x_0, y_0), \hat{x}((\tau-h), x_0, y_0), \hat{y}(\tau, x_0, y_0), \hat{y}((\tau-h), x_0, y_0)) d\tau,$$

Taking: -

$$\begin{aligned}
& \|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| \\
& \leq \alpha(t) R_1 \|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| \\
& + \alpha(t) R_2 \|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| \\
& + \alpha(t) R_3 \|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| \\
& + \alpha(t) R_4 \|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\| \quad (42)
\end{aligned}$$

Similarly

$$\begin{aligned}
& \|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| \\
& \leq \alpha(t) G_1 \|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| \\
& + \alpha(t) G_2 \|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| \\
& + \alpha(t) G_3 \|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| \\
& + \alpha(t) G_4 \|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\|, \quad (43)
\end{aligned}$$

and

$$\begin{aligned}
& \|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| \\
& \leq \alpha(t-h)R_1\|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| + \alpha(t-h)R_2\|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| + \alpha(t-h)R_3\|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| + \alpha(t-h)R_4\|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\|
\end{aligned} \quad (44)$$

And

$$\begin{aligned}
& \|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\| \\
& \leq \alpha(t-h)G_1\|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| + \alpha(t-h)G_2\|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| + \alpha(t-h)G_3\|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| + \alpha(t-h)G_4\|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\|
\end{aligned} \quad (45)$$

Rewrite the inequalities (42), (43), (44) and (45) in the vector form: -

$$\begin{aligned}
& \begin{pmatrix} \|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| \\ \|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| \\ \|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| \\ \|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\| \end{pmatrix} \\
& \leq Q \begin{pmatrix} \|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| \\ \|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| \\ \|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| \\ \|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\| \end{pmatrix}
\end{aligned} \quad (46)$$

Now, by the condition (16), we have: -

*the contradiction, then*

$$\begin{pmatrix} \|x(t, x_0, y_0) - \hat{x}(t, x_0, y_0)\| \\ \|y(t, x_0, y_0) - \hat{y}(t, x_0, y_0)\| \\ \|x((t-h), x_0, y_0) - \hat{x}((t-h), x_0, y_0)\| \\ \|y((t-h), x_0, y_0) - \hat{y}((t-h), x_0, y_0)\| \end{pmatrix} \rightarrow \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Hence

$$\begin{pmatrix} x(t, x_0, y_0) \\ y(t, x_0, y_0) \\ x((t-h), x_0, y_0) \\ y((t-h), x_0, y_0) \end{pmatrix} = \begin{pmatrix} \hat{x}(t, x_0, y_0) \\ \hat{y}(t, x_0, y_0) \\ \hat{x}((t-h), x_0, y_0) \\ \hat{y}((t-h), x_0, y_0) \end{pmatrix}$$



Thus  $\begin{pmatrix} x(t, x_0, y_0) \\ y(t, x_0, y_0) \end{pmatrix}$  is a unique solution of (1).

### III. Existence periodic solution of (1).

The existence of periodic solution for the system (1) is uniquely connected with the existence of zeros of the functions  $\Delta_1^*(0, x_0, y_0)$ ,  $\Delta_2^*(0, x_0, y_0)$ ,  $\Delta_3^*(0, x_0, y_0)$  and  $\Delta_4^*(0, x_0, y_0)$  which defined by: -

$$\begin{aligned} \Delta_1^*(0, x_0, y_0) = & \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\ & + n(s, x(t, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), v)] ds + \frac{1}{T} \left[ \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 - \frac{\mathfrak{X}_1(T, \alpha)}{F_1} \right] \end{aligned} \quad (47)$$

$$\begin{aligned} \Delta_2^*(0, x_0, y_0) = & \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\ & + m(s, x(t, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), u)] ds + \frac{1}{T} \left[ \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 - \frac{\mathfrak{X}_2(T, \beta)}{F_2} \right] \end{aligned} \quad (48)$$

and

$$\begin{aligned} \Delta_3^*(0, x_0, y_0) = & \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\ & + n(s, x(t, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), v)] ds + \frac{1}{T} \left[ \left( \frac{E_1}{F_1} + e^{A(T-h)} \right) x_0 \right. \\ & \left. - \frac{\mathfrak{X}_1((T-h), \alpha)}{F_1} \right] \end{aligned} \quad (49)$$

$$\begin{aligned} \Delta_4^*(0, x_0, y_0) = & \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\ & + m(s, x(t, x_0, y_0), x((s-h), x_0, y_0), y(s, x_0, y_0), y((s-h), x_0, y_0), u)] ds + \frac{1}{T} \left[ \left( \frac{E_2}{F_2} + e^{B(T-h)} \right) y_0 \right. \\ & \left. - \frac{\mathfrak{X}_2((T-h), \beta)}{F_2} \right] \end{aligned} \quad (50)$$

Since the functions are approximately determined from the sequences of functions  $\Delta_1^*(0, x_0, y_0)$ ,  $\Delta_1^*(0, x_0, y_0)$ ,  $\Delta_3^*(0, x_0, y_0)$  and  $\Delta_4^*(0, x_0, y_0)$ :-

$$\begin{aligned}
\Delta_{1i}^*(0, x_0, y_0) &= \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\
&+ n(s, x_i(t, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), v_i)] ds + \frac{1}{T} \left[ \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 - \frac{\mathfrak{X}_1(T, \alpha)}{F_1} \right] \quad (51)
\end{aligned}$$

$$\begin{aligned}
\Delta_{2i}^*(0, x_0, y_0) &= \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\
&+ m(s, x_i(t, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), u_i)] ds + \frac{1}{T} \left[ \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 - \frac{\mathfrak{X}_2(T, \beta)}{F_2} \right] \quad (52)
\end{aligned}$$

and

$$\begin{aligned}
\Delta_{3i}^*(0, x_0, y_0) &= \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\
&+ n(s, x_i(t, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), v_i)] ds + \frac{1}{T} \left[ \left( \frac{E_1}{F_1} + e^{A(T-h)} \right) x_0 - \frac{\mathfrak{X}_1((T-h), \alpha)}{F_1} \right] \quad (53)
\end{aligned}$$

$$\begin{aligned}
\Delta_{4i}^*(0, x_0, y_0) &= \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\
&+ m(s, x_i(t, x_0, y_0), x_i((s-h), x_0, y_0), y_i(s, x_0, y_0), y_i((s-h), x_0, y_0), u_i)] ds + \frac{1}{T} \left[ \left( \frac{E_2}{F_2} + e^{B(T-h)} \right) y_0 - \frac{\mathfrak{X}_2((T-h), \beta)}{F_2} \right] \quad (54)
\end{aligned}$$

**Theorem 3.** If all assumptions and condition of theorem 1 be given, then the following inequality holds: -

$$\begin{pmatrix} \Delta_1^*(0, x_0, y_0) - \Delta_{1i}^*(0, x_0, y_0) \\ \Delta_2^*(0, x_0, y_0) - \Delta_{2i}^*(0, x_0, y_0) \\ \Delta_3^*(0, x_0, y_0) - \Delta_{3i}^*(0, x_0, y_0) \\ \Delta_4^*(0, x_0, y_0) - \Delta_{4i}^*(0, x_0, y_0) \end{pmatrix} \leq \begin{pmatrix} b_{1i} \\ b_{2i} \\ b_{3i} \\ b_{4i} \end{pmatrix} \quad (55)$$

$$\text{where } b_{1i} = \left\{ \begin{pmatrix} R_1 \\ R_2 \\ R_3 \\ R_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\}, b_{2i} = \left\{ \begin{pmatrix} G_1 \\ G_2 \\ G_3 \\ G_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\}$$

$$b_{3i} = \left\{ \begin{pmatrix} R_1 \\ R_2 \\ R_3 \\ R_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\}, b_{4i} = \left\{ \begin{pmatrix} G_1 \\ G_2 \\ G_3 \\ G_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\}$$

will be satisfied for all  $i \geq 0$ .

**Proof.** By the equations (47) and (51), we have

$$\|\Delta_1^*(0, x_0, y_0) - \Delta_{1i}^*(0, x_0, y_0)\| \leq \left\{ \begin{pmatrix} R_1 \\ R_2 \\ R_3 \\ R_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\} = b_{1i} \quad (56)$$

Also, from the equation (48) and (52), we get

$$\begin{aligned} \|\Delta_2^*(0, x_0, y_0) - \Delta_{2i}^*(0, x_0, y_0)\| &\leq \left\{ \begin{pmatrix} G_1 \\ G_2 \\ G_3 \\ G_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\} \\ &= b_{2i} \end{aligned} \quad (57)$$

Similarly, from the inequality (49) and (53), we find

$$\begin{aligned} \|\Delta_3^*(0, x_0, y_0) - \Delta_{3i}^*(0, x_0, y_0)\| &\leq \left\{ \begin{pmatrix} R_1 \\ R_2 \\ R_3 \\ R_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\} \\ &= b_{3i} \end{aligned} \quad (58)$$

and

Also, from the inequality (50) and (54), we have

$$\begin{aligned} \|\Delta_4^*(0, x_0, y_0) - \Delta_{4i}^*(0, x_0, y_0)\| &\leq \left\{ \begin{pmatrix} G_1 \\ G_2 \\ G_3 \\ G_4 \end{pmatrix}, Q^i(E - Q)^{-1}\lambda \right\} \\ &= b_{4i} \end{aligned} \quad (59)$$

From (56), (57), (58) and (59), we get (55).

By using the theorem 3, we can state and prove the following theorem: -

**Theorem 4.** Let the system (1) be defined in the intervals  $[a, b]$  and  $[c, d]$  on  $R^1$  and periodic in  $t$  of period  $T$ , assume that for all  $i \geq 0$  the sequence of functions (55) and (56) satisfies the inequalities: -

$$\begin{cases} \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{1i}^*(0, x_0, y_0) \leq -b_{1i} \\ \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{1i}^*(0, x_0, y_0) \geq b_{1i} \end{cases} \quad (60)$$

$$\begin{cases} \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{2i}^*(0, x_0, y_0) \leq -b_{2i} \\ \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{2i}^*(0, x_0, y_0) \geq b_{2i} \end{cases} \quad (61)$$

$$\begin{cases} \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{3i}^*(0, x_0, y_0) \leq -b_{3i} \\ \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{3i}^*(0, x_0, y_0) \geq b_{3i} \end{cases} \quad (62)$$

$$\begin{cases} \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{4i}^*(0, x_0, y_0) \leq -b_{4i} \\ \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{4i}^*(0, x_0, y_0) \geq b_{4i} \end{cases} \quad (63)$$

Then (1) has periodic solution  $x = x(t, x_0, y_0)$  and  $y = y(t, x_0, y_0)$  such that: -

$$\begin{aligned} x_0 \in J_1 = & \left[ a + \delta_3 \left[ \left[ \frac{T}{2} (M_1 + T^\beta M_2) + M \right] + z_1 \right], b \right. \\ & \left. - \delta_3 \left[ \frac{T}{2} [(M_1 + T^\beta M_2) + M] + z_1 \right] \right] \end{aligned}$$

and

$$\begin{aligned} y_0 \in J_2 = & \left[ c + \delta_4 \left[ \left[ \frac{T}{2} (N_1 + T^\beta N_2) + N \right] + z_3 \right], d \right. \\ & \left. - \delta_4 \left[ \frac{T}{2} [(N_1 + T^\beta N_2) + N] + z_3 \right] \right] \end{aligned}$$

**Proof:** Let  $x_1, x_2$  be any points in the interval  $J_1$  and  $y_1, y_2$  be any points in the interval  $J_2$  such that: -

$$\left. \begin{aligned} \Delta_{1i}^*(0, x_1, y_1) &= \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{1i}(0, x_0, y_0) \\ \Delta_{1i}^*(0, x_2, y_2) &= \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{1i}(0, x_0, y_0) \end{aligned} \right\} \quad (64)$$

$$\left. \begin{aligned} \Delta_{2i}^*(0, x_1, y_1) &= \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{2i}(0, x_0, y_0) \\ \Delta_{2i}^*(0, x_2, y_2) &= \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{2i}(0, x_0, y_0) \end{aligned} \right\} \quad (65)$$

$$\left. \begin{aligned} \Delta_{3i}^*(0, x_1, y_1) &= \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{1i}(0, x_0, y_0) \\ \Delta_{3i}^*(0, x_2, y_2) &= \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{1i}(0, x_0, y_0) \end{aligned} \right\} \quad (66)$$

$$\left. \begin{aligned} \Delta_{4i}^*(0, x_1, y_1) &= \min_{x_0 \in J_1, y_0 \in J_2} \Delta_{2i}(0, x_0, y_0) \\ \Delta_{4i}^*(0, x_2, y_2) &= \max_{x_0 \in J_1, y_0 \in J_2} \Delta_{2i}(0, x_0, y_0) \end{aligned} \right\} \quad (67)$$

By using the inequalities (56), (57), (58), (59), (60), (61), (62), (63), (64), (65), (66) and (67) we have

$$\left. \begin{aligned} \Delta_1^*(0, x_1, y_1) &= \Delta_{1i}^*(0, x_1, y_1) + (\Delta_1^*(0, x_1, y_1) - \Delta_{1i}^*(0, x_1, y_1)) < 0 \\ \Delta_1^*(0, x_2, y_2) &= \Delta_{1i}^*(0, x_2, y_2) + (\Delta_1^*(0, x_2, y_2) - \Delta_{1i}^*(0, x_2, y_2)) > 0 \end{aligned} \right\} \quad (68)$$

$$\left. \begin{aligned} \Delta_2^*(0, x_1, y_1) &= \Delta_{2i}^*(0, x_1, y_1) + (\Delta_2^*(0, x_1, y_1) - \Delta_{2i}^*(0, x_1, y_1)) < 0 \\ \Delta_2^*(0, x_2, y_2) &= \Delta_{2i}^*(0, x_2, y_2) + (\Delta_2^*(0, x_2, y_2) - \Delta_{2i}^*(0, x_2, y_2)) > 0 \end{aligned} \right\} \quad (69)$$

$$\left. \begin{aligned} \Delta_3^*(0, x_1, y_1) &= \Delta_{3i}^*(0, x_1, y_1) + (\Delta_3^*(0, x_1, y_1) - \Delta_{3i}^*(0, x_1, y_1)) < 0 \\ \Delta_3^*(0, x_2, y_2) &= \Delta_{3i}^*(0, x_2, y_2) + (\Delta_3^*(0, x_2, y_2) - \Delta_{3i}^*(0, x_2, y_2)) > 0 \end{aligned} \right\} \quad (70)$$

$$\left. \begin{aligned} \Delta_4^*(0, x_1, y_1) &= \Delta_{4i}^*(0, x_1, y_1) + (\Delta_4^*(0, x_1, y_1) - \Delta_{4i}^*(0, x_1, y_1)) < 0 \\ \Delta_4^*(0, x_2, y_2) &= \Delta_{4i}^*(0, x_2, y_2) + (\Delta_4^*(0, x_2, y_2) - \Delta_{4i}^*(0, x_2, y_2)) > 0 \end{aligned} \right\} \quad (71)$$

And from the continuity of the functions

$\Delta_1^*(0, x_1, y_1), \Delta_2^*(0, x_1, y_1), \Delta_3^*(0, x_1, y_1)$  and  $\Delta_4^*(0, x_1, y_1)$  and the inequalities (68), (69), (70) and (71) then there exist an isolated points  $x^0 \in [x_1, x_2]$  and  $y^0 \in [y_1, y_2]$  where  $\Delta_1^*(0, x_0, y_0) = 0, \Delta_2^*(0, x_0, y_0) = 0, \Delta_3^*(0, x_0, y_0) = 0$  and  $\Delta_4^*(0, x_0, y_0) = 0$ , this means that (1) has periodic solution  $x = x(t, x_0, y_0)$  and  $y = y(t, x_0, y_0)$ .

#### IV. Stability periodic solution of (1).



In this section, we study the stability theorem of a periodic solution for (1).

**Theorem 5.** Assume that the vector functions  $\Delta_1^*(0, x_0, y_0), \Delta_2^*(0, x_0, y_0), \Delta_3^*(0, x_0, y_0)$  and  $\Delta_4^*(0, x_0, y_0)$  be defined by the following inequalities: -

$$\begin{pmatrix} \|\Delta_1^*(0, x_0, y_0)\| \\ \|\Delta_2^*(0, x_0, y_0)\| \\ \|\Delta_3^*(0, x_0, y_0)\| \\ \|\Delta_4^*(0, x_0, y_0)\| \end{pmatrix} \leq \begin{pmatrix} \delta_3[(M_1 + T^\beta M_2) + M] + \frac{z_5}{T} \\ \delta_4[(N_1 + T^\beta N_2) + N] + \frac{z_6}{T} \\ \delta_3[(M_1 + T^\beta M_2) + M] + \frac{z_7}{T} \\ \delta_4[(N_1 + T^\beta N_2) + N] + \frac{z_8}{T} \end{pmatrix} \quad (72)$$

and

$$\begin{pmatrix} \|\Delta_1^*(0, x_0^1, y_0^1) - \Delta_1^*(0, x_0^2, y_0^2)\| \\ \|\Delta_2^*(0, x_0^1, y_0^1) - \Delta_2^*(0, x_0^2, y_0^2)\| \\ \|\Delta_3^*(0, x_0^1, y_0^1) - \Delta_3^*(0, x_0^2, y_0^2)\| \\ \|\Delta_4^*(0, x_0^1, y_0^1) - \Delta_4^*(0, x_0^2, y_0^2)\| \end{pmatrix} \leq \begin{pmatrix} N_1 & N_2 \\ N_3 & N_4 \\ N_5 & N_2 \\ N_3 & N_6 \end{pmatrix} \begin{pmatrix} \|x_0^1 - x_0^2\| \\ \|y_0^1 - y_0^2\| \\ \|x_0^1 - x_0^2\| \\ \|y_0^1 - y_0^2\| \end{pmatrix} \quad (73)$$

for all  $x_0, x_0^1, x_0^2 \in D_\rho$  and  $y_0, y_0^1, y_0^2 \in D_\sigma$

where

$$z_5 = \left\| \left( \frac{E_1}{F_1} + e^{AT} \right) x_0 - \frac{\mathfrak{X}_1(T, \alpha)}{F_1} \right\|, z_6 = \left\| \left( \frac{E_2}{F_2} + e^{BT} \right) y_0 - \frac{\mathfrak{X}_2(T, \beta)}{F_2} \right\|,$$

$$z_7 = \left\| \left( \frac{E_1}{F_1} + e^{A(T-h)} \right) x_0 - \frac{\mathfrak{X}_1((T-h), \alpha)}{F_1} \right\|$$

$$z_8 = \left\| \left( \frac{E_2}{F_2} + e^{B(T-h)} \right) y_0 - \frac{\mathfrak{X}_2((T-h), \beta)}{F_2} \right\|$$

$$z_9 = \left\| \left( \frac{E_1}{F_1} + e^{AT} \right) \right\|, z_{10} = \left\| \left( \frac{E_2}{F_2} + e^{BT} \right) \right\|, z_{11} = \left\| \left( \frac{E_1}{F_1} + e^{A(T-h)} \right) \right\|$$

$$z_{12} = \left\| \left( \frac{E_2}{F_2} + e^{B(T-h)} \right) \right\|, V_1 = \left( 1 - \left( \frac{T}{2} R_1 + \frac{T}{2} R_2 \right) \right)^{-1},$$

$$V_2 = \left(1 - \left(\frac{T}{2}G_3 + \frac{T}{2}G_4\right)\right)^{-1}, V_3 = (1 - W_2W_4)^{-1}$$

$$W_1 = V_1(E + z_9), W_2 = \frac{T}{2}(R_3 + R_4) V_1$$

$$, W_3 = V_2(E + z_{10}), W_4 = \frac{T}{2}V_2(G_1 + G_2)$$

$$W_5 = V_1(E + z_{11}), W_6 = V_2(E + z_{12})$$

$$U_1 = V_3W_1, U_2 = V_3W_2W_3$$

$$U_3 = (W_3 + W_4U_2), U_4 = W_4U_1$$

$$U_5 = V_3W_5, \quad U_6 = V_3W_2W_6$$

$$U_7 = (W_6 + W_4U_6), U_8 = W_4U_5$$

$$N_1 = (R_1U_1 + R_2U_5 + R_3U_4 + R_4U_8) + \frac{z_9}{T}$$

$$N_2 = (R_1U_2 + R_2U_6 + R_3U_3 + R_4U_7),$$

$$N_3 = (G_1U_1 + G_2U_5 + G_3U_4 + G_4U_8)$$

$$N_4 = (G_1U_2 + G_2U_6 + G_3U_3 + G_4U_7) + \frac{z_{10}}{T}$$

$$N_5 = (R_1U_1 + R_2U_5 + R_3U_4 + R_4U_8) + \frac{z_{11}}{T}$$

$$N_6 = (G_1U_2 + G_2U_6 + G_3U_3 + G_4U_7) + \frac{z_{12}}{T}$$

**Proof.** From the equation (47), we have

$$\|\Delta_1^*(0, x_0, y_0)\| \leq \delta_3[(M_1 + T^\beta M_2) + M] + \frac{z_5}{T} \quad (74)$$

Also, by using (48), we have

$$\|\Delta_2^*(0, x_0, y_0)\| \leq \delta_4[(N_1 + T^\beta N_2) + N] + \frac{z_6}{T} \quad (75)$$

Similarly, by the inequality (49) and (50), we find

$$\|\Delta_3^*(0, x_0, y_0)\| \leq \delta_3[(M_1 + T^\beta M_2) + M] + \frac{z_7}{T} \quad (76)$$

$$\|\Delta_4^*(0, x_0, y_0)\| \leq \delta_4[(N_1 + T^\beta N_2) + N] + \frac{z_8}{T} \quad (77)$$

Then we rewrite (74), (75), (76) and (77) by the vector form, we get (72).

Also, by using equation (47) for  $x_0^1, y_0^1$  and  $x_0^2, y_0^2$  we have

$$\begin{aligned} & \|\Delta_1^*(0, x_0^1, y_0^1) - \Delta_1^*(0, x_0^2, y_0^2)\| \\ & \leq R_1 \|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \\ & \quad + R_2 \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \\ & \quad + R_3 \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \\ & \quad + R_4 \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| + \frac{Z_9}{T} \|x_0^1 \\ & \quad - x_0^2\| \quad (78) \end{aligned}$$

and

$$\begin{aligned} & \|\Delta_2^*(0, x_0^1, y_0^1) - \Delta_2^*(0, x_0^2, y_0^2)\| \\ & \leq G_1 \|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \\ & \quad + G_2 \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \\ & \quad + G_3 \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \\ & \quad + G_4 \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| + \frac{Z_{10}}{T} \|y_0^1 \\ & \quad - y_0^2\| \quad (79) \end{aligned}$$

Similarly, by equation (48) we obtain that

$$\begin{aligned} & \|\Delta_3^*(0, x_0^1, y_0^1) - \Delta_3^*(0, x_0^2, y_0^2)\| \\ & \leq R_1 \|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \\ & \quad + R_2 \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \\ & \quad + R_3 \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \\ & \quad + R_4 \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| \\ & \quad + \frac{Z_{11}}{T} \|x_0^1 - x_0^2\| \quad (80) \end{aligned}$$

and

$$\begin{aligned} & \|\Delta_4^*(0, x_0^1, y_0^1) - \Delta_4^*(0, x_0^2, y_0^2)\| \\ & \leq G_1 \|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \\ & \quad + G_2 \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \\ & \quad + G_3 \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \\ & \quad + G_4 \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| + \frac{Z_{12}}{T} \|y_0^1 \\ & \quad - y_0^2\| \quad (81) \end{aligned}$$

where  $x(t, x_0^1, y_0^1)$ ,  $y(t, x_0^1, y_0^1)$ ,  $x(t, x_0^2, y_0^2)$  and  $y(t, x_0^2, y_0^2)$  are the solutions of the integral equations: -

$$\begin{aligned}
x(t, x_0^k, y_0^k) &= x_0^k e^{At} + \int_0^t e^{A(t-s)} [f(s) \\
&\quad + n(s, x(s, x_0^k, y_0^k), x((s-h), x_0^k, y_0^k), y(s, x_0^k, y_0^k), y((s-h), x_0^k, y_0^k), v)] - \frac{1}{T} \int_0^T e^{A(t-s)} [f(s) \\
&\quad + n(s, x(s, x_0^k, y_0^k), x((s-h), x_0^k, y_0^k), y(s, x_0^k, y_0^k), y((s-h), x_0^k, y_0^k), v) ds] ds + \frac{t}{T} \delta_3 \left[ \frac{\mathfrak{X}_1(T, \alpha)}{F_1} \right. \\
&\quad \left. - \left( \frac{E_1}{F_1} + e^{AT} \right) x_0^k \right] \quad (82)
\end{aligned}$$

and

$$\begin{aligned}
y(t, x_0^k, y_0^k) &= y_0^k e^{Bt} + \int_0^t e^{B(t-s)} [g(s) \\
&\quad + m(s, x(s, x_0^k, y_0^k), x((s-h), x_0^k, y_0^k), y(s, x_0^k, y_0^k), y((s-h), x_0^k, y_0^k), u)] - \frac{1}{T} \int_0^T e^{B(t-s)} [g(s) \\
&\quad + m(s, x(s, x_0^k, y_0^k), x((s-h), x_0^k, y_0^k), y(s, x_0^k, y_0^k), y((s-h), x_0^k, y_0^k), u) ds] ds \\
&\quad + \frac{t}{T} \delta_4 \left[ \frac{\mathfrak{X}_2(T, \beta)}{F_2} - \left( \frac{E_2}{F_2} + e^{BT} \right) y_0^k \right] \quad (83)
\end{aligned}$$

with  $x(t, x_0^k, y_0^k) = x_0^k e^{At}$ ,  $y(t, x_0^k, y_0^k) = y_0^k e^{Bt}$ , where  $k = 1, 2$ .

where

$$\begin{aligned}
v &= \int_{-\infty}^s \frac{F(s, \tau)}{(s-\tau)^\alpha} \mathfrak{X}(\tau, x(\tau, x_0^k, y_0^k), x((\tau-h), x_0^k, y_0^k), y(\tau, x_0^k, y_0^k), y((\tau-h), x_0^k, y_0^k)) d\tau \\
u &= \int_{-\infty}^s \frac{G(s, \tau)}{(s-\tau)^\alpha} \mu(\tau, x(\tau, x_0^k, y_0^k), x((\tau-h), x_0^k, y_0^k), y(\tau, x_0^k, y_0^k), y((\tau-h), x_0^k, y_0^k)) d\tau
\end{aligned}$$

By the equation (82), we obtain that

$$\begin{aligned}
&\|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \\
&\leq V_1(E + z_9) \|x_0^1 - x_0^2\| + \frac{T}{2} (R_3 \\
&\quad + R_4) V_1 \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\|
\end{aligned}$$

$$\begin{aligned} & \|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \\ & \leq W_1 \|x_0^1 - x_0^2\| + W_2 \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \end{aligned} \quad (84)$$

Also

$$\begin{aligned} & \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \\ & \leq V_2(E + z_{10}) \|y_0^1 - y_0^2\| + \frac{T}{2} V_2(G_1 \\ & + G_2) \|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \\ & \|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \\ & \leq W_3 \|y_0^1 - y_0^2\| + W_4 \|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \end{aligned} \quad (85)$$

and

$$\begin{aligned} & \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \\ & \leq V_1(E + z_{11}) \|x_0^1 - x_0^2\| + \frac{T}{2} V_1(R_3 \\ & + R_4) \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| \\ & \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \\ & \leq W_5 \|x_0^1 - x_0^2\| \\ & + W_2 \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| \end{aligned} \quad (86)$$

By the same way above, we get

$$\begin{aligned} & \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| \\ & \leq W_6 \|y_0^1 - y_0^2\| \\ & + W_4 \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \end{aligned} \quad (87)$$

and

$$\|x(t, x_0^1, y_0^1) - x(t, x_0^2, y_0^2)\| \leq U_1 \|x_0^1 - x_0^2\| + U_2 \|y_0^1 - y_0^2\| \quad (88)$$

Similarly, we have

$$\|y(t, x_0^1, y_0^1) - y(t, x_0^2, y_0^2)\| \leq U_3 \|y_0^1 - y_0^2\| + U_4 \|x_0^1 - x_0^2\| \quad (89)$$

Also

$$\begin{aligned} & \|x((t-h), x_0^1, y_0^1) - x((t-h), x_0^2, y_0^2)\| \\ & \leq U_5 \|x_0^1 - x_0^2\| + U_6 \|y_0^1 - y_0^2\| \end{aligned} \quad (90)$$

Thus

$$\begin{aligned} & \|y((t-h), x_0^1, y_0^1) - y((t-h), x_0^2, y_0^2)\| \\ & \leq U_7 \|y_0^1 - y_0^2\| + U_8 \|x_0^1 - x_0^2\| \end{aligned} \quad (91)$$



Finally, we obtain

$$\begin{aligned} & \|\Delta_1^*(0, x_0^1, y_0^1) - \Delta_1^*(0, x_0^2, y_0^2)\| \\ & \leq ((R_1 U_1 + R_2 U_5 + R_3 U_4 + R_4 U_8) + \frac{Z_9}{T}) \|x_0^1 - x_0^2\| \\ & \quad + (R_1 U_2 + R_2 U_6 + R_3 U_3 + R_4 U_7) \|y_0^1 - y_0^2\| \end{aligned}$$

Therefore

$$\|\Delta_1^*(0, x_0^1, y_0^1) - \Delta_1^*(0, x_0^2, y_0^2)\| \leq N_1 \|x_0^1 - x_0^2\| + N_2 \|y_0^1 - y_0^2\| \quad (92)$$

So

$$\begin{aligned} & \|\Delta_2^*(0, x_0^1, y_0^1) - \Delta_2^*(0, x_0^2, y_0^2)\| \\ & \leq ((G_1 U_1 + G_2 U_5 + G_3 U_4 + G_4 U_8) \|x_0^1 - x_0^2\| \\ & \quad + ((G_1 U_2 + G_2 U_6 + G_3 U_3 + G_4 U_7) + \frac{Z_{10}}{T}) \|y_0^1 - y_0^2\| \end{aligned}$$

And hence

$$\|\Delta_2^*(0, x_0^1, y_0^1) - \Delta_2^*(0, x_0^2, y_0^2)\| \leq N_3 \|x_0^1 - x_0^2\| + N_4 \|y_0^1 - y_0^2\| \quad (93)$$

Furthermore

$$\begin{aligned} & \|\Delta_3^*(0, x_0^1, y_0^1) - \Delta_3^*(0, x_0^2, y_0^2)\| \\ & \leq ((R_1 U_1 + R_2 U_5 + R_3 U_4 + R_4 U_8) + \frac{Z_{11}}{T}) \|x_0^1 - x_0^2\| \\ & \quad + (R_1 U_2 + R_2 U_6 + R_3 U_3 + R_4 U_7) \|y_0^1 - y_0^2\| \end{aligned}$$

and

$$\|\Delta_3^*(0, x_0^1, y_0^1) - \Delta_3^*(0, x_0^2, y_0^2)\| \leq N_5 \|x_0^1 - x_0^2\| + N_2 \|y_0^1 - y_0^2\| \quad (94)$$

Also, we find

$$\begin{aligned} & \|\Delta_4^*(0, x_0^1, y_0^1) - \Delta_4^*(0, x_0^2, y_0^2)\| \\ & \leq ((G_1 U_1 + G_2 U_5 + G_3 U_4 + G_4 U_8) \|x_0^1 - x_0^2\| \\ & \quad + ((G_1 U_2 + G_2 U_6 + G_3 U_3 + G_4 U_7) + \frac{Z_{12}}{T}) \|y_0^1 - y_0^2\| \end{aligned}$$

So

$$\|\Delta_4^*(0, x_0^1, y_0^1) - \Delta_4^*(0, x_0^2, y_0^2)\| \leq N_3 \|x_0^1 - x_0^2\| + N_6 \|y_0^1 - y_0^2\| \quad (95)$$

Rewrite the above inequalities in a vector form, we have (73 ).

**V.Conclusion.**

This paper provided the results in the existence, uniqueness and stability solutions of new Volterra integral equations have retarded argument with boundary conditions of Gamma functions. Theorems on existence and uniqueness and stability periodic solution are established under some necessary and sufficient conditions on closed and bounded domains (compact spaces). The numerical-analytic method has been used to study the periodic solutions of ordinary differential equations which were introduced by Samoilenko [13].

## References

- [1] Abbas, S. (2011). existence of solution to fractional order ordinary and delay differential equation and applications. *Electronic Journal of differential equations*, 09:1-11. ISSN:1072-6691.
- [2] Arnold. (1992). *Ordinary Dfferential Equations*. Cambridge, Springer-Verlag: New York.
- [3] Benaicha, S. (2009). Periodic boundary value prblems for second order ordinary differential equation. *Applied Mathematical Science, University of Oran, Es-Senia, Algeria*, 3(6):267-276.
- [4] Butris, R. N and Taher, R. F. (2019). Periodic solution of integro- differential equations depended on special function with singular Kernels. *International Journal of Machanical Engineering and Technology (IJMET)*, Vol 10, Issue 04:786-800.
- [5] Butris, R. N. (2013). Periodic solution of non-linear system of integro-differential equations depending on the Gamma distribution. *Math. Notes, India, Gen*, 15(1):56-71.
- [6] Butris, R. N and Abdi, S. B. (2021). Periodic solution of Volterra integro-differential equations with retarded argument and symmetric matrices. *International Journal of advanced research in Engineering and Technology (IJARET)*, 12(2):pp.337-360.
- [7] Hernan, R. H. (2000). Existence of periodic solutions of neural functional differential equations with boundary delay. *Proyecciones Revista de Mathematica, University Catolica del Norte, Chile*, 19(19):305-329.
- [8] Ishak, A. S. (2005). Solutions for certain sysyemes of non-linear integro-differential equations with having retarded argument and boundary conditions. *M.Sc. Thesis, College of Education, Univercity of Mosul*.
- [9] Mitropolsky, Yn. A and Martynyuk, D. I. (1979). For periodic solutions for the Oscillations system with retarded argument. *Ukrain Mat. J*, No. 5.
- [10] Ronto, A. and Ronto, M. . (2000). On the investigation of some boundary value problems with non-linear conditions. *Mthematical Notes, Miskolc*, 1(1):43-55.
- [11] Ronto, A., Ronto, M. and Shchobak, N. (2012). On numerical-analytic methods techniques for boundary value problem. *Acta Electronica et informatica*, 12(3):67-72, Doi: 10.2478/v 10198-012-0035-1.
- [12] Samoilenko, A. M. and Ronto, N. I. (1985). *Numerical- analytic methods for investigating solutions of boundary value problem*. Kieve, Ukraine.
- [13] Samoilenko, A. M. and Ronto, N. I., (1976), A Numerical – Analytic Methods for Investigating of Periodic Solutions, Kiev, Ukraine.

- [14] Zevizion, G. V. (2009). Periodic solutions of integro-differential equations. *Jornal of differential Equations*, 45(2).

**EGE DENİZİNDE YAŞAYAN MOR BOYA SALYANGOZUNUN (*BOLINUS BRANDARIS*) FARKLI YAPILARINDAN YAŞ BELİRLEME ÇALIŞMALARI****AGE DETERMINATION STUDIES FROM DIFFERENT STRUCTURES OF THE PURPLE DYE MUREX (*BOLINUS BRANDARIS*) INHABITING AEGEAN SEA****Nuri BAŞUSTA<sup>1\*</sup>**<sup>1</sup>Firat University, Faculty of Fisheries, Department of Marine Biology, Elazığ, Turkey.  
ORCID 0000-0002-2363-8977**Özet**

Mor boya salyangozu, *Bolinus brandaris* (Linnaeus, 1758) Akdeniz ve Ege Denizi boyunca iyi bilinen deniz salyangozu türüdür. Mor boya salyangozu bazı ülkelerde sıklıkla Türkiye’de ise ara sıra insan tüketimi için avlanmaktadır. Bu çalışma Ege denizinde yaşayan mor boya salyangozunun farklı yapılarından yaş belirlemelerini rapor etmektedir. Bu amaçla 2020-2021 balıkçılık sezonunda, Ege Denizi, Güllük Koyu kıyılarındaki yaklaşık 44-47 m derinlikte ticari fanyalı uzatma ağıyla toplam 202 deniz salyangozu örneği yakalandı. Yakalanan mor boya salyangozlarının minimum ve maksimum boy ve ağırlıkları sırasıyla 52.58-88.41 mm ve 10.52-39.86 g olarak belirlendi. *B. brandaris* için operkulum üzerindeki halkalar ve statolitlerden yaş belirleme yöntemleri incelendi. *B. brandaris* bireyinin ayak bölgesinden statolitler çıkarıldı. İlk kez bu türe ait statolitlerden yaşlar belirlendi. Mor boya salyangozunun yaş belirlemesine karar vermede statolit halkalarından yaş okuma yöntemi en uygun yöntem olarak karar verildi.

**Anahtar Kelimeler :** Mor Boya salyangozu, *Bolinus brandaris*, Yaş Belirleme, Operkulum, Statolit, Ege Denizi

**Abstract**

The purple dye murex, *Bolinus brandaris* (Linnaeus, 1758) is well known muricid species throughout the Mediterranean and Aegean Seas. The purple dye murex is fished for human consumption in some countries and occasionally in Turkey. The present study reports age determinations from different structures of the purple dye murex inhabiting Aegean sea. For this purpose, a total of 202 samples were caught by commercial trammel net fishing in Güllük Bight, Aegean Sea coasts of Turkey at about depth of 44-47 m during the 2020-2021 fishing season. Minimum-maximum lengths and weights of caught the purple dye murex were determined as 52.58-88.41 mm and 10.52-39.86 g respectively. Opercular rings and statoliths age determination methods were examined for *B. brandaris*. Statoliths were extracted from the foot part of the *B. brandaris*. For the first time, it were determined from the annual rings of these statoliths for this species. Statolith rings reading method provided more reliable results to decide of the purple dye murex age determination.

**Keywords:** The purple dye murex, *Bolinus brandaris*, Age Determination, Operculum, Statolith, Aegean Sea

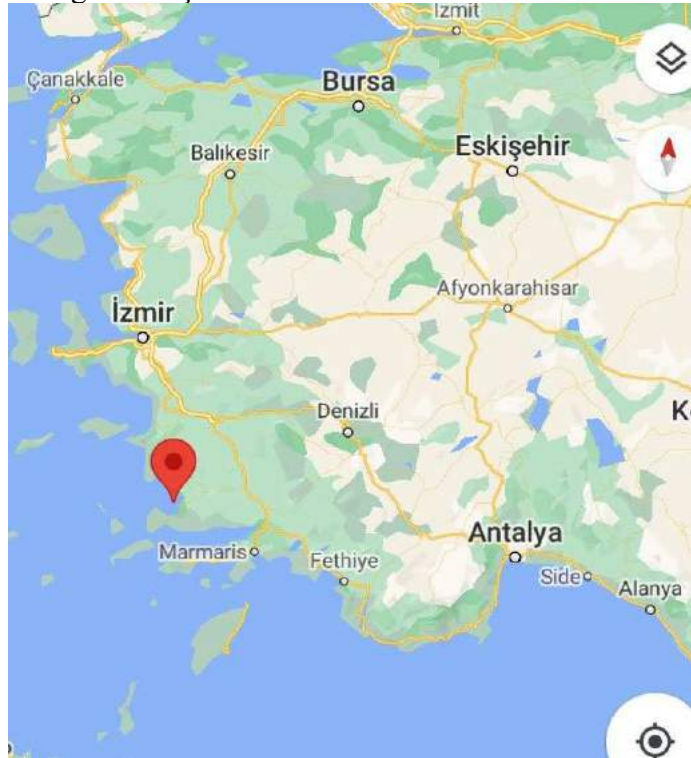
## GİRİŞ

Deniz yumuşakçaları, dünya deniz omurgasızları balıkçılığındaki arasında yerini almıştır ve gastropodlarda % 2 'lik kısmını oluşturmaktadır (Leiva ve Castilla 2002). Ülkemizde Ege denizi kıyılarında “madya” olarak bilinen mor boya salyangozu *Bolinus brandaris* özellikle Fenikeliler zamanında mor-pembe çivit mavisi türevi olan bir patlıcan moru boya özütünün elde edilmesi için avlanılmıştır (Spanier ve Karmon 1987). Şimdilerde ise Fransa, Portekiz, İtalya ve İspanya gibi ülkelerde insan gıdası olarak tüketilmektedir (Bartolome 1985; Cecalupo vd. 2006; Vasconcelos vd. 2008; Ramón ve Flos 2001). Ülkemizde ise paraketa avcılığı tarafından çoğunlukla balık yemi olarak kullanılmaktadır. Bu nedenle uluslararası ekonomik önemi artmakta ve küçük ticari balıkçıların sosyo ekonomik yapısında rol oynamaktadır. Yaş bilgisi ve büyüme bu ticari deniz kaynaklarının sürdürülebilir yönetimi için doğru karar vermede önemli bir araçtır (Ramón ve Flos 2001; Reeves, 2003). Bugüne kadar bazı gastropodların yaşını belirlemek için uzunluk frekans dağılımı, Operkulum halkaları, kabuk izotop analizi ve kabuk yüzeyi okuma; statolit büyüme halkaları, kabuk dikey kesim yöntemi gibi yöntemler kullanılmıştır (Şahin vd. 2005; Kos'yan ve Antipushkina, 2011; Arrighetti vd. 2012; Bökenhans vd. 2016; Başusta 2021).

Bu çalışmanın amacı Ege denizinde yaşayan mor boya salyangozunun farklı yapılarından yaşlarını belirlemek ve en gerçekçi ve güvenilir yöntemin hangisi olduğuna karar vermektir.

## MATERYAL VE METOT

Bu çalışmada *Bolinus brandaris* türüne ait örnekler 2020-2021 balıkçılık sezonunda Ege Denizi Güllük koyu kıyılarında (Şekil 1) 44-47 m arası derinliklerde, fanyalı uzatma ağıları ile ticari balık avcılığı yapan balıkçılardan elde edilmiştir (Şekil 2). Mor boya salyangozu örnekleri soğuk zincirde muhafaza edilerek incelenmek üzere Fırat Üniversitesi, Su Ürünleri Fakültesi laboratuvarına getirilmiş ve derin dondurucuda muhafaza edilmiştir.



Şekil 1. Örnekleme alanı Ege Denizi Güllük Koyu açıkları



Şekil 2. Ticari fanyalı uzatma ağı ile hedef dışı *Bolinus brandaris* avcılığı

Laboratuvarda mor boya deniz salyangozlarının boy ölçümleri 0.01 mm hassasiyetli dijital kumpasla ölçülmüş (Şekil 3) ve ağırlıkları 0.01 g hassasiyetli terazi ile tartılmıştır. Çalışma öncesi buzluktan çıkarılan salyangozlar pens yardımıyla kabuklarından çıkarılarak yapılacak işlemler için hazır hale getirilmiştir. Önce operkulum dikkatli bir şekilde çıkarılmış ve numara verilmiştir. Daha sonra ayak bölgesinden daha önce belirlenen bölgeye bistüri ile artı şeklinde kesik atarak pedal ganglionların olduğu bölgeden statositlerin yeri belirlenmiş ve o bölge olduğu gibi petri kutusuna alınarak Leica S8 APO binoküler görüntülü mikroskop ile görüntülenmiştir. Statositler içerisinde yer alan statolitler enjeksiyon iğne yardımıyla dokulardan ayrılmış ve %85 lik etanol ile muamele edilerek distile su ile işlemlerden geçirilmiştir. Oda sıcaklığında kurutulan (20 C) statolitler lam üzerine yapıştırılmış ve okuma için hazır hale getirilmiştir (Barroso vd. 2005; Fisher 2018).



Şekil 3. *Bolinus brandaris* bireyinin dijital kumpas ile boy ölçümü

## SONUÇ

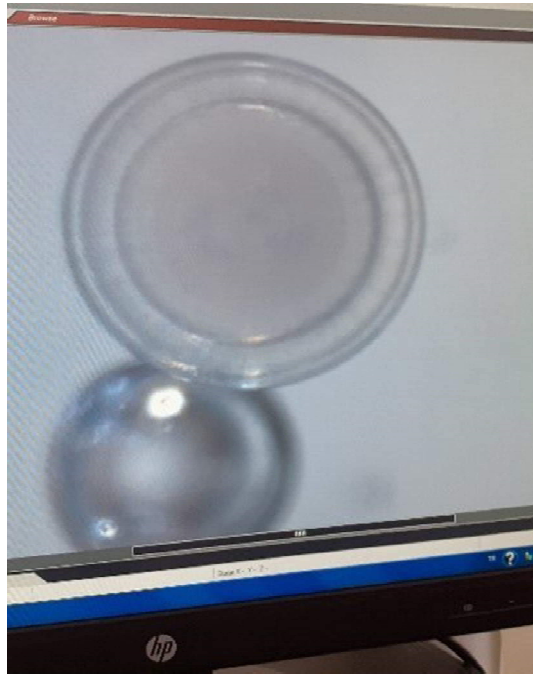
Çalışmada 202 adet mor boya deniz salyangozu kullanılmıştır. Yakalanan mor boya salyangozlarının minimum ve maksimum boy ve ağırlıkları sırasıyla 52.58-88.41mm ve 10.52-39.86 g olarak belirlenmiştir. Çalışmada önce operkulum üzerindeki halkalar sayılmış ve daha



sonra statolitler üzerindeki halkalar sayılmıştır (Şekil 4, Şekil 5). Farklı boy gruplarına ait *B. brandaris* bireylerinin yaş okumaları gerçekleştirilmiştir. Aynı bireye ait operkulum ve statolitlerin yaş okuma karşılaştırmaları yapılmıştır. Buna göre farklılıklar tespit edilmiştir. Operkulum okumalarında yaş halkalarının daha fazla olduğu görülmüştür. Bunun da yalancı halkalardan oluşabileceği düşünülmektedir.



Şekil 4. *Bolinus brandaris* bireyine ait operkulumda yaş halkaları



Şekil 5. *Bolinus brandaris* bireyine ait statolit üzerindeki yaş halkaları

## TARTIŞMA

Daha önce deniz salyangozları ile bazı gastropodların yaşını belirlemek için uzunluk frekans dağılımı yapılmış ancak bu yöntemin doğruluğu örnek sayısının miktarı ve büyüklüğüne bağlıdır. Kabuk izotop analizi ise pahalı bir yöntem olup tercih edilmemiştir. Operkulum halkaları ise çoğu bilim insanları tarafından kullanılmasına rağmen her tür için iyi sonuç vermemektedir. Ayrıca operkulum dış yapı organıdır ve çevresel faktörlerin etkisi altında kalmakta ve kenarları erozyona uğramaktadır. Kabuk yüzeyi okuma yöntemi ve kabuk dikey kesim yöntemi gibi yöntemler ise *Rapana venosa* türü için kullanılmış olup her tür için geçerli teknikler değildir (Şahin vd. 2005; Kos'yan ve Antipushkina, 2011; Arrighetti vd. 2012; Bökenhans vd. 2016; Başusta 2021). Statolitler ise içsel kalkerli yapılardır ve çevresel faktörlerin etkisi altında operkulum gibi etkilenmezler (Barroso vd. 2005; Fisher 2018).

Bu çalışma ile *Bolinus brandaris* türüne ait bireylerin operkulum ve statolitler üzerindeki yaş halkaları incelenmiş ve yaş belirlemede her iki yönteminde kullanılabilecekleri belirlenmiş olup bunlardan statolitle yaş tayininin daha uygun olacağı düşünülmektedir. Bununla birlikte ilk kez bu tür için statolitle yaş tayini yapılmış ve bundan sonraki çalışmalar için temel olacağı düşünülmektedir.

## TEŞEKKÜR

Bu çalışma Fırat Üniversitesi, Bilimsel Araştırmalar Koordinasyon Birimi (FÜBAP) SÜF.21.02 Nolu proje desteklenmiştir.

## KAYNAKLAR

1. Alpaslan, M., Özalp, B., Sağır-Odabaşı, S. 2006. "Çanakkale Boğazı ve yöresinde istilacı-ekonomik bir gastropod *Rapana venosa* (Valenciennes, 1846): biyoekolojisi ve avcılığı" E.U. Journal of Fisheries & Aquatic Sciences, 23(3-4):485-487.
2. Arrighetti, F., Teso V., Brey, T., Mackensen, A., Penchaszadeh, P.E. 2012. "Age and growth of *Olivancillaria deshayesiana* (Gastropoda: Olividae) in the Southwestern Atlantic Ocean". Malacologia, 55 (1):163-170.
3. Bartolome C (1985. "Contribution à l'étude du gastéropode *Murex brandaris* (Linnaeus, 1758) dans le Golfe du Lion". Diplôme d'Etudes Approfondies de Sciences de l'Eau et Aménagement, Académie de Montpellier, Université des Sciences et Techniques du Languedoc.
4. Barroso, C.M., Nunes, M., Richardson, C.A., Moreira, M.H., 2005. "The gastropod statolith: a tool for determining the age of *Nassarius reticulatus*". Marine Biology, 146: 1139-1144.
5. Başusta, N. 2021. "A Study on the age determination using vertical Shell cutting method of rapa whelk (*Rapana venosa*)", 2nd International Baku Conference on Scientific Research April 28-30, 2021 / Baku, Azerbaijan. p.82-87.
6. Bökenhans, V., Bigatti, G. & Averbuj, A. 2016. "Age estimation methods in the marine gastropod *Buccinanops globulosus* comparing shell Marks and opercula growth rings. Marine Biology Research 12(8), 881-887.
7. Cecalupo A, Vianello M, Perini L. 2006. "Alcune forme aberranti rinvenute nel Mare Adriatico di *Hexaplex trunculus* (Linnaeus, 1758) e *Bolinus brandaris* (Linnaeus, 1758)". Not SIM Pubbl Soc Ital Malacol 24: 13-15.
8. Fisher. R.A. 2018. "Age, growth, size at sexual maturity and reproductive biology of channeled whelk, *Busycotypus canalicularis*, in the U.S. Mid-Atlantic". VIMS Marine Resource Report No. 2015-15-15 VSG-15-09.
9. Kos'yan A. R. & Antipushkina, Zh. A. 2011. "Determination of *Rapana venosa* Individuals' ages based on  $\delta^{18}O$  dynamics of the shell carbonates". Oceanology 51 (6) 1082- 1089.

10. Leiva, G.E., Castilla, J.C., 2002. "A review of the world marine gastropod fishery: evolution of the catches, management and the Chilean experience". *Reviews in Fish Biology & Fisheries*, 11 (4), 283-300.
11. Ramón. M., Flos R. 2001."First trials to cultivate the muricid gastropod *Bolinus brandaris* (Linnaeus). *Eur Aquac Soc Spec Publ* 29: 219–220
12. Reeves, S.A. 2003. "A simulation study of the implications of age-reading errors for stock assessment and management advise. *ICES Journal of Marine science*, 60:314-328.
13. Spanier E, Karmon, N 1987. " Muricid snails and the ancient dye industries. In:Spanier E (ed) *The royal purple and the biblical blue:argaman and tekhelet*. Keter Publishing House, Jerusalem, p 179–192
14. Şahin C., Düzgüneş, E., Engin, S., Mutlu, C. & Hacımurtazaoğlu, N. 2005." Deniz salyangozu (*Rapana thomasiana*)nun yaş büyüme parametrelerinin analizi". *Türk Sucul Yaşam Dergisi*, 3 (4): 34-38.
15. Vasconcelos P, Carvalho S, Castro M, Gaspar MB 2008." The artisanal fishery for muricid gastropods (banded murex and purple dye murex) in the Ria Formosa lagoon (Algarve coast, southern Portugal)", *Sci Mar* 72: 287–298.

## PHOTOCHEMICAL OXIDATION AND DISSOLUTION OF COPPER SLAG IN ACIDIC MEDIA

Zeynel Abidin SARI<sup>1\*</sup>, M. Deniz TURAN<sup>2</sup>, Mustafa BOYRAZLI<sup>3</sup>, Murat ERDEMOĞLU<sup>4</sup>

<sup>1\*</sup>*Department of Metallurgy-Iskenderun Vocational School of Higher Education, Iskenderun Technical University, 31200, Hatay, Turkey*

<sup>1\*</sup>ORCID ID: 0000-0001-5932-2141

<sup>2,3</sup>*Department of Metallurgy and Materials Engineering, Firat University, 23119 Elazığ, Turkey*

<sup>2</sup>ORCID ID: 0000-0002-2136-1425

<sup>3</sup>ORCID ID: 0000-0002-2340-6703

<sup>4</sup>*Department of Mining Engineering, İnönü University, 44280 Malatya, Turkey*

<sup>4</sup>ORCID ID: 0000-0003-2922-7965

### Abstract

This study demonstrated the comparative dissolution behavior of various metals (Cu, Fe) from the copper slag both in photoreactor systems and in atmospheric conditions, separately. For this purpose, an ultraviolet (UV) lamp with a 185 nm wavelength was used in photoreactor systems. In this context, all experimental studies were carried out in the presence of H<sub>2</sub>SO<sub>4</sub>, at an air feed rate of 6 L/min, in order to form active radicals and reactive species, especially in the UV environment. The parameters examined in the study are as follows: the power of the UV lamp: 10-50W, H<sub>2</sub>SO<sub>4</sub> concentration: 0-3M, leaching temperature: 35-55°C, and leaching time: 5-180 min. On the other hand, in the experiments in the UV (185 nm - 48W) and non-UV environments under optimum conditions, the copper extraction rates were 85.1% and 70.7%, respectively.

**Keywords:** Photochemical oxidation, Ultraviolet (UV), Hydrometallurgy, Leaching, Copper Slag.

### INTRODUCTION

The vast majority of copper extraction from copper minerals is pyro-metallurgical. These processes generate slags, which generally contain some significant metals of value. The flotation process plays an important role in the evaluation of slags and it is utilized in some copper smelting processes (Turan et al., 2019). Hydrometallurgical techniques for processing (leaching) the slags and the products of their application are taken attention, recently. These techniques include: leaching with chlorate, hydrogen peroxide, solutions of sulfuric acid, ferric sulfate or chloride, and potassium dichromate. Industrial application of these techniques is, however, impeded by their high cost and the heavy environmental problems caused by discharge of toxic liquid waste (Gbor et al., 2006).

Ultraviolet (UV) radiation covers the wavelength range from 1 to 400 nm. Within this range it can be distinguished between UV-A (380-315 nm), UV-B (315-280 nm), UV-C (280-200 nm), vacuum-UV (VUV) (200-100 nm), and extreme UV (100-1 nm) (Oppenlander, 2003). UV-C radiation, which is also referred to as short-wave radiation, is used for disinfection of water and wastewater. Due to the direct formation of hydroxyl radicals VUV irradiation is counted among the advanced oxidation processes (AOP). VUV photolysis of water is a highly efficient method for the generation of advanced oxidation conditions and the formation rate of hydroxyl radicals is comparable to other advanced oxidation processes (Legrini et al., 1993). APO technologies

can be broadly divided into the following groups: (1) vacuum ultraviolet (VUV) photolysis, (2) ultraviolet (UV)/oxidation processes, (3) the photo-Fenton process, and (4) sensitized APO processes.

Advanced oxidation processes generally involve generation and use of powerful but relatively nonselective transient oxidizing species, primarily the hydroxyl radical ( $\text{OH}\cdot$ ); in some vapor-phase advanced oxidation processes, singlet oxygen ( $\text{O}(^1\text{D})$ ), super oxide radical ( $\text{O}_2^{\cdot-}$ ) and perhydroxy radical ( $\text{HO}_2^{\cdot-}$ ) has also been identified as the dominant oxidizing species (Loraine and Glaze 1992).  $\text{OH}\cdot$  has the highest thermodynamic oxidation potential.  $\text{OH}\cdot$ -based oxidation processes have gained the attention of many advanced oxidation technology developers. The formation of hydroxyl radicals and oxidizing species depends on the emission power of the lamp, the reactor design, and the optical properties of the irradiated medium (Imoberdorf and Mohseni, 2011d).

As a consequence of the absorption of the VUV radiation the homolysis (Eq. (1)) and photochemical ionization of water take place (Eq. (2)). The formed products are hydroxyl radicals, hydrogen atoms, and solvated electrons (Eqs. (1) and (2)) which initiate manifolds of reduction and oxidation reactions implying molecular oxygen and oxygenated species (Gonzalez and Braun, 1995)



This experimental study demonstrated the comparative dissolution behavior of various metals (Cu, Fe) from the copper slag both in photoreactor systems and in atmospheric conditions, separately. The study includes the use of photochemical reactions to create solution environments with high oxidation potential in the processes performed in photoreactor systems with UV environment and the research and application of suitable conditions for this method to create an alternative to hydrometallurgical applications.

## MATERIAL AND METHODS

The copper slag used in the experiments was obtained from the Karadeniz Copper Plant in Samsun. This slag is made up of the slag formed during the matte production in a flash-type copper melting furnace of chalcopyrite concentrate and the slag formed during blister copper production in a converter furnace. After grinding the slag mixture sample in a ring mill, it was sieved and the part with a -200-mesh (74  $\mu\text{m}$ ) grain size was used in all experiments.

Chemical analyses of the slag were carried out by ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometer- Perkin-Elmer, Optima 2000DV) in clear supernatant that was obtained by the digestion process. Chemical analysis of the slag sample is: 6.74 % Cu, 36.45 % Fe, 1.66 % S, 4.34 % Zn and 0.25 % Pb. The mineralogical forms of the metals were determined by XRD (X-Ray Diffraction- Bruker/D8 Advance) analysis. According to the results of the XRD analysis, the copper slag sample was mainly composed of  $\text{FeSiO}_4$ ,  $\text{Cu}_9\text{S}_5$ ,  $\text{ZnSiO}_3$ , and  $\text{Cu}_{67}\text{Fe}_{2.33}\text{O}_4$ .

A magnetic stirrer (Multi channel stirrer-MS53M) equipped with water heated circulation device was used in comparative leaching experiments without UV light. Experiments in the presence of UV were carried out using a photoreactor setup designed by the researchers of this study. The photoreactor system (equipped with a magnetic stirrer at the bottom) consisted of a cylindrical geometry leaching vessel made of jacketed glass with a total volume of 0.6 L. Also, the reactor system had a quartz sheath in which a submersible UV lamp was placed from the top to the inside, and an air supply distributor made of glass. The air supply was provided using an air compressor (Intertek /AS18-2) with a 20 L/min air discharge rate and the airflow rate determined during the experiment was controlled by a rotameter (s-meter). In the experiments with the photoreactor system, a lamp of varying power (14W-18W-48W) with a wavelength of 185 nm (VUV) (Atlantic Ultraviolet) was used.

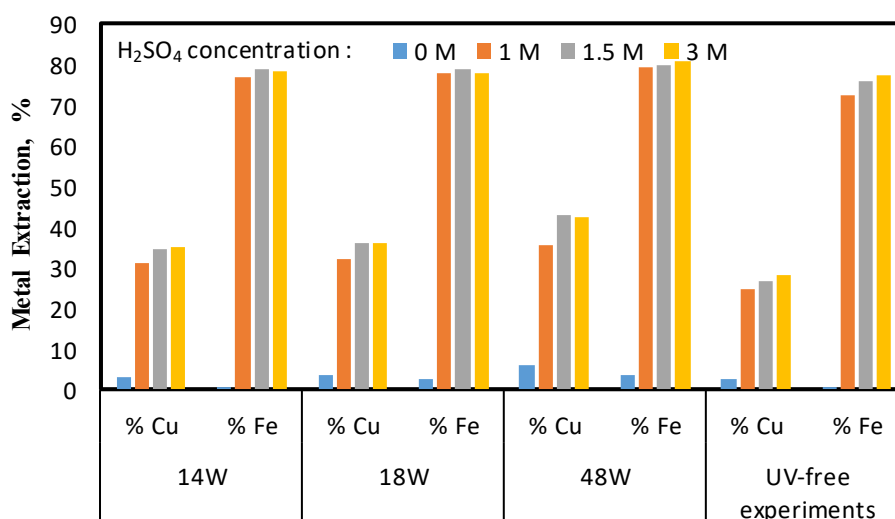
At the end of the leaching period, the contents were cooled and filtered. The filtered solutions were analyzed for copper and iron using AAS (Atomic Absorption Spectrometer- Perkin Elmer, AAnalyst 400 Model).

## RESULTS AND DISCUSSION

In experiments carried out in photoreactor systems with UV, photolysis of water in an aqueous medium without the addition of any chemicals such as  $\text{H}_2\text{O}_2$  or  $\text{O}_3$ , using lamps of certain wavelengths, and active radicals such as  $\text{OH}\cdot$  (hydroxyl radical),  $\text{HO}_2\cdot$  (perhydroxy radical) and oxidants such as  $\text{O}_3$  and  $\text{H}_2\text{O}_2$  with very good oxidizing ability can be produced. That is, under VUV and/or UVC light, water can be converted to hydrogen atoms and hydroxyl radicals or simultaneously form another oxidative species, hydrogen peroxide. The existing dissolved oxygen in the environment is converted to ozone and hydroxyl radical under VUV. In this context, all experiments were carried out in the presence of  $\text{H}_2\text{SO}_4$ . Due to possible sulfate radical formation reactions in the leaching experiments under UV,  $\text{H}_2\text{SO}_4$  was used to both benefit from the formed radicals and provide the acidic environment in all experiments with and without UV. The parameters examined in the study are as follows: the power of the UV lamp: 10-50W,  $\text{H}_2\text{SO}_4$  concentration: 0-3M, leaching temperature: 35-55°C, and leaching time: 5-180 min.

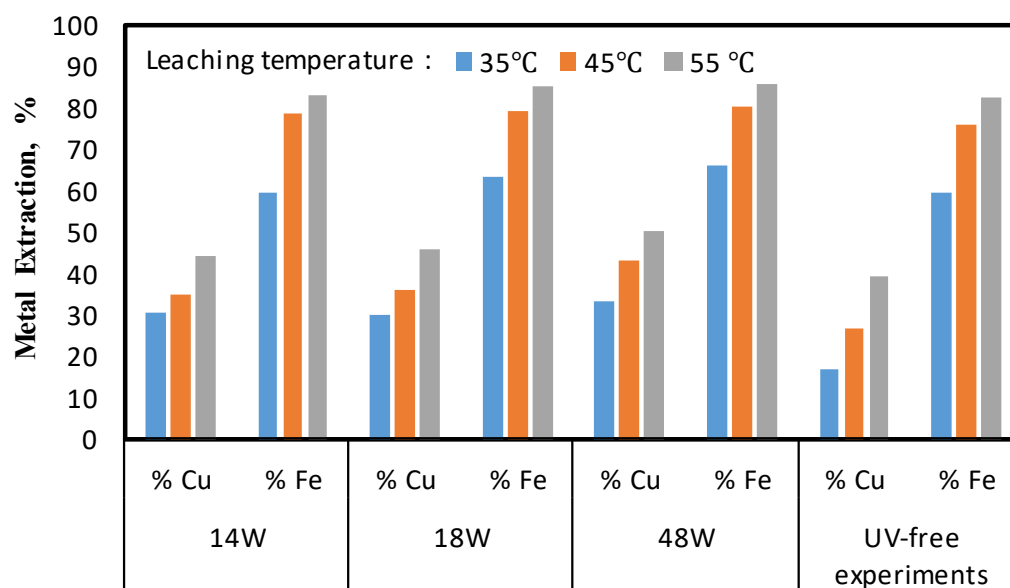
The effects of acid concentration were investigated at a constant air supply rate of 6 L/min. The studies carried out in the UV and non-UV environments are presented in Figure 1. In the experiments conducted in the non-UV environment, the solubility of copper and iron increased up to a certain point with the increasing concentration. For example, at 0M  $\text{H}_2\text{SO}_4$  concentration, 2.7% copper was dissolved, while at 1.5M  $\text{H}_2\text{SO}_4$  concentration, copper and iron solubility reached 26.9% and 76.02%, respectively. In the studies carried out in UV photoreactor systems, especially at 1.5M  $\text{H}_2\text{SO}_4$  concentration, dissolved copper and iron at 185nm wavelength (48W) were calculated as 43.02% and 80%, respectively.

It can be seen that copper extraction increased with increasing leaching temperature in the experiments performed in the non-UV environment (Figure 2). Accordingly, at 35°C, 17% copper was extracted, while at 55°C copper and iron extractions were around 39.22% and 82.5%, respectively. In the temperature studies carried out using a lamp with a 185 nm wavelength and a power of 48W, the Cu yield was 33.1% at 35°C in the first 60-minute period, while it reached 50.03 at 55°C.





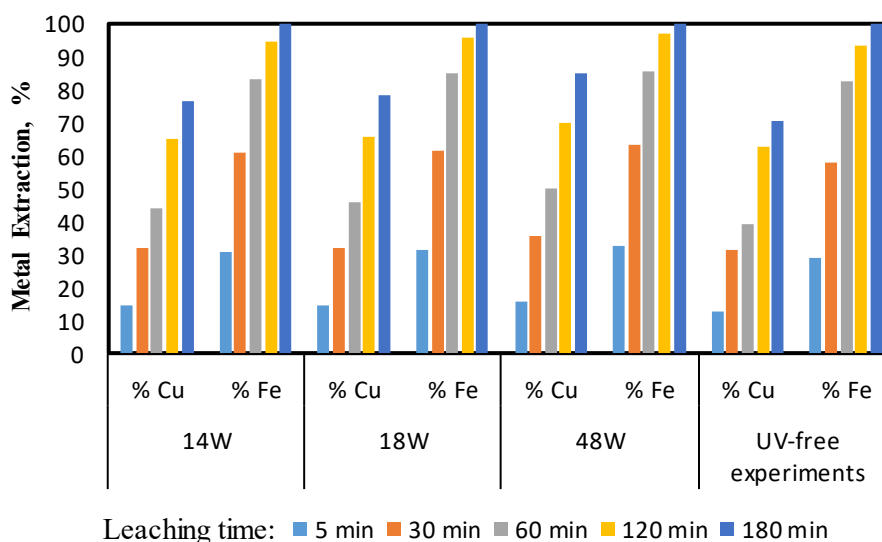
**Fig 1.** The effect of  $\text{H}_2\text{SO}_4$  concentration on metal extraction from copper slag in UV and non-UV environment (Air supply rate: 6 L / min; leaching time: 60 min; leaching temperature: 45 °C; liquid-solid ratio: 50 ml / g; stirring speed: 400 rpm).



**Fig 2.** The effect of leaching temperature on metal extraction from copper slag in UV and non-UV environment (Air supply rate: 6 L / min; leaching time: 60 min;  $\text{H}_2\text{SO}_4$  concentration: 1.5 M; liquid-solid ratio: 50 ml / g; stirring speed: 400 rpm).

Figure 3 presents the effects of the leaching time in the studies carried out in the UV and non-UV environments. Accordingly, it was determined that only around 13% of the copper in the slag was extracted in the first 5 minutes of the leaching period in the non-UV environment. However, it was determined that there was an increase in copper extraction with increasing leaching time and around 70% copper was recovered at the end of 180 min.

In the experiments conducted in the UV environment, in terms of copper extraction, the results obtained in the first 5 and 30 minutes of the leaching time at all lamp powers were almost similar to the extraction efficiencies calculated in the non-UV environment. The most significant differences were obtained at the end of the 180-minute leaching period. Because, in the presence of possible oxidative species and sulfate radicals formed by the lamp at the wavelength in question, it was determined that after a certain point, there were significant differences in copper recovery with increasing time, depending on the lamp power. On the other hand, in the studies conducted at 185nm wavelength (48W), the copper recovery was at around 85%.



**Fig 3.** The effect of leaching time on metal extraction from copper slag in UV and non-UV environment (Air supply rate: 6 L / min; leaching temperature: 55 °C; H<sub>2</sub>SO<sub>4</sub> concentration: 1.5 M; liquid-solid ratio: 50 ml / g; stirring speed: 400 rpm).

## CONCLUSION

In the study, it was revealed that photochemical reactions can be used to create solution environments with high oxidation potential in the leaching process. Experiments on metal extraction from copper slag under UV and non-UV conditions showed a significant difference in copper recovery, especially in studies under UV. On the other hand, it was found that increasing lamp power, which is a parameter affecting the UV dose, had an impact on gain. The UV dose emitted by the 48W lamp to the leaching environment during the 180-minute experiment was calculated as 518,4 kJ/m<sup>2</sup>. However, it was determined that the 185 nm wavelength lamp consumed 4800 kWh/m<sup>3</sup> of electrical energy during the 180-minute experiment in a 300 ml solution, whereas the copper and iron dissolved in the medium were 1.15 g/L and 7.29 g/L, respectively.

## REFERENCES

- Gbor, P.K., Hoque, C., Jia, C.Q., 2006. Dissolution behavior of Fe, Co, and Ni from non-ferrous smelter slag in aqueous sulphur dioxide, *Hydrometallurgy*, 81, 130–141.
- Gonzalez, M.C., Braun, A.M., 1995. VUV photolysis of aqueous solutions of nitrate and nitrite. *Res. Chem. Intermed.* 21 (8/9), 837-859.
- Han, W., Zhang, P., Zhu, W., Yin, J., Li, L., 2004. Photocatalysis of *p*-chlorobenzoic acid in aqueous solution under irradiation of 254 nm and 185 nm UV light. *Water Research*, vol. 38, 4197-4203.
- Imoberdorf, G., Mohseni, M., 2011d. Experimental study of the degradation of 2,4-D induced by vacuum-UV irradiation. *Water Sci. Technol.* 63 (7), 1427-1433.
- Legrini, O., Oliveros, E., Braun, A.M., 1993. Photochemical processes for water treatment. *Chem. Rev.* 93, 671-698.
- Loraine, G.A., and Glaze, W.H., 1992. "Destruction of Vapor Phase Halogenated Methanes by Means of Ultraviolet Photolysis." 47th Purdue Industrial Waste Conference Proceedings. Lewis Publishers, Inc. Chelsea, Michigan.
- Oppenlander, T. (Ed.), 2003. *Photochemical Purification of Water and Air*. Wiley-VCH.

Turan, M.D., Sarı, Z.A., Demiraslan, A., 2019. Ultrasound-Assisted Leaching and Kinetic Study of Blended Copper Slag. Metallurgical And Materials Transactions B, Volume, 50B, 1949-1956.

**Acknowledgments**

This study is a part of FÜPAB project (MF.19.51). The authors like to acknowledge the FÜBAP (FIRAT University Scientific Research Projects).

## ANTIMICROBIAL INVESTIGATION AND DOCKING ANALYSIS OF QUINOLINE COMPOUNDS

K. K. Ilavenil<sup>1</sup> and V. Senthilkumar<sup>2</sup>

<sup>1</sup>Department of Chemistry, Nehru Memorial College (Autonomous)/Bharathidasan University, Puthanampatti, Tiruchirappalli - 621 007, (Tamilnadu) India.

<sup>2</sup>Department of Mechanical Engineering, SRM-TRP Engineering College/Anna University, Irungalur, Tiruchirappalli - 621105, Tamilnadu, India.

### Abstract

The organic compounds benzene-1,4-diol and quinhydrone were subjected to antimicrobial studies against few gram positive and gram negative bacteria and fungi. The zone of inhibition towards the microbes was investigated by agar well diffusion method and the compound benzene-1,4-diol is more resistant towards the organisms like *Bacillus subtilis* (38 mm/ml), *Enterococcus faecalis* (40 mm/ml) and for quinhydrone *Staphylococcus aureus* (40 mm/ml), *Pseudomonas aeruginosa* (38 mm/ml) at higher concentrations. The docking analysis was performed for the small ligand interactions with macromolecules and the least binding energy, hydrogen atom interactions are reported using autodock 4.2.6.

Key Words: benzene-1,4-diol. Quinhydrone, antimicrobial studies, autodock.

### INTRODUCTION

The compound benzene-1,4-diol is originated in the plant food as glucose or its conjugate called as arbutin widely found in fruit pears, beverages, onion and it is hydrolysed to free benzene-1,4-diol and absorbed by the intestinal gland<sup>1</sup>. They are active against few bacteria, weed, pests and fungus<sup>2-5</sup>. The multidrug resistance is also shown by few pathogenic strains like *Enterococcus faecium*, *Streptococcus pneumonia* and *Staphylococcus aureus*<sup>6</sup>. Various heterocyclic compounds have antitumour, analgesic activities, anti-inflammatory and antiallergic activity. Quinhydrone is employed as redox electrodes and it is used as an alternative for the glass electrode. Naturally it is found in humic substances comprising of sea water, coal and soil particles. The antibacterial and antifungal behavior of the compounds benzene-1,4-diol, and quinhydrone are evaluated against few bacteria and fungi like *Streptococcus*, *Staphylococcus aureus*, *E.coli*, *Vibrio Chlorae*, *Candida albicans*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *A. niger*, *Bacillus subtilis* and *Klebsiella pneumonia*. The hydrogen bond interactions, pi-alkyl interactions, aromaticity and many ligand interactions are predicted using docking method.

### EXPERIMENTAL

#### Materials and Methods

The organic compounds benzene-1,4-diol and quinhydrone were purchased from Sigma Aldrich of AnalaR grade. The bacteria and Fungus were acquired from Eumic analytical Laboratory and Research Institute, Tiruchirappalli. The Hi media nutrient agar slants at 4 °C was employed to uphold the bacterial strains. The prepared compounds are employed as the ligand interacts with the macromolecule and the binding sites, binding energy are determined from autodock tools and Discovery studio visualizer software.

#### Spectral Data

**Quinhydrone:** Strong peak at 3034 cm<sup>-1</sup> (-C-H), -OH (stretching) group at 3852cm<sup>-1</sup>, -C=O stretching frequency at 1700cm<sup>-1</sup>, bending frequency for -C-H- at 3100 to 3000 cm<sup>-1</sup>, 3640 to 3610 cm<sup>-1</sup>, =C=O at 1760 to 1665 cm<sup>-1</sup>, benzene ring at 3100 to 300 cm<sup>-1</sup>.

The structures of the protein macromolecule were obtained from the website of protein data bank resource. The protein with ID 5AF1 was collected for studying the biointeraction of ligand and the protein molecules. The compound benzene-1,4-diol and quinhydrone were the ligands.

The ligand structures were downloaded from NCBI-PubChem database and the molecule in the SDF mode was converted into charged PDBQT form and saved for docking, using open bable software.

### Anti-bacterial Assay

Standard agar well diffusion method was employed for anti-bacterial assay. Anti-bacterial activity was evaluated by measuring the zone of inhibition against the test organism. The zone of inhibition diameter is noted down and then compared with the standard antibiotics and results are interpreted. The compound benzene-1,4-diol (A) showed lethal zone for the species (Figure 1), *Bacillus subtilis* (38 mm/ml), *E.coli* (38 mm/ml), *Salmonella typhi* (26 mm/ml), *Candida albicans* (40 mm/ml), *Enterococcus* (40 mm/ml). The bacteria *Staphylococcus aureus* (40 mm/ml), *Klebsiella pneumoniae* (32 mm/ml), *Streptococcus* (32 mm/ml), *Pseudomonas aeruginosa* (38 mm/ml) and *Candida albicans* (30 mm/ml) showed activity against the compound quinhydrone (Figure 2).

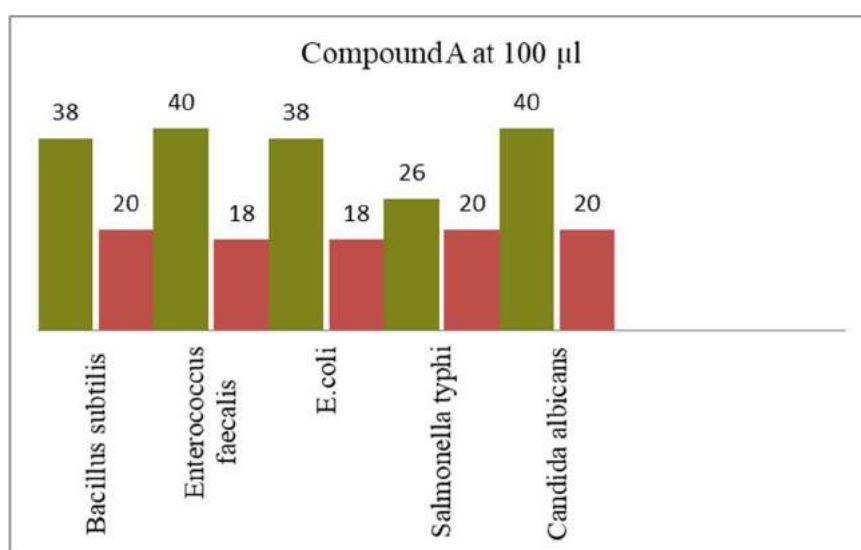
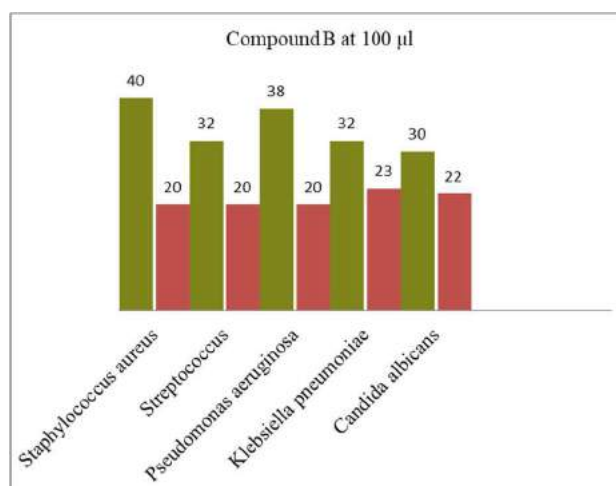
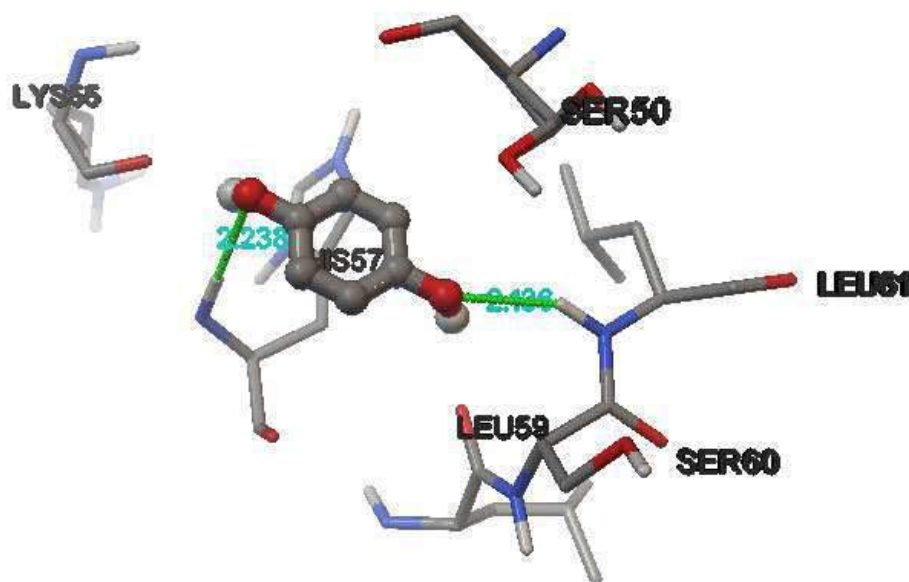


Figure 1: Activity of the compound (A)



**Figure 2: Activity of the compound (A)****Molecular Docking**

The ligand benzene-1,4-diol bind with the macromolecule 5AF1 and exhibits two hydrogen atoms in bonds through the residue HIS57, LEU61, SER60 (Figure 3). The binding energy is -5.17 Kcal/mol, intermolecular energy is -5.77 Kcal/mol, torsional energy 0.6 Kcal/mol respectively.

**Fig-3: Two hydrogen atoms interactions with 5AF1 macromolecule for benzene-1,4-diol**

The quinhydrone ligand bind with the 5AF1 macro molecule and exhibits pi donor hydrogen bond through HIS220, SER60, conventional hydrogen bond with LEU59, LEU61, LYS55, HIS57, SER50, pi alkyl interaction with HIS220, HIS57 as depicted in the figure 2. The same ligand has the bonded with the residue with energy -4.87 Kcal/mole, intermolecular energy -5.46 Kcal/mol and torsional energy 0.6 Kcal/mol.

**Conclusion**

The current investigation provides a basis for the treatment of hazardous products using microorganisms. The antibacterial and antifungal activity revealed that quinoline compounds displayed significant action. They hydroxyl groups, hetero cyclic nitrogen atom imparts more potential towards Gram-positive, Gram-negative bacteria and few fungi. The computer assisted molecular docking predicts the ligand interactions, the hydrogen bond interactions at various poses of macromolecule and the natural activities of quinoline compounds are efficiently determined.

**REFERENCES**

1. McDonald T. A, Holland N. T, Skibola C, Duramad P and Smith M. T. Hypothesis: phenol and hydroquinone derived mainly from diet and gastrointestinal flora activity are causal factors in leukemia, Leukemia. 2001: 15(1); 10–20.
2. Khambay B. P. S, Jewess P. The potential of natural naphthoquinones as the basis for a new class of pest control agents. Crop Prot. 2000: 19(1); 597–601
3. Sasaki K, Abe H, Yoshizaki F. In Vitro antifungal activity of naphthoquinone derivatives. Biol. Pharm. Bull. 2002: 25(5); 669– 670.



4. Binutu O. A, Adesogan K. E, Okogun J. I. Antibacterial and antifungal compounds from *Kigelia pinnata*. *Planta Med.* 1996; 62 (4); 352–353.
5. Reichman L. B. Multidrug Resistance in the World: The Present Situation. *Chemotherapy.* 1996; 42 (3); 2-9.
6. Lipsitch M, Samore M. H. Antimicrobial use and antimicrobial resistance: a population perspective. *Emerg Infect Dis.* 2002; 8(4); 347-354.

## STRUCTURE AND PROPERTIES OF THERMALLY STABILIZED POLY(HEXAMETHYLENE ADIPAMIDE) AS CARBON FIBER PRECURSOR: X- RAY DIFFRACTION, TGA, AND FT-IR SPECTROSCOPY ANALYSIS

**Md. Mahbubor Rahman**

Bangladesh University of Textiles, Tejgaon, Dhaka, Bangladesh

<https://orcid.org/0000-0001-7104-9459>

**Ismail KARACAN**

Department of Textile Engineering, Erciyes University, Kayseri, Turkey

<https://orcid.org/0000-0002-9047-1011>

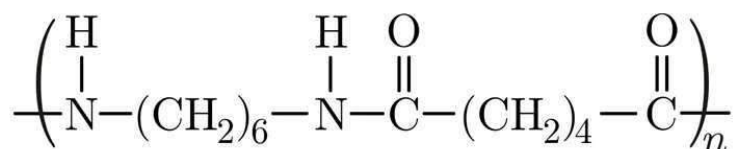
### Abstract

Poly(hexamethylene adipamide) or polyamide 66 was utilized to perform thermal oxidation after chemical pretreatment with aqueous solution of boric acid, phosphoric acid, and urea (BPU). A two-step oxidative stabilization process at temperatures up to 245 °C was employed with different oxidation times including 30, 60, 90, 120, and 150 min, which cause major physical and structural alterations in the polyamide 66 (PA 66) fibers. In this work, X-ray diffraction (XRD), thermogravimetric analysis (TGA), and Fourier transform infrared (FT-IR) spectroscopy techniques, were employed to perform structural characterization of the pristine, and BPU integrated-oxidized samples. The results revealed that BPU integration improved the thermal stability of PA66 fibers prior to the carbonization stage. The study of the equatorial X-ray diffraction data revealed a continuous loss of crystalline structure, which is caused by disordering methods due to the hydrogen bond breakage of the PA66 structure. The TGA thermograms showed a relative improvement in the thermal stability of the PA66 fibers by the increased carbon yield by the rise of the oxidation time. As a result of the simultaneously occurred dehydration and dehydrogenation reactions, the continuous loss of intermolecular and intramolecular hydrogen bonds was noticed from the FT-IR analysis.

**Keywords:** Poly(hexamethylene adipamide), oxidation, XRD, TGA, FT-IR spectroscopy.

### INTRODUCTION

Carbon fiber is a novel class of high-performance materials that has the highest specific modulus and specific strength of any known reinforcing fiber (Chand, 2000). Carbon fibers have been utilized as reinforcements in structural composite materials including carbon-carbon composites, carbon fiber reinforced polymers, carbon fiber reinforced materials, and carbon fiber reinforced cement for many years (Chand, 2000). Electric lights, which Edison invented in 1880 using cellulose-based cotton and bamboo fibers (Edison, 1880), were the first industrial application of carbon fiber. In the 1880s, his cellulose-based carbon fiber was utilized in the electrical illumination of the German metropolis of Berlin (Frohs and Jaeger, 2012). Carbon fibers are used in the manufacture of vehicles, commercial and military planes, wind turbines, pressure tanks, off-shore tethers, medical and sporting products, and other items due to a combination of desirable attributes (Chung and Chung, 2012; Mangalgiri, 1999). Polyacrylonitrile (PAN), rayon, and pitch are the most common precursor fibers used in the production of carbon fibers. PAN fiber accounts for about 90% of global carbon fiber manufacturing (Frank et al., 2012; Khayyam et al., 2020; Sunil et al., 2019; Tsai and Lin, 1991) due to its outstanding combination of carbon yield and tensile characteristics. Polyamide fibers have also been reported to be used as a carbon fiber precursor in a number of research (Andrichenko and Druzhinina, 1999; Santangelo, 1970; Tovmash et al., 2007).

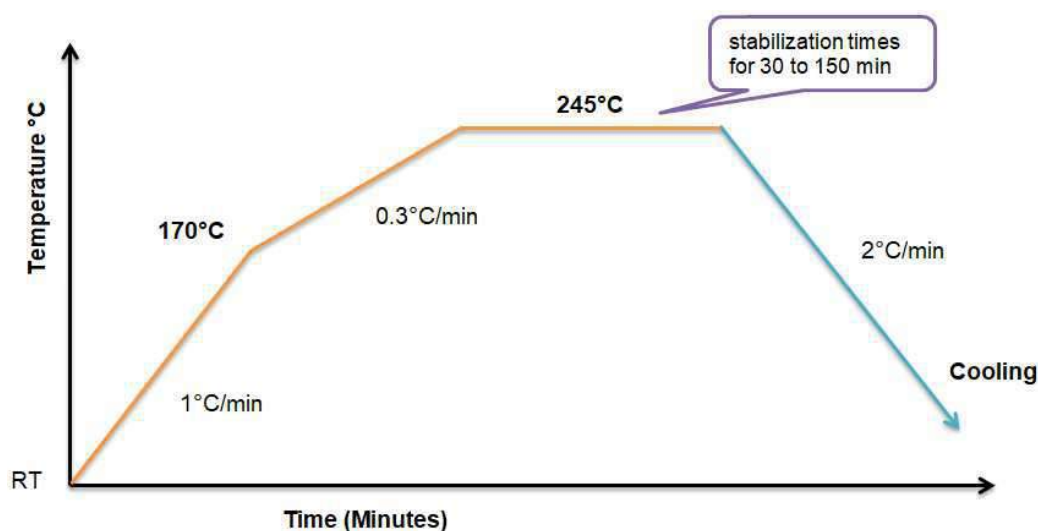


**Figure 1** Chemical structure of polyamide 66.

In this work, polyamide 66 multifilament was utilized for optimizing thermal oxidation process in carbon fiber manufacturing. The main objective of this research was to assess the impact of boric acid, phosphoric acid, and urea complexation on the thermal stability of polyamide 66 fibers before they were carbonized. With the goal of monitoring and following the physical and chemical changes as a function of stabilization time, structural characterisation was carried out using a combination of X-ray diffraction, thermogravimetric analysis, and infrared spectroscopy measurements.

## MATERIALS AND METHODS

The raw polyamide 66 fibers were treated with a 10% ethanol-water solution at 50°C for 40 minutes to remove surface impurities from the fibers. The sample was allowed to dry at room temperature overnight before being dried in an air oven at 80°C for 5 hours after surface impurities were removed. The PA66 yarn was chemically processed by soaking it for 24 hours at room temperature in a solution of 3% boric acid, 3% phosphoric acid, and 3% urea with ethanol. The thermal oxidation process was then carried out in an air environment at 245 °C for 30, 60, 90, 120, and 150 minutes of stabilization time, while the temperature was raised from room temperature to 170 °C at a 1 °C/min rate, and then elevated to 245 °C at a 0.3 °C/min rate without waiting.



**Figure 2** Annealing stages of Raw PAN filament

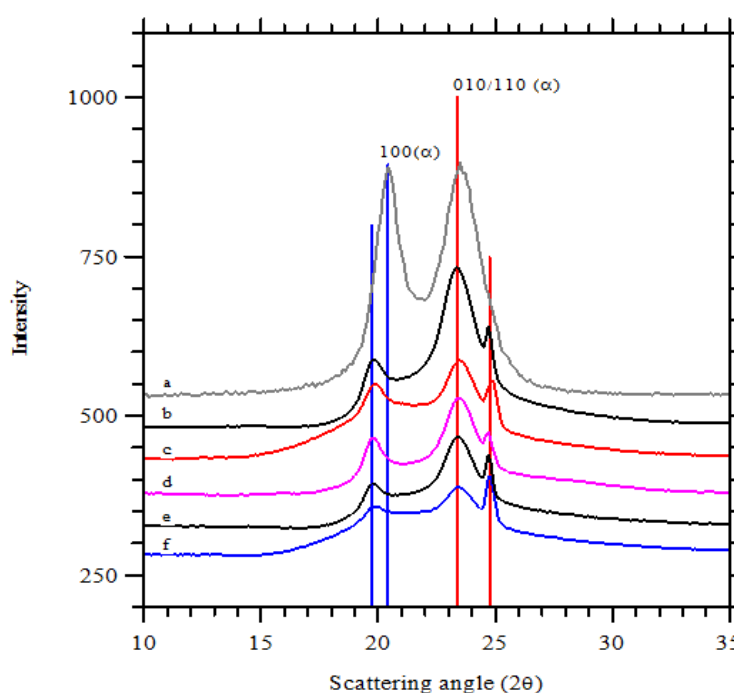
X-ray profiles were attained by a Bruker AXS D8 model XRD machine. Counting was done at a rate of 10 steps per degree. For both original and thermally stabilized materials, X-ray diffraction data were acquired between 5–35° 2θ, and incoherent scatter, Lorentz, and polarization factors were adjusted (Hindeleh et al., 1983). The TGA profiles of the pristine and oxidized PAN were obtained using a Perkin Elmer TGA scheme. The maximum temperature in the TGA studies was 1000°C, and a sample weight of approximately 5-6 mg. Temperature scaling of TGA was completed employing melting point benchmarks of gold, indium, aluminum, zinc, and tin. FT-IR study was carried out using a Perkin Elmer FT-IR

spectrometer. The average value was calculated using 50 interferograms and a Norton-Beer apodization algorithm. All the bands were ratioed by retaining unchanging device modifications.

## RESULTS AND DISCUSSIONS

### X-RAY DIFFRACTION

The equatorial X-ray diffraction traces of untreated PA66 fiber and BPU pretreated and thermally stabilized PA66 fibers stabilized at 245 °C, with stabilization times ranging from 30 to 150 min, are presented in Figure 3. Bunn and Garner (Bunn et al., 1947) indicated the presence of  $\alpha$  and  $\beta$  crystalline forms coexisting in the PA66 multifilaments based on the X-ray diffraction extents. In the PA66 multifilaments, the  $\alpha$ -phase structure was originally proposed (Bunn et al., 1947) as the primary phase. At  $2\theta=12^\circ$  related with the 010 reflection, just a minor part of the  $\beta$ -phase was detected.



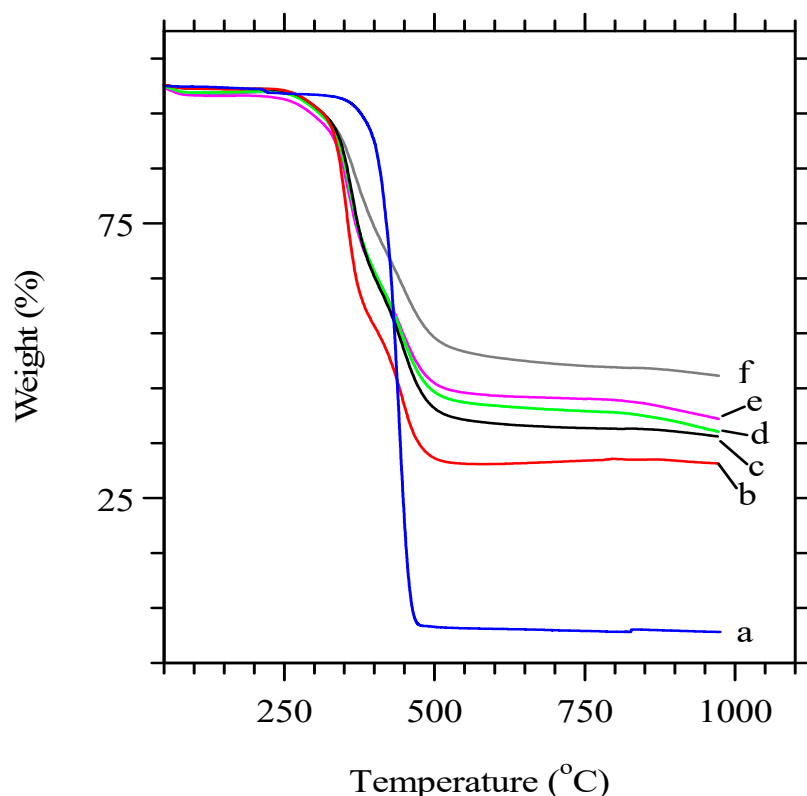
**Figure 3** X-ray diffraction (XRD) traces of untreated (a) and thermally oxidized polyamide 66 fiber as a function of oxidation periods for 30-60-90-120-150 min respectively.

The  $\alpha$ -phase is recognized in the (010) plane as holding the H-bonded chain enclosed planar sheets. The polymer chains are linked to one other by H-bonds inside the amide groups to form sheets at this step. These H-bonded sheets are 0.36 nm higher in the vertical direction. Hydrogen-bonded sheets for the  $\beta$ -phase can also be found in the (010) plane. The only difference between the two crystalline phases along the c-axis is the relative locations of the following H-bonded sheets. For the pristine and BPU incorporated-oxidized PA66 multifilaments stabilized at 245 °C by various stabilization durations, the succeeding H-bonded layer is pushed upward in relation to the first one, and the third sheet returns to a similar stage as the first sheet.

### THERMOGRAVIMETRIC ANALYSIS (TGA)

A thermogravimetric analysis approach was used to characterize the thermal properties of untreated, BPU pretreatment, and thermally stabilized PA66 fibers. The TGA curves of BPU

pretreatment and thermally stabilized PA66 fibers as a function of stabilization duration are displayed in Figure 4. Because of the growing intermolecular crosslinking processes between the PA66 polymer chains, the TGA curves indicate decreased weight loss as the stabilization time increases, suggesting increased char production. Because of the increased intermolecular crosslinking associated ladder-like structure development, the untreated sample loses weight over a small temperature range, while thermally stabilized samples lose weight over a broad range of temperatures.

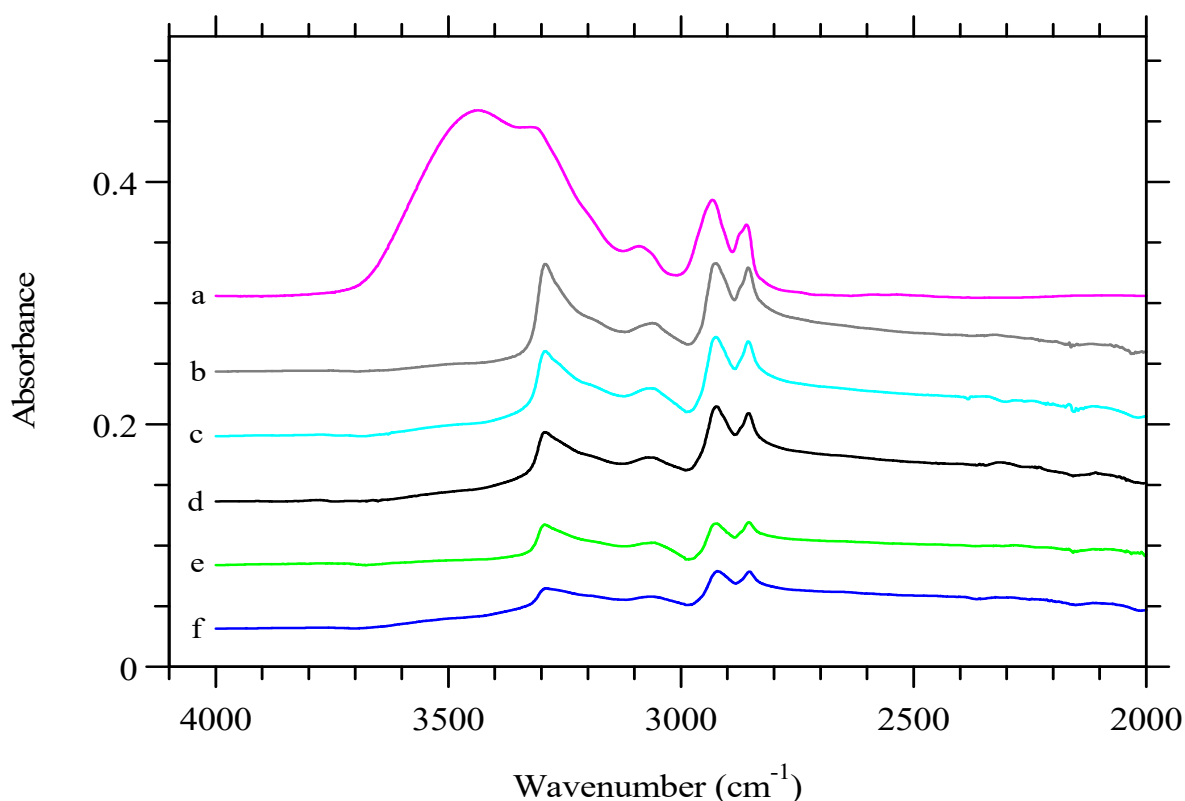


**Figure 4** TGA thermograms of untreated (a) and thermally oxidized polyamide 66 fiber as a function of oxidation periods for 30-60-90-120-150 min respectively.

In a nitrogen atmosphere, the TGA micrographs of the original PA66 shows a single step breakdown at 430 °C. The TGA thermograms for the BPU impregnated and oxidized PA66 samples show a two-step breakdown at 430 and 360 °C in nitrogen environment. The raw PA66 fibers are thermally stable at temperatures ranging from 50 to 350 °C, with no signs of weight loss. Figure 4 depicts a single-step breakdown at temperatures over 400 °C. Up to 470 °C, a relatively faster rate of breakdown follows this zone of thermal stability. At around 1000 °C, the total weight loss was 99.5 percent, with a 0.6 percent carbon yield.

### FT-IR SPECTROSCOPY ANALYSIS

To investigate chemical changes that occur during the thermal stabilization process, IR spectroscopy was used extensively. As a function of stabilization time, the intensity and spectroscopic variations were investigated. Figure 5 shows the IR spectra of the untreated, cupric chloride pretreatment, and thermally stabilized PA66 fibers in the 4000-2000  $\text{cm}^{-1}$  area as a function of stabilization time.

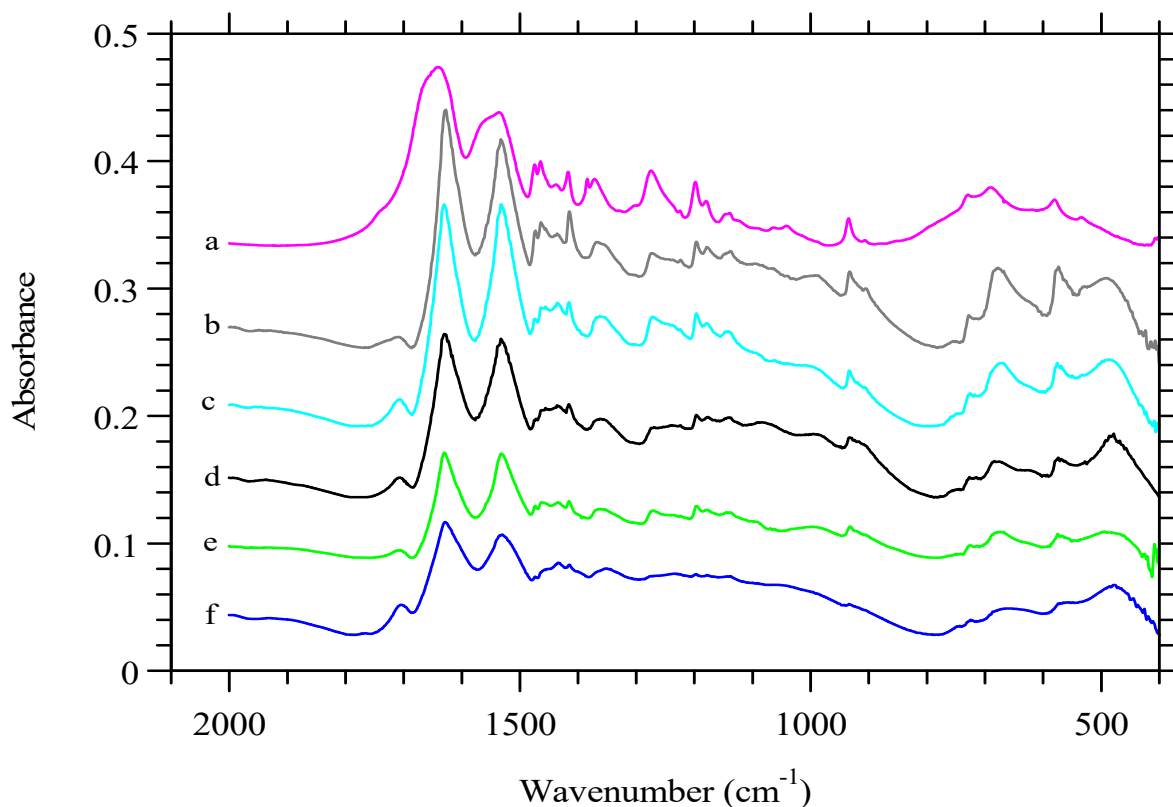


**Figure 5** IR spectra between 4000 and 2000  $\text{cm}^{-1}$  of untreated (a) and thermally oxidized polyamide 66 fiber as a function of oxidation periods for 30-60-90-120-150 min respectively.

At wavenumbers ranging from 3400 to 2800  $\text{cm}^{-1}$ , the infrared vibrations of PA66 multifilaments showed typical intensity variations, notably in vibrations associated to  $\text{CH}_2$  and N-H stretching. The oxidized PA66 multifilaments show the formation of a broad 'free N-H' spectrum between 3600 and 3400  $\text{cm}^{-1}$ . The presence of free N-H spectra is caused by the attachment of BPU to the oxygen molecule of amide groups (Figure 5). H-bonds from polymer structures are split and the N-H spectra are liberated as soon as the BPU forms coordination bonding with the oxygen molecule of amide groups (Vasanthan et al., 2004).

Figure 6 shows the IR spectra of untreated and thermally stabilized PA66 fibers as a function of stabilization time in the 2000-400  $\text{cm}^{-1}$  range. Several bands, including amide I, amide II, amide III, amide IV, amide V, and amide VI vibrations, as well as crystalline and amorphous vibrations, are present in this area. The existence and development of a new shoulder at 1714  $\text{cm}^{-1}$  in the IR spectra of stabilized PA66 fibers was attributed to carbonyl ( $\text{C}=\text{O}$ ) stretching as a result of oxidative crosslinking processes. With increasing stabilization time, the intensity of this band gradually and progressively increased. The most strong bands in the spectra displayed in Figure 6 are the amide I and amide II peaks at 1634 and 1530  $\text{cm}^{-1}$ , respectively.





**Figure 6** IR spectra between 4000 and 2000  $\text{cm}^{-1}$  of untreated (a) and thermally oxidized polyamide 66 fiber as a function of oxidation periods for 30-60-90-120-150 min respectively. The carbonyl ( $\text{C}=\text{O}$ ) stretching band is known to dominate the amide I band, which is located at  $1634 \text{ cm}^{-1}$ . With increasing stabilization time, the IR bands corresponding to crystalline phase at  $1198$  and  $934 \text{ cm}^{-1}$  lost most of their intensities as a consequence of the beginning of decrystallization processes, probably driven by the breakdown of hydrogen bonds between the polymer chains (Cooper et al., 2001).

## CONCLUSIONS

Boric acid, phosphoric acid, and urea were pretreated in an air environment before being thermally stabilized, resulting in significant physical and structural changes. Using a combination of XRD, TGA, and IR spectroscopy studies, the effect of this chemical inclusion on the thermal stability of PA66 fibers was studied. With the passage of time, the TGA thermograms revealed a relative increase in thermal stability, as seen by rising char production. For the BPU processed PA66 fibers stabilized for 150 min at  $245^\circ\text{C}$ , the char yield reached a high of 47 percent at  $1000^\circ\text{C}$ . With increasing stabilization time, the experimental data from TGA, X-ray diffraction, and IR spectroscopy techniques revealed progressive decrystallization as a result of hydrogen bond breakage.

## REFERENCES

- Andrichenko, Y.D., Druzhinina, T. V, 1999. Fabrication of metal-containing carbon fibre based on modified polycarproamide fibre. *Fibre Chem.* 31, 1–7.
- Bunn, C.W., Garner, E. V, Bragg, W.L., 1947. The crystal structures of two polyamides ('nylons'). *Proc. R. Soc. London. Ser. A. Math. Phys. Sci.* 189, 39–68.
- Chand, S., 2000. Review carbon fibers for composites. *J. Mater. Sci.* 35, 1303–1313.
- Cooper, S.J., Coogan, M., Everall, N., Priestnall, I., 2001. A polarised  $\mu$ -FTIR study on a model system for nylon 6 6: implications for the nylon Brill structure. *Polymer (Guildf)*. 42, 10119–10132.

- Edison, T.A., 1880. Electric lamp.
- Frank, E., Hermanutz, F., Buchmeiser, M.R., 2012. Carbon fibers: precursors, manufacturing, and properties. *Macromol. Mater. Eng.* 297, 493–501.
- Frohs, W., Jaeger, H., 2012. Carbon fiber & composite material–Landscape Germany. *Carbon* N. Y. 2, 737.
- Hindeleh, A.M., Johnson, D.J., Montague, P.E., 1983. In *Fibre Diffraction Methods* ACS Symp. No. 141, pp.149-182; French, AD, Gardner, KH, Eds.
- Khayyam, H., Jazar, R.N., Nunna, S., Golkarnarenji, G., Badii, K., Fakhrhoseini, S.M., Kumar, S., Naebe, M., 2020. PAN precursor fabrication, applications and thermal stabilization process in carbon fiber production: Experimental and mathematical modelling. *Prog. Mater. Sci.* 107, 100575.
- Mangalgi, P.D., 1999. Composite materials for aerospace applications. *Bull. Mater. Sci.* 22, 657–664.
- Santangelo, J.G., 1970. Graphitization of fibrous polyamide resinous materials. 3,547,584.
- Sunil, S., Abhilas, J.K., Kumar, A., Shukla, H.K., 2019. Oxidative stabilization studies on pretreated polyacrylonitrile precursor fiber suitable for carbon fiber production, in: *AIP Conference Proceedings*. AIP Publishing LLC, p. 20018.
- Tovmash, A. V., Budyka, A.K., Mamagulashvili, V.G., Rykunov, V.A., Shepelev, A.D., Ogorodnikov, B.I., 2007. Adsorption of hydrogen and methane by carbon foam based on carbonized polyamide fibres. *Fibre Chem.* 39, 450–453.
- Tsai, J., Lin, C., 1991. Effect of comonomer composition on the properties of polyacrylonitrile precursor and resulting carbon fiber. *J. Appl. Polym. Sci.* 43, 679–685.
- Vasanthan, N., Kotek, R., Jung, D.-W., Shin, D., Tonelli, A.E., Salem, D.R., 2004. Lewis acid–base complexation of polyamide 66 to control hydrogen bonding, extensibility and crystallinity. *Polymer (Guildf)*. 45, 4077–4085.

## HARUKİ MURAKAMI’NİN TUHAF KÜTÜPHANE ADLI ESERİNİN PSİKOLOJİK PERSPEKTİFLERİ

### PSYCHOLOGICAL PERSPEKTIVES OF THE STUDY CALLED “THE STRANGE LIBRARY” BY HARUKI MURAKAMI

**Dr. Canan COŞKUN**

*Milli Eğitim Bakanlığında öğretmen, Çamlıca Anadolu Lisesi Türkiye, Bursa*

#### Özet

Dünyaca ünlü çağdaş Japon yazarlarından Haruki Murakami’nin kitapları gerçeklikle masal arasındaki ince bir çizgide geçiyor. Kitaplarında Murakami, bazı imgeler belirleyip ve parçaları sonradan birleştirerek bir olay örgüsü oluşturuyor. Kolay kelimeler seçip ustaca cümleler inşa ederek bir alegori oluşturuyor. Eserlerinde ana karakterler genelde bir şeyleri kaybetmiştir ve onu aramak zorundadır. Murakami’nin “Tuhaf kütüphane” başlıklı kitabı 2005 de Japonya’da ilk baskısını yaptı. 2016 yılında Türkçeye çevrildi. Kitaba yüzeysel bakıldığında sıradan görünümlü bir kütüphanede geçen adı üzerinde tuhaf, fantastik ve biraz da korku/gerilim unsurları içeren masalsı bir öykü kitabı olduğu görülür. Büyükler için yazılmış illüstrasyonlarla süslenmiş (Türkçe baskısında Kat Menshik’in illüstrasyonları kullanılmış) 62 sayfadan oluşan bu masalsı hikâyeyi okuduğumuzda aslında öyle olmadığını, herkesin okurken farklı anlamlar ve çözümlemeler yapabileceği psikolojik temelleri olan bir hikâyeyi barındırdığı gerçeği gün yüzüne çıkmaktadır. Okuyucusuna göre anlam kazanan hatta aynı okuyucunun farklı zamanlarda farklı anlam ve çözümlemeler yapabileceği psikolojik temelleri olan bu kitabı bu makalede yas ve travma açısından değerlendirilmesi yapılmıştır.

**Anahtar Kelimeler:** Alegori, Kaygı, Korku, Kayıp-Yas Süreci, Travma, Belirsiz, Muğlak kayıp, Fiziksel Kayıp, Psikolojik Kayıp

#### Abstract

One of the world-famous contemporary Japanese writers, Haruki Murakami's books pass on a fine line between reality and fairy tale. In his books, Murakami creates a plot by identifying some images and then putting the pieces together. He creates an allegory by choosing easy words and constructing ingenious sentences. In his works, the main characters have often lost something and have to look for it. The book "The Strange Library", which was first published in Japan in 2005, was translated into Turkish in 2016. When the book is looked at superficially, it is seen that it is a fairy-tale story book with strange, fantastic and a bit of horror/tension elements on its name, which takes place in an ordinary looking library. When we read this 62-page fairy tale, which is decorated with illustrations written for adults (Kat Menshik's illustrations were used in the Turkish edition), the fact that it is not so, but that it contains a story with psychological foundations that everyone can make different meanings and analyzes while reading, comes to light. This book, which has a psychological basis that makes sense according to its reader and even the same reader can make different meanings and analyzes at different times, is evaluated in terms of grief and trauma in this article.

**Keywords:** Allegory, Anxiety, Fear, Loss-Mourning Process, Ambiguous Loss, Physical loss, Psychological loss, Grief

## Atom Bombalarının Gölgesinde Haruki Murakami'nin Yaşamı

Amerika Birleşik Devletleri “Enola Gay” adlı bir B-29 bombardıman uçağından 6 Ağustos 1945 Pazartesi günü Hiroşima (Hiroşima Japonca geniş ada demek) yerel saatiyle 08.15’te bıraktığı Uranyum-235 tipi “Little Boy/Küçük Çocuk” adlı atom bombasıyla 70 bin kişilik katliam gerçekleştirdi. Sonrasında radyasyon hastalıkları sebebiyle ölenlerle birlikte bu sayı 90 bini geçti. Amerika Hiroşima’ya atılan uranyum bombasından üç gün sonra 9 Ağustos 1945 Perşembe günü Nagasaki yerel saati 11.02’de Plütinyum-239 tipi “Fat Man/Şişman Adam” adı verilen ikinci bir atom bombasıyla (Plutonyum bombası) nükleer saldırısını gerçekleştirdi (Payza, 2019, s. 10) tarihten henüz 4 yıl geçmişti. 12 Ocak 1949 tarihinde Kyoto’da Murakami doğdu. Murakami 2. Paylaşım Savaşını görmemiş ama savaş sonrasının tüm kalıntılarını bizzat yaşamış nesildendir. Murakami ayrıca Baby boom (1946-1964 arası doğmuş nesil için kullanılır) neslindendi. Annesi ve babası Japon Edebiyat öğretmeni idi. Haruki 2 yaşına bastıktan sonra Kyoto’dan Kobe’ye taşındılar. Kyoto Japonya’nın eski bir başkentiydi. Kobe ise canlı bir liman şehri ve yapancılara özellikle de Amerikalı denizcilerin sıklıkla ziyaret ettiği kozmopolit bir liman kentidir. Liman kentlerinin özelliği gereği yabancı kültürün ilk girdiği yerler olarak teşkil edilir. Murakami bu sayede, Japonya’nın ardındaki hayatı, caz kayıtları, Hollywood filmleri ve ikinci el ucuz yabancı kitap satan dükkânları daha yakından tanıma imkânını bulur.

Murakami’nin en çok severek yaptığı şeyler müzik dinlemek özellikle de caz müziği, sinemaya gitmek, kedilerle oynamak ve kitap okumak. Murakami okuldan arta kalan zamanın çoğunu okuyarak geçiriyordu. Kobe’nin liman kenti olması Murakami’ye kitap okuma noktasında çok büyük şans tanımıştı. Özellikle Amerikalı gemiciler, yanlarında getirdikleri İngilizce kitapları civardaki sahaflara sattıklarından Murakami de bu kitapları okuyordu hatta doğru düzgün İngilizce bilmediği halde kendini okumaya zorluyordu. Bu kitaplar genellikle bilim kurgu, dünya klasikleri ve polisiye kitaplarıydı. Murakami kitap okuma düşkünlüğünü şöyle ifade etmiştir: *“Benim için okumak denen eylem, başlı başına bir okuldu ve ben orada çok sayıda önemli şeyi kendime mal ederek öğrendim. Orada son derece sıkıcı kurallar olmadığı gibi puanlara bağlı değerlendirme de yoktu, en başarılı öğrenciler sıralaması baskısı da. Kuşkusuz zorbalık görme gibi bir şey de yoktu. Ben büyük bir sistemin içine dâhil olarak kendi farklı sistemimi başarılı şekilde kurmuştum”*.

Murakami 1968-1975 yılları arasında Tokyo Venessa Üniversitesi Tiyatro Bölümünden mezun olmuştur. Memur bir ailenin çocuğu olduğu için doğru düzgün bir gelire sahip değildi. Bu yüzden okurken çeşitli işlerde yarı zamanlı olarak çalışmaya başladı. Gündüzleri okula gittiği için mecburen gece işleri yapması gerekiyordu. Şincuku Kabukiço’daki barlara bu nedenden dolayı çalışmaya başladı. Murakami bu sayede hem insanları hem de sokakları yakından tanıma fırsatı buldu. 2. Paylaşım Savaşının ardından dünyaya gelen Murakami, globalleşen dünya düzeninde Japon toplumunun değişen ülke ideolojileri sonucu toplumsal bellek ve kimlik yapısının form oluşturmada etken olan faktörleri gözlemleyebilme ve bu faktörleri de eserlerine yansıtabilme olanağı bulabilmiştir.

İnsanları yaşadıkları ve yetiştikleri ortamlardan ayrı değerlendiremeyiz. Kimileri için Murakami biraz fazla Batıdan özellikle de Amerikan kültüründen etkilenen bir yazar olduğu için eleştirilmektedir. Eserlerine baktığımızda yazılarının çoğunda yalnızlık ve ölüm teması çok güçlüdür. Murakami eserlerinde yalnızlığı anlatması aslında onun mensubu olduğu Japon toplumundaki sosyal sorunların izlerini yansıttığı gerçeğini gözler önüne serer. Örneğin Japonya’da özellikle 20-44 yaş arasındaki ana ölüm sebeplerinin en başında intihar, harakiri gelmektedir. Kültürle ilintili olan bu durumun öncesinde Japoncada “elini ayağını çekmek, geri çekilmek gibi anlamlarına gelen Hikikomori adlı ruhsal bir hastalığın yattığı gerçeği fark edilmiştir. Hikikomori, kelime anlamı olarak “içeri çekilme, hapsedilmiş olma” anlamına gelen “yalnızlığı seven modern çağ keşişleri” şeklinde de tanımlanan ve Japonca bir kelimedir. Münzevi, yetişkin ve ergen bireylerin toplumsal yaşamdan çekilmeleri ve sıklıkla aşırı seviyelerde kendilerini izole etmeleri olayını anlatır. Hikikomori belirtileri olarak şunlar ifade edilir: Evden dışarı çıkmamak, kimseyle konuşmak

istememek, sosyal hayattan kopmak, arkadaşlıkları bitirmek, aşırı stres, uykusuzluk, sinirlilik, bilgisayar başında yemek yemek, insanlardan kaçmak, bağırarak cevap vermek gibi. Hikikomori tedavisi için de en başta gelen önemli etkenler şunlardır: Kişinin çocukluğunda yaşadığı incinmiş çocuk modunun kaynağını bulup mutlu çocuk moduna, sağlıklı yetişkin moduna dönüştürmektir. Çocuklarla iletişim kurmak, onların davranışlarını takip etmek ve çocukların ilgisini çekecek aktivitelerle onları sosyal hayata tekrardan adapte edebilmeye gayret etmeye çalışmak.

Japon kültüründe derinleşmiş bir öge olsa da Murakami kitaplarındaki ölüm ve intihar eğilimi, bir özeleştirici bağlamında olmasa da kültürel değişimden kaynaklanan ruhsal çelişkiler bağlamında incelenmektedir. Kendi yalnızlığımızı içimizde kurabileceğimizi çoğunlukla çok iyi yakalıyor ve hissettirerek anlatıyor. İnsan kendi yalnızlığını bir yük olarak görmekten vazgeçip başkalarının yalnızlığı ile iletişim kurmaya çalışmaya başlıyor, empati kuruyor.

Konu örüntü biçimi olarak Murakami, aslında çok fazla Japon toplumunu yansıttığı görülmektedir. Murakami eserlerinden tıpkı bir pergel gibi bir ayağı dünyayı dolaşırken pergelin iğneli sabit kısmı hep Japonya’da Japon toplumunda ve kültüründe ve hedeflerindedir. Japonların ve Japon toplumunun öfkesini, acılarını, hayal kırıklıklarını, çaresizliklerini, umutlarını, umutsuzluklarını, derin yalnızlıklarını, boşluk algılarını, dışlanma ve soyutlanmalarını, Japon gençliğinin eğitim sistemine, Amerika’ya ve Amerikan kültürüne karşı duruşlarını ve gündelik yaşamlarındaki Amerikan etkisini bazen gençlerin bazen de savaş öncesi ve sonrası dönemi yaşayanların bakış açısından anlatıyor.

Günümüz Japon edebiyatının en popüler yazarı olan Haruki Murakami’nin eserleri gerçeklikle masal arasındaki ince bir çizgide geçiyor. Kitaplarında Murakami, bazı imgeler belirleyip ve parçaları sonradan birleştirerek bir olay örgüsü kuruyor. Kolay kelimeler seçip ustaca cümleler inşa ederek bir alegori oluşturuyor. Eserlerinde ana karakterler genelde bir şeyleri kaybetmiştir ve onu aramak zorundadır. Bu bir bellek, toplumsal bellek, kimlik, özgürlük, çocukluk anısı, eşya, kedi, tarihsel bir dönem vs. olabilir. *“Biz hepimiz, sürekli değerli bir şeyimizi kaybediyoruz” dedi zil sesi kesildikten sonra. “Önemli fırsatları, olasılıkları, bir daha yerini asla dolduramayacağımız duyguları. Hayatta olmanın bir anlamı da bu işte. Fakat kafamızın içinde olduğunu sanıyorum, öyle şeyleri bellek haline getirebilmemiz için küçük bir oda var. Herhalde, kütüphanenin depo kısmı gibi. Dahası, bizler kendi yüreğimizin ne urumda olduğunu doğru şekilde takip edebilmek için, sürekli arama kartları yapmak zorundayız. O odayı temizlememiz, havalandırmamız, çiçeklerine su vermemiz de gerekiyor. Başka bir deyişle, sen sonsuza kadar kendi kütüphanende yaşayacaksın”*. (Murakami, 2009, s.646)

### **Haruki Murakami’nin “Tuhaf Kütüphane” adlı eserinin Travma ve Yas ekseninde Değerlendirilmesi**

*“Tuhaf kütüphane”* kitabı konusu kısaca şöyle: Ana karakteri olan bir Japon çocuğunun yeni aldığı deri ayakkabılarını giyip evinin yakınındaki kütüphaneye gitmesi ve ödünç aldıkları kitapları iade etmesiyle başlar. Bu kitaplar şunlardır: “Denizaltı Nasıl Yapılır? , “Bir Çobanın Anıları”. Kitapları vaktinde iade etmiştir çocuk. “Her zamanda vaktinde getiririm, çünkü annem bana böyle öğretmişti” der. “Çobanlarında böyle vaktinde kurallara ve saatlere uyduğunu eğer uymazlarsa koyunların başına olmadık şeyler gelebileceğini” söyler çocuk ve ardından da daha önce görmediği bu görevli kadına bir konuda kitap aradığını söyler. Kadın da “merdivenlerden inip sağa dönmesini, başını kaldırmadan 107 no.’lu odaya gitmesini” söyler. Görevli kadının onu bodrum katına yönlendirmesiyle çocuk denilen yere gelir. Ancak çocuk bu kütüphaneye defalarca gelmesine rağmen bir bodrum katı olduğunu ilk kez görüyordu. Bodrum katındaki 107 nolu odaya girdiğinde çocuk odanın ortasında eski, küçük bir masanın yer aldığını görüyor. Masanın ardında ise ufak tefek, yaşlı bir adam oturuyordu. Yüzünde sanki sinekler konmuş gibi siyah noktalar vardı. Yaşlı adamın saçları dökülmüştü ve kalın bir gözlük takıyordu. Adam tam kel değildi; beyaz saçları başının iki yanına yapışmıştı. (Murakami; 2016, s.5-10)



İlk bakışta tuhaf gelen şey kütüphane değil küçük bir çocuğun hatta bir Japon çocuğunun merak sardığı konudur. Konu ise şöyle: “Osmanlı İmparatorluğu’nda vergi tahsil sistemi” üzerinedir. Yaşlı adama çocuk “Annem çocukluğumdan beri, bilmediğin bir şey olduğunda hemen kütüphaneye gidip araştırma yap diyerek eğitmişti beni” der. Sarsak sarsak sandalyesinden kalkan yaşlı adam kucağında üç kalın kitapla gelir. Bu kitaplar şunlardır: “Osmanlı İmparatorluğu’nda Vergi Tahsili Üzerine, Bir Osmanlı Vergi Tahsildarının Güncesi ve Osmanlı İmparatorluğu’nda Vergi Toplanmasına Karşı Ayaklanmaların Bastırılması.” Huzursuz edici bu odadan hemen çıkmak istiyordu ve üç kitabı da alıp odadan çıkmak için kapıya yönelen çocuk yaşlı adamın sesiyle durur. Yaşlı adam o üç kitabında kütüphane dışına çıkarılmasının yasak olduğunu söyler. Ardından yaşlı adam “okumak istiyorsan eğer içerideki odada okumak durumundasın” der. Kolundaki saatine bakan çocuk “saat beşi yirmi geçiyor kütüphanenin kapanma zamanı yaklaştı, hem akşam yemeğine gecikirsem annem benim için endişelenir” der. Garip bir konuşma tarzı olan yaşlı adam çocuğu azarlar nitelikte konuşarak “kapanış saatinin sorun olmadığını, ben tamam diyorsam, tamamdır. Yoksa bu iyi niyetli davranışım hoşuna gitmedi mi? Ben ne diye o ağır kitapları, üstelik üçünü birden kucaklayıp getirdim? Ha? Hareket etmiş olmak için mi?” diye söyler. Birilerine hayır demek konusunda beceriksiz olduğunu düşünen çocuk “daha fazla kalmam mümkün değil gerçekten, küçüklüğümde yolda yürürken iri, siyah bir köpek ısırılmıştı beni, o günden beridir ne zaman eve birazcık geç kalsam, annem tuhaf davranmaya başlar” diye yaşlı adama söyler. Yaşlı adamın suratında hafif bir rahatlama ifadesi belirir ve “Demek kalıp okuyacaksın, öyle mi?” der çocuğa. Çocuk “evet, ama sadece yarım saat” der. Yaşlı adam “Beni takip et” diyerek çocuğu koridora okuma odasına götürür. Ama koridordan okuma odasına gitmek için sanki bir labirentten geçmek zorundaydılar. Kafası karışan çocuk “Nasıl oluyor da bir şehir kütüphanesinin bodrum katında böylesine büyük bir labirent bulunabiliyordu? Çok tuhaf bir durum bu, şehir kütüphanelerinin bütçeleri hiçbir zaman yeterli olmazdı ki, küçük bir labirent yapmaya bile elvermezdi”. Bunları düşünen çocuk yaşlı adama bununla ilgili soru sormayı düşünse de yeniden bağırmasından korkup vazgeçiyor. Nihayet labirentin sonuna gelirler ve en uçta büyük demir bir kapı görülür. Üzerinde okuma odası yazılan bir tabela asılıdır. Ortaklık gece yarısı karanlığı gibi ve mezarlıklar ne kadar sessizse o kadar sessizdi. Yaşlı adam cebinden bir anahtar destesi çıkarır ve şakır, şukur sesler arasında bir tanesini seçer, büyük eski tarz bir anahtardır bu. Sonra kapıyı açar. Yaşlı adam “girsene” der çocuğa. “Buraya mı?, içerisi zifiri karanlık” diye karşı çıkar çocuk. Yaşlı adam çocuğa “sen önemli önemsiz hiç ayırım gözetmeden her şeyden şikayet eden bir karakterde biri misin?” der. “Hayır, öyle biri değilim”. der çocuk. Kes sesini diye çıkışır yaşlı adam, “ona buna mazeret bulup insanların iyi niyetlerini hiçe sayanlar, insanların yüz karasıdır” der. İçeri girer girmez bir merdiven çıkacak karşına ve aşağı inerken tökezleyip düşmemek için parmaklığı tutunacaksın der ve ardından kapıyı kapatır yaşlı adam ve ortalık zifiri karanlığa bürünür. Kapının neden kilitlendiğini soran çocuğa yaşlı adam “bu kapıyı hep kilitli tutarız, kurallar gereği” der. Koyun kılığında küçük bir adam görür çocuk. Koyun adam çocuğa hoş geldin der. Çocuk hoş bulduk, merhaba der. Koyun adam önde, çocuk arkasında onun da arkasında yaşlı adam koridorda yürürler. Çocuk buranın bir hücre olduğunu fark eder. “Burası, bir hücre değil mi? ,“Okuma odasına gidiyoruz denildiği için geldim buraya” der. Yaşlı adam çocuğa “tartışma, sus ve gir oraya, üç kitabı da oku, tek bir satır atlamadan yazılanların tümünü ezberle” der. “Bir ay sonra sınava sokacağım seni. Eğer yazan her şeyi tamamıyla ezberlemişsen seni serbest bırakacağım” der. (Murakami; 2016, s.11-21)

Hücreye giren çocuk kitapları okumaya başlar koyun adam günde üç öğün yemek getireceğini söyler. Yemekler lezzetli olmasına lezzetliydi ama yarısını bile yiyemeyen çocuk eğer eve dönmezsem annem endişelenmekten kendini alamayacak, sonra aklını yitirecek gibi olunca da evde beslediğim sığırcık kuşuna yem veremeyecek, kuşumda ölecek diye kaygılanır çocuk. “Annem ve sığırcık kuşum iyiler mi acaba? Aklıma takılıyor da” der çocuk. “Dünya bir şekilde dönmeye devam eder, herkes kendini düşünür ve yaşamaya devam eder, annen de öyledir sığırcık kuşunda” der yaşlı adam. (Murakami; 2016, s.22-44)



“*Tuhaf kütüphane*” adlı eserinde Murakami, yetişkin bir bireyin içindeki çocuğu bulup onun yalnızlığıyla yüzleşmesini ve sorununun temel kaynağına inmesine yardımcı olmaya çalışarak onun anne kaybını aşmasını, yas sürecinden çıkmasını ve tuhaf bulduğu ölüm gerçeğiyle yüzleşmesini sağlamaktadır. Ama bunu direk olarak anlatmaz Murakami. Alışlagelmiş metaforlarıyla ve simgesel anlatımıyla popüler bir Japon yazar olan Murakami kitaplarında genellikle okuyucuya geniş bir olay örgüsüyle beraber bir deneyim yaşantısı sunmaya çalışır. “*Tuhaf kütüphane*” aslında sonuyla anlam kazanan ve gerçeklikle bağdaşan bir eserdir. Her masalda olduğu gibi biraz derinlere indikçe masalın anlamı ifşa olduğu ve verdiği mesaj gün yüzüne çıkmaktadır. İmgesel ve alegorik tarzda yazılan bu eserde olayların psikolojik farkındalıklarına kapı aralayan bir yönü bulunmaktadır. Eserin kahramanları şunlardır: Yalnız bir çocuk, korkunç ve yaşlı bir adam, elleriyle konuşan gizemli ve çok güzel bir kız, koyun adam, sığırcık kuşu ve mücevherlerle süslü deri bir tasmalı siyah bir köpek.

Siyah köpek İngilizcede “Black Dog” olarak geçer ve depresyonun simgesidir. Murakami kitapta sürekli olarak siyah bir köpek tarafından ısırıldığından ve o zamandan beri siyah köpeklerden korktuğundan bahseder. Bilindiği üzere depresyonla uğraşmış bir kişi ne kadar kendini toparlarsa da korkuları vardır, çünkü bu hastalığın nüksetme olasılığı hastalığı geçirenlerde daha fazladır. (Leader, 2018, s.18-22) Köpeği öyle bir betimler ki Murakami okurken bile ürperir insan.

Çözümlemek gerekirse; ana karakter, annesinin ölümünün üstesinden gelmeye çalışmaktadır aslında, hatta beklide annesi küçük yaşta ölmüş bir yetişkindir. Küçükken beslediği sığırcık kuşu bu hikayede sessiz bir kıza dönüşerek onu labirent şeklinden dizayn edilen kütüphanedeki bodrum katında bulunan hücreden çıkmasına yardım eder. Belki de çocuk ölümle ilk kez çocukken beslediği sığırcık kuşunun ölümüyle yüzleşmiştir. Annesinin ölümü ezberlenilmesi gereken vergi tahsil kitaplarıdır. Ölümü öğrenmesi gerekmektedir. Aradığı kurtuluşu ancak eski anılarına bir ziyaretle birlikte çocukluk travmasını görselleştirip, kederinin labirentinden çıkışı Nazik Koyun Adam ile bulabilir. Bu noktada onun hücreden çıkarken ayakkabılarını geride bırakması hüznü bir ayrıntıdır. Büyüdükümüzde ayakkabılarımız bizlere uymaz. Çocukların sık sık ayakkabıları yenilenir. Tuhaf kütüphanenin ziyaretçisi de travmasından kaçarken ayakkabılarını geride bırakmış, artık büyümüştür.

Travma, tanım olarak katlanılamaz ve dayanılamaz(dır) bir haldir. (Van der Kolk, 2015, s.1) Travma sözcüğü yaralanma anlamına gelir. Bu anlamıyla, tıp alanında kemik ya da doku (örneğin kafatası ya da beyin travması) hasarlarını içeren fiziksel yaralanmaları tarif etmek için kullanılır. Ruhsal ve duygusal alanda ise; algılama, hissetme, düşünme, hafıza ya da hayal kurma gibi süreçler belli dönemlerde ya da uzun vadede, işlevleri belirgin derecede kısıtlanmışsa ve normal olarak işlev görmüyorsa, ruhsal bir yaralanmadan söz ediliyor demektir. Örneğin en küçük bir görüntünün kişiyi şok içinde yerinden zıplattığı ve kaygıdan terlettiği aşırı duyarlılık ve aşırı uyanıklık durumları ya da bir insanın belli fikir ve imgelere takılıp kaldığı ya da düşüncelerinin geçmiş bir olayın etrafında takıntılı bir şekilde dönüp durduğu durumlarıdır. Travma kavramı sadece biyolojik ya da ruhsal fenomenlerin incelenmesine indirgenemez; travma her zaman bir sosyal bağlam içerisinde gerçekleşir. Bir olaydan etkilenen çok sayıda insan olabilir ve doğrudan ruhsal olarak yara almasalar da yine çok sayıda insan travma sonrası etkilerden ciddi şekilde mustarip olabilir. Mesela, savaşta travma yaşamış bir askerin evine döndüğü gün, o ailede olabilecekleri düşünebiliriz. (Ruppert, 2014, s.94- 115) Travmaya maruz kalan çoğu kişi, bir yandan yaşadıkları şeyi zihinlerinden atmaya çalışır, hiçbir şey olmamış gibi normal hayatlarını sürdürmeye çalışırken öbür yandan da yaşadıkları travmatik deneyimi düşündüklerinde derin bir acı, keder, hüznün, yoğun üzüntü yaşarlar, kendilerini üzgün ve mutsuz hissederler. Bir yakınının ölümü travmatik bir krizdir. Travmatik bir kriz aniden ortaya çıkan acı verdiği herkes tarafından kabul edilen ruhsal varoluşu, sosyal kimliği, güvenliği ve hoşnutluğu tehdit eden bir durumdur.

Kayıp, sevilen birinin, bir şeyin, bir nesnenin yitirilmesidir. Toplum olarak yas tutmayı sadece ölüm ya da boşanma gibi büyük yitimlere bir yanıtmış gibi düşünme eğilimiz var. Oysaki yas tutma herhangi bir yitim ya da değişikliğe verdiğimiz bir psikolojik yanıt, iç dünyamız ile gerçeklik arasında uyum sağlayabilmek amacıyla yaptığımız bir uzlaşmadır. Yas genellikle sevilen bir kişi

ya da kaybedilen kişinin yerine konan soyut bir kavramın yitirilmesine verilen tepkidir; anayurt, özgürlük ya da bir ülke gibi. (Freud 2014, s. 18) Keder ise yas tutmaya eşlik eden bir duygu(dur) durumudur. Hayatımız boyunca karşımıza çıkan alelade yitimler karşısında keder duyma tekrarlayıcı biçimde başımıza gelen bir olaydır. Yitirilen şey aile yadigârı bir küpe olabileceği gibi, bir umut, bir ülke, bir dostluk, bir vatan, bir sevgili hatta bir eski kendilik olabilir.

Kayıplar farklı biçimlerde gerçekleşebilir: (Volkan & Zıntl 2010, s.20-50)

- Ebeveyn kaybı
- Sevilen yakının kaybı (arkadaş, dost, akraba, sevgili)
- İlişki kaybı (ayrılma, aldatılma, boşanma, terk etme/terk edilme)
- Sağlık kaybı (organ yitimi, ağır hastalıklarla mücadele etme,
- Evcil hayvan kaybı
- Ekonomik- Meslek kaybı (statü veya iş kaybı)
- Hayat rutinin değişmesi
- Taşınma, zorunlu göç, (yitirilen/terk edilen bir ülke)
- Yitirilen bir umut/ bir ülke
- Yitirilen eski bir kendilik
- Kimlik kaybı (Alzheimer, Parkinson, Demans Bunama gibi)

Yas; çeşitli kayıplar sonrasında tecrübe edilen biyopsikososyal, evrensel, normal ve doğal bir tepkidir. Bu ölüm/ler kadar, kayıp, boşanma, aldatılma, terk edilme, terk etme, hayat rutinin değişmesi, statü veya iş kaybı, organ yitimi, zorunlu göç, taşınma, ağır hastalıklarla baş etme, eski kendilik gibi sebeplerle de yaşanabilir. Yas, bir kayıp sonrası ortaya çıkan şiddetli ve uzun süreli bir acıdır. Varlığına alıştığımız-bağlandığımız bir şeyden kopmak acı verir. Bu kopma değer verdiğimiz bir eşyanın kaybı kadar somut ya da bir hayalin kaybı kadar soyut olabilir. Kaybımız için yas tutarız. Yas bu noktada bizi iyileştirmeye götüren doğal bir süreçtir diğer bir deyişle o şey olmadan yaşamaya tekrar alışmaya çalışmaktır.

İnsanoğlunun baş etmekte zorlandığı bir deneyim olan kayıp; hepimizin hayatında var. Yaşamımızda kaçınılmaz olarak yaşadığımız süreçlerden birisini teşkil eder. Ama yaslarımız parmak izleri kadar kişiseldir. Aynı aile içinde bile her bireyin yası, kederi kişiseldir. (Volkan & Zıntl 2010, s. 20) Diğer bir deyişle yas tepkileri kişiseldir ve bireysel farklılıklar göstermektedir. Aynı ailede bireyler aynı kayba farklı tepkiler gösterilebilir. Bireysel ve kendine özgü bir süreci kapsayan yas sürecini herkes “kendine göre yaşar” ve özgün tepkiler verir. Yaşamın en büyük acılarından olan yas; bireysel farklılıklar olmakla birlikte benzer şekilde yaşanmakta ve benzer tepkiler verilmektedir.

Yas içerisindeki bireylerin duygularının yaşamalarının sağlanması gerekmektedir. Bu süreç doğal olarak yaşandığında kişi kayıpla sağlıklı bir şekilde baş etmiş ve güçlenmiş olur. Normal yas süreci; Herhangi bir kayba verilen fizyolojik, duygusal, düşünsel ve sosyal reaksiyonların bütünü kapsar. Kaybedilen kişinin, şeyin, nesnenin yokluğundan sonraki yeni yaşama alışma evresidir. Yasın evreleri yaygın bir biçimde şöyle bilinir; Süreler ve şiddeti değişse de birçoğumuz bu evrelere paralel tepkiler veririz. Diğer bir deyişle bu aşamaların sırası, süresi ve yoğunluğu herkeste aynı değildir. Kişiler arası farklılıklar gösterebilir.

#### A) İnanmama-İnkâr Aşaması:

Yas süreci önce inanmama – Şok geçirme/Yadsıma/İnkâr dönemi ile başlar. Burada insanlar inanmama, gerçeği ret etme davranışı içerisine girebiliyorlar. İnkâr bazen işlevsel bazen de problematik olarak karşımıza çıkabilir. Kayıp haberine verilen ilk tepkileri içerir. Sonra şok ve uyuşma olur. İnkâr, inanmama, şok, hissizlik, uyuşukluk, donma gibi tepkileri içerir. “Hayır bu doğru değil”, “Olamaz”, “Öldüğüne inanmam” gibi söylemleri içerir.

#### B) Arzu etme aşaması:

Kaybedilen kişinin geri gelmesi arzu edilir ve beklenirde. Gelmeyeceğini bilirse de o arzu ve beklenti oluşuyor kişilerde. Tabi haliyle bu arzu gerçekleşmiyor. Gerçekleşmeyince de kızgınlık ve

öfke hissi oluşuyor. En yoğun olarak görülen duygu hisleri arasında olabiliyor kızgınlık ve öfke. Ardından yüzleşme ve öfke denetimi dönemi başlar. Artık kaybın farkına varılmaya başlanmıştır. “Neden Ben?”, “Neden?”, “Bunu hak edecek ne yaptım?”, Öfke; kendine, dış dünyaya ve ölen kişiye yönelebilir. Beklenen arzu edilen durum oluşmadığı için sonrasında çaresizlik hissediliyor.

#### C) Pazarlık dönemi aşaması:

Keşkeler ve suçluluk duyguları ile kaplı bir dönem, kabul etme ancak koşullar koyma vardır. “Şöyle yapsaydım ölmezdi”, “Yeterince zaman ayırsaydım..... olurdu”. Kaybı önleyemedikleri için ve kaybedilen kişiyi geri getirmek anlamında ellerinden hiçbir şey gelmediği için suçluluk ve çaresizlik hissedilmiş oluyor. Yoğun bir acı ve üzüntü eşlik ediyor bu aşamada.

#### D) Kabul ve Çökkünlük dönemi:

Kişi kaybı ile yüzleşmiş, bu kayıpla nasıl başa çıkacağını ve yaşamını nasıl devam ettireceğini araştırmaya, yıkıntıları onarmaya çalışmaya başlamıştır. Üzüntü bu sürece hâkim olan duygudur. Sonrasında ardından arzu etmek, özlemek, hasret çekmek, çaresizlik ve hayatı tekrar düzenleme kabul etmekle son bulur. Mevcut olan duruma bir uyum sağlama süreci içerisine girilmiş oluyor.

#### E) Yeniden Yapılanma:

Bu son dönemde, kişinin kaybı ile birlikte yaşamayı kabullenişini, yaşamını yeniden düzene sokmaya başlaması ve yaşamına devam etmesini içerir. Yaşamın devam etmesi şaşırtıcı olmakla beraber artık bir gerçeklik olmuştur. Mevcut olan duruma bir uyum sağlama süreci içerisine girilmiş oluyor. Burada kaybedilen kişiye karşı özlem duyulur. Ancak bir yandan da gündelik yaşama devam edilir. Acının hafiflemesi ve hayata devam edebilmek için kaybın gerçekleştiğini kabullenmek acıyı yaşamak ve yas tutmak kaybedilen kişinin içinde olmadığı bir dünyaya uyum sağlamak ve yaşamak yaşamın diğer alanlarında ilgilenmeye başlamak önem arz etmektedir.

Bu evreler düz bir çizgi halinde değildir, genellikle inişli çıkışlı, zikzaklı bir yol izler. Bazen evreler iç içe girerek kesin çizgilerle ayrılamayabilir. Kaybı kabullenmek ve hazmetmek demek, kaybı unutmak demek değildir.

Temelleri Pauline Boss’un 1970’li yıllardaki çalışmalarına dayanan Belirsiz Kayıp Teorisi (Boos, 1999) alışılmamış bir kayıp türünü açıklamaktadır. Ölüm yoluyla yaşanan kayıp ve yasın aksine, bu olağandışı deneyimde kayıp kişinin varlığı veya yokluğu belirsiz kalmaktadır. Belirsiz (muğlak) kayıp iki şekilde olmaktadır. Birincisi Fiziksel olarak yok- Psikolojik olarak var olma durumu söz konusudur. Hoşçakal demeden gitme, vedalaşmadan gitme. Kişinin aile fertleri ve yakınları tarafından fiziksel olarak yok ama psikolojik olarak var algılanması. Örneğin evlat edinilen kişilerin biyolojik ailelerini bulma eğilimi bu belirsiz kayıp durumunu kırmak için bir çaba olarak görülebilir. Kaybolmuş aileler, kaçırılmış çocuklar, doğal bir afet sonrası kaçırılma, kaybolma ya da rehin alınma, uçak kazasında ölmüş ya da ve cesedi bulunamamış kişiler buna örnek olarak gösterilebilir. Kişinin canlı ya da ölü olmasıyla ilgili net bir bilgi yoktur. Kişiye ya da bedenine ulaşmadıkça, yani ölüm netleşmedikçe geride kalan aile için psikolojik var oluşu sürmektedir. Yine bu tip belirsiz kayıp durumu içerisinde değerlendirilebilecek diğer bir yaşam deneyimi de göçtür. Hem göç eden kişiler hem de onların geride bıraktıkları için fiziksel olarak yok ama psikolojik olarak var olma durumu söz konusu olmaktadır.

İkincisi Gitmeden hoşçakal demek. Psikolojik olarak yok – fiziksel olarak var olma durumu için en belirgin örnek bir aile üyesinin Alzheimer, Parkinson, Demans (bunama) ya da ağır beyin hasarı olması, bağımlılıklar ve diğer kronik ruhsal hastalıkları olanlar gösterilebilir. Sevdiğimiz kişi ölmüş değildir ama bizimle ilişkide olmayışı sonucu psikolojik boyutta yoktur. Bunun gibi aşırı alkol, madde ya da teknoloji bağımlısı kişilerin, akıl sağlığı hastalarının, iş-kolik bireylerin aileleri içinde belirsiz kayıp deneyimi yaşadıkları söylenebilir. Benzer şekilde ebeveynleri tarafından ihmal edilmiş ya da eşleri evlik dışı ilişki yaşayan kişiler, birbirlerinden çok uzaklaşmış adeta yabancı gibi olmuş çiftler de belirsiz kayıp deneyimi yaşamaktadırlar.

Shakespeare “Üzüntünü dile getir. Duygularını açığa vur. Konuşulamayan yas, dile gelmeyen acı, kalbe yüklenir, kalbe düğümler atar, onu sertleştirir ve kırar onu”. (Shakespeare, 2016, s.88) der. Ölüm bir yaşamı sonlandırır; bir ilişkiyi değil...

**KAYNAKÇA**

- Boos, P. (1999) *Ambiguous Loss (Learning to Live with Unresolved Grief*. Printed in the United States of America, Harvard University Press.
- Freud, S. (2014) *Yas ve Melankoli*. (A. Emirsoy, çev.) İstanbul: Telos Yayınevi,
- Leader, D. (2018) *Depresyon, Yas ve Melankoli* (A. Göçmen, çev.) İstanbul: Encore Yayınları,
- Murakami, H. (2009) *Sahilde Kafka*, (H. Can Erkin, çev.) İstanbul: Doğan Yayıncılık
- Murakami, H. (2016) *Tuhaf Kütüphane*. (A. Volkan Erdemir, çev.) İstanbul: Doğan Yayıncılık.
- Payza, H. (2019) *Hiroşima'daki Küçük Çocuk, Nagasaki'deki Şişman Adam*. İstanbul: Japon Yayınları, 1. Basım.
- Ruppert, F. (2014) *Travma, Bağlanma ve Aile Konstelasyonları (Ruhun Yaralarını anlamak ve İyileştirmek)*. (F. Zengin, çev.) İstanbul: Kaknüs Psikoloji Yayıncıları, 2. Baskı.
- Shakespeare, W. (2006) *Macbeth*, (S. Eyüpoğlu) İstanbul: İş Bankası Yayınları,
- Van Der Kolk, B.A. (2015) *The Body Keeps The Score; Mind, Brain and Body in the Transformation of Trauma*. USA: Published in Penguin Books.
- Volkan, Vamık D & Zıntı E. (2010) *Gidenin Ardında (Life After Loss: The Lessons Of Grief*. (I. Vahap & M. Kocadere, çev.) İstanbul: oa yayınları, 2. Basım.

## THE FOUNDATIONS OF AESTHETICS IN THE TEXT IN THE VISION OF THE POET “MAEDUMI”

**Assistant Pro Hawzhen Slewa Issa , Ala Dara Abdul Majed**

*Koya University, Faculty of Education, Kurdish Department, Koya – Arbil , Iraq.*

*orcid.org/0000-0001-6777-0112*

### Abstract

Ideal aesthetics as a source for all other genres is a product of Plato's philosophical imprints, It has effects on the vision of philosophers and their vision of the world, art, humanity and literature .And after centuries and thousands of jurisprudence until the emergence of eco-feminism ,Which is the latest cultural, literary and global approach in our world now .So that its roots reached the combination of literature, race, religions and coexistence In order to create a new beautiful world centered around improving The conditions of the world and anarchic living through the principles of ideological and realism at the same time .

Aesthetics remains the only bright face that shines in all situations and at every creator , Each one is as creative and enthusiastic as possible and increases his own footprint in his work. There we see the beauty of aesthetics in the Kurdish poet “ Maedoumi” .Where it has the advantages and accuracy of static systems and a line between the spirit of western and eastern static at the same time So that we see in poetic examples a mixture between the greatest views of the philosophers on aesthetics Knowing that he was a poet in a high-rise area that is difficult to reach, but the aesthetics of the region and his own ideology ,He made his poems an ideal and realistic aesthetic treasure.

This research includes two parts: The first part gives a vision of aesthetics for philosophical and poetic text. And the opinions of the great philosophers, as well as in the East, and their amalgamation, The second part includes an explanation of the poetic text according to aesthetics In terms of the principles of aesthetic sciences and eco- feminism.

**Keywords:** Aesthetics, vision, eco- feminism , poet “ Maedumi”.

### INTRODUCTION

We are supposed to know the relationship of aesthetics to the special light and beauty that makes it within us, and that thing is whether it is embodied or visual. By transferring it to us, through influence and impact And we make it a means of making good and fairness so that it becomes clear in the poetic and philosophical points of view. Thus, the science of aesthetics may be rooted in virtue and nourished by it, and the laws of goodness have grown, and this is the principle of philosophy. From this point of view, we analyze the point of view of the Kurdish poet Mawlavi and her vision of spiritual aesthetics, that is, in his noble poems, where he urges spiritual energies and physical purification, and then the prominent spiritual from blemishes and sins. It refers to the reader, regardless of his intellectual and intellectual level, to take the path of virtue.

Being away from the most extreme and accurate ways that lead us to the machinations of evil that revolve around man, and living in a land that embraces us with our positive energy, like that which flows from its first creation to us and generations.

1-Spiritual aesthetics and from where and how the spiritual energy came to it?

- 1.1 Energy from a scientific point of view:
- 1.2 Spiritual energy from a religious point of view, including the heavenly religions:
- 1.3 Spiritual energy in terms of philosophical and literary theories

- 1.4 Ecofeminism Aesthetic spirituality
- 1.5 Energy Compound:

## 2/ Maedumi 's aesthetic :

- 2.1 Poetic examples:
  - 1.1 " *the forehead* "
  - 1.2 "Night journey spiritually and spiritually ascending " *Israa and meraaj* " the night journey and ascension to heavens ."
- 2.2 Maedumi 's aesthetic vision:
- 2.3 Applying the theory to Meadumi's poetry code :
- 2.4 The result of the Isra' and Mi'raj poetry we summarize in the following equation.
- 2.5 The validity of this spiritual journey.

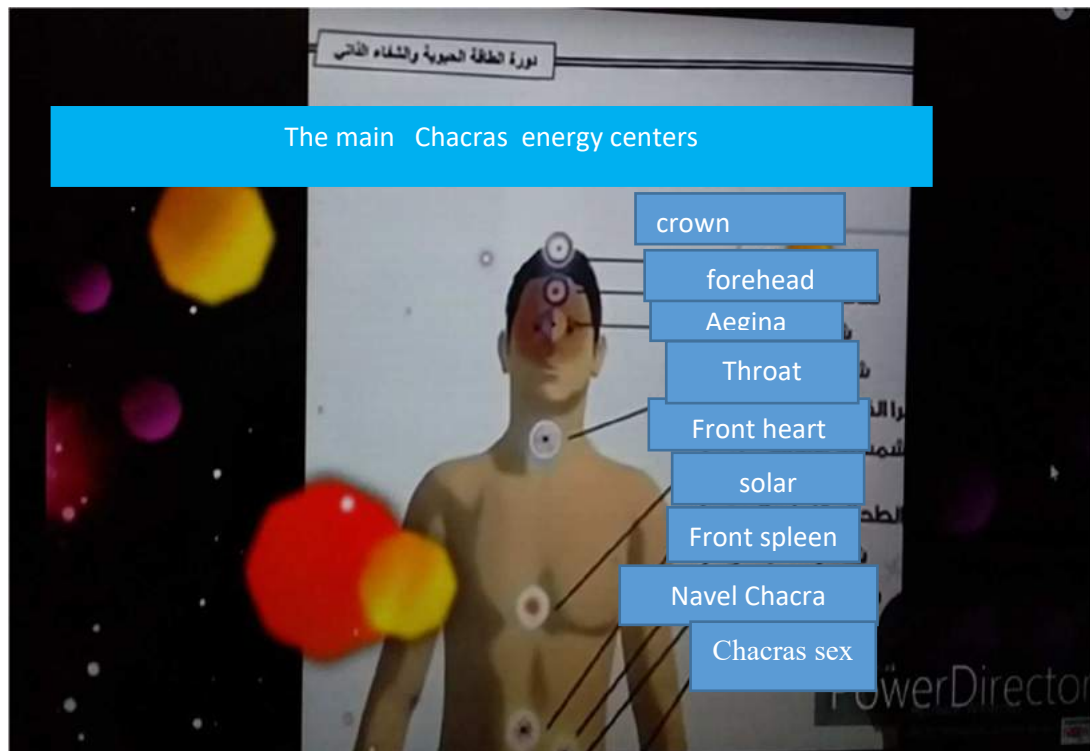
## 2/ Maedumi 's aesthetic :

- 2.1 Maedumi 's aesthetic vision:
- 2.2 Poetic examples:
- 2.3 Night journey spiritually and spiritually ascending ( Israa and meraaj ) the night journey and ascension to heavens .
- 2.4 Applying the theory to Mulavi's poetry code.
- 2.5 The validity of this spiritual journey.

- 1.1 Energy from a scientific point of view:

After technological development and globalization, there are issues that we cannot do without, because we are human beings and we have souls and feelings just as we are bodies. The soul has energy, transcendence, strength and health, as do our physical bodies. From a purely scientific point of view: (Spiritual energy is recognized as one of the types of spiritual force, and that energy is defined as a great ability to give the body the ability so that it can perform a large number of works, That is, it is very similar to the relationship of electricity generation and the appearance of light, Energy is one of those images that it gives to the body. Spiritual energy is also known as a type of energy that works to supply the body with more energy than it is in normal matters.)( hadeer said 2019. ) And we knew a lot about the existence of energy auras until scholars recognized them, including them : According to Dr. Mohamed Emara / human energy expert: The auras of energy if it is pure affects the heart ,It makes him reassuring, affects the mind, and makes a person wise, and so on. But the opposite so was the human energy auras , Full of sins and disobedience, this makes its owner : Idle, lazy, gloomy wishing to commit suicide. It also indicates the purity of a person in terms of the face and forehead point Where it makes a person wise and enlightened And his positive energy increases to a degree He does not feel any pain all his life And the stronger the energy the more this person wisdom . (Ahmad Emara 2019 ) Here, science warns us that the issue of the soul and its energy is not only compared to the body in terms of importance, but is affected by it, and the soul is stronger and has greater advantages in terms of being immortal and the body perishes.



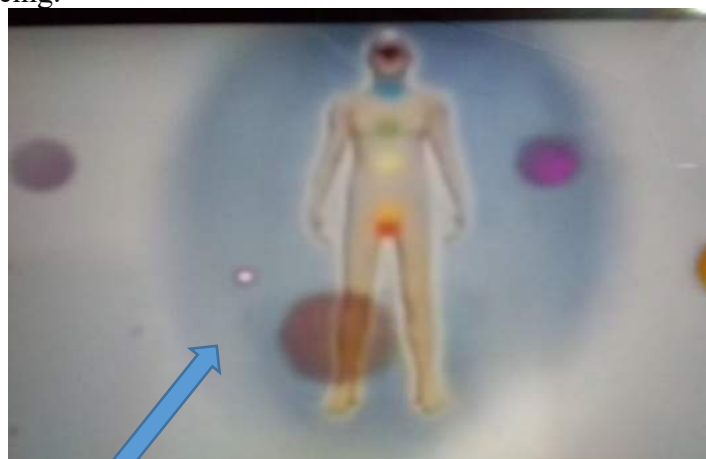


(Ahmad Emare , The concept of energy and its relationship to the Islamic religionhttps.)

- 1.2 Spiritual energy from a religious point of view, including the heavenly religions: After we have reached the importance of spiritual energy, here we turn to the heavenly religions .Because it is the source of human soul nergy. We see in the heavenly books where it urges purity Including Miriam the bachelor where she was Honorable and brings food and fruits to her as a miracle, as well as the birth of Christ without a father. Mary's purity and illumination came by the miracle of the birth of Christ. Because she prayed to God to give her a son without human touching her

In the Islamic religion, too, there are trends that:

2.1 A person has a book and he writes in it everything he does, good and bad, and he will get it on the Day of Resurrection. Either good is in his right hand, or evil is in his left hand. And he will be rewarded for all that was brought in it, if it is good for Paradise, and if it is evil, it will be in Hell. According to contemporary science, that book is the aura that revolves around every human being.



The energy aura that revolves around the human being

(Ahmad Emare , The concept of energy and its relationship to the Islamic religion .)

If there are positive charitable deeds, then his aura will be pure and luminous, and on the contrary, if he is evil, his aura will be black after he had dots that lead to the passage of time and the darkness became filled with it.

2.2 There are hadiths of the Prophet Muhammad," may God bless him and grant him peace": (He urges energy and the cleanliness of the human aura When a person raises his hand to the sky asking for God's help, he takes positive energy from the sky as well. When a person makes the pilgrimage to the House of God, the person is pure from sins as the day his mother gave birth to him, and also when he is anointed with the Black Stone in the House of God. This all indicates the energy that a person takes, and it is a positive, luminous energy, and there is light around him.)(Ahmad Emara 2019) and (You can also see the energy that surrounds the human body by photographing the energy level of each human body, and there you can notice its colors and its difference from one person to another.)( hadeer said 2019.) In fact, we can feel the spiritual energy through many examples, including: ( Ordinary people can feel this spiritual energy, but it is in certain moments, for example, a person who reads verses from the Holy Qur'an can feel that he is inside an aura, so he feels some goosebumps in his body, and that energy can be felt by people When they meet other people, that energy also comes in the form of a very large physical activity that a person can do.) ( hadeer said 2019. ) This is also what psychology indicated that there are positive rays that come out of some people and merge with all and vice versa.

- 1.3 Spiritual energy in terms of philosophical and literary theories :

When Plato believed that there is an ideal world, the real. It has the fullest true virtue. He held that all the aesthetic we see and everything on the face of the earth is but a copy of the real and idealistic world.

In this way, all things are fake, and the original in the sky is the example of a pen, a chair, and a cave. Therefore, we cannot see the real things, nor will we feel their full aesthetic and spiritual energy As long as the world is in the sky and complete .

Here we resort to that beauty and luminous energy in order to reach the true beauty, as he also claimed in another way. For example: he believed that the forest or garden on the ground is not beautiful because it is in it Things that are not beautiful or impure. There are innocents and there are monsters too.

But Aristotle believed that beauty in reality or on earth is an imitation of nature. That is, there are beautiful flowers in nature, and the poet imitates nature by creating a poetic image and drawing beautiful flowers in our minds.

While Socrates believed that beauty is linked to benefit, he does not benefit in anything or poetry unless it is useful, he does not believe in anything that does not bring us closer to virtue. (More widely diffused among medieval thinkers was the Neoplatonist theory, in which beauty is seen as a kind of divine order conforming to mathematical laws: the laws of number, which are also the laws of harmony. Music, poetry, and architecture all exhibit the same conformity to a cosmic order)( Thomas Munro 2020 )

But the German niche believed in beauty in the stray force only, so he expelled all the weak, including the handicapped, women as well from aesthetics, and this was not originally. And the Orientals, but the Islamists, saw beauty in morals, so there is no beauty in things or poetry unless it supports morals and does not accept instinctive excitement, as Plato saw this also from the poets. In their opinion, poetry is useless if it is provocative or violates the general legal lines, so as not to degrade humanity from the lofty principles. From most of them, we see

beauty directing us to goodness, and from there to charitable energy, purifying the spirit of humanity and purifying its aesthetics.

It is from this virtuous path that benevolent poets and theories of improving and beautifying the mind and spirit and highlighting its deep inner outer beauty. There are rare philosophical opinions where:

(Edmund Burke attempted to draw a distinction between two aesthetic concepts and, by studying the qualities that they denoted, to analyze the separate human attitudes that are directed toward them.

Burke's distinction between the sublime and the beautiful was extremely influential, )( Thomas Munro 2020 ) From an aesthetic point of view and aesthetic vision things ( Is not then, also, a beautiful woman useful in proportion as she is beautiful; and a boy and a youth useful in proportion to their beauty? Well then, a handsome boy and a handsome youth must be useful exactly in proportion as they are handsome. Now the use of beauty is, to be embraced. If then a man embraces a woman just as it is useful that he should, he does not do wrong; nor, again, will he be doing wrong in employing beauty for the purposes for which it is useful. )( Sartwell, Crispin 2017 ). Often we see the personality of the poets and analyze it that they were sick and attached to the things for which they sought poetry, as an example of the love of women.))And they are not lovers because they only seek darkness, despair and psychological poisoning. True love, which is not mentally ill, or psychologically ill, leads us to light and positive energy.

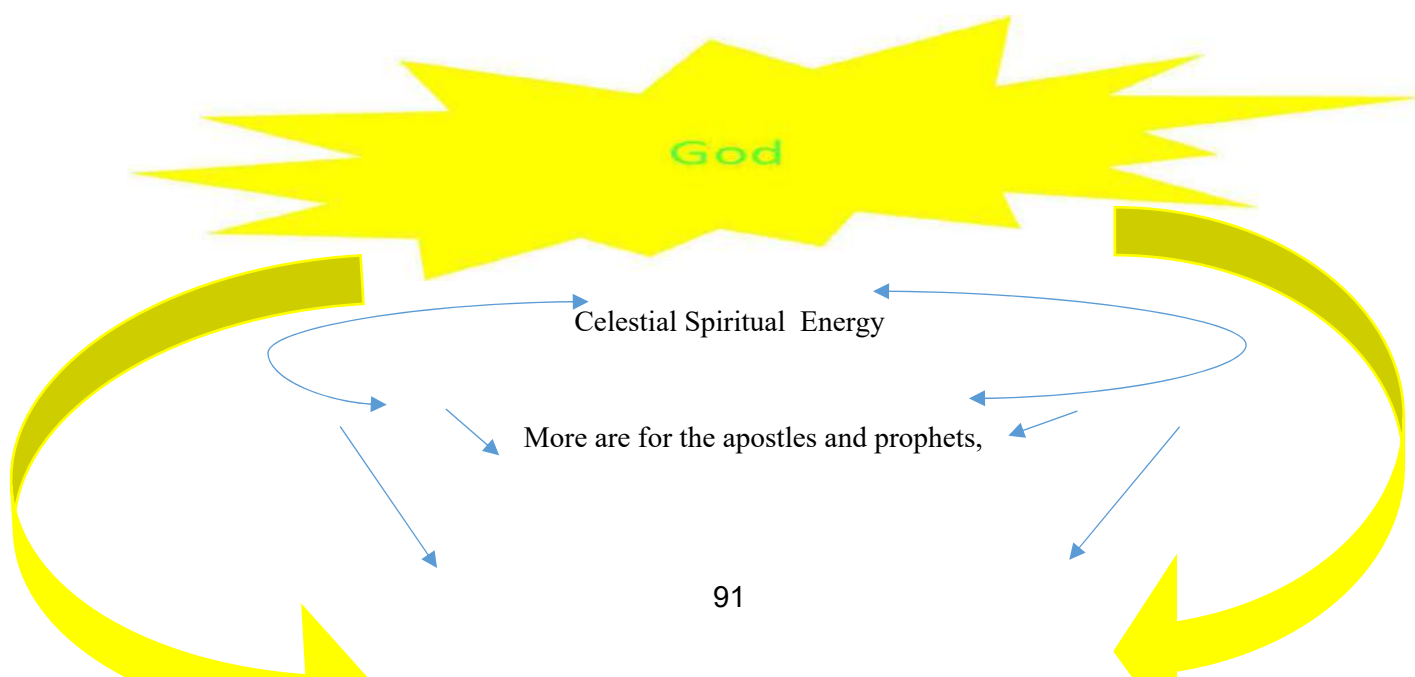
- 1.4 Ecofeminism Aesthetic spirituality :

Ecofeminism has another code except " Virtue and Aesthetics As we knew in the past." It is a symbol of spiritual energy." Through it, we communicate the external virtue to the inside of the human soul and vice versa From within the human soul to the outside. through the auras and luminous energies emanating from them. With this, it gives a basis for the aesthetics of human's spirituality and feeling until it reaches his literature, poetry and philosophy. This merges with as stated in Sarah Gamble's book on feminist views on the possibility of changing or elevating feminism. (In Faces of Feminism (1998) Sheila Tobias states that 'If feminism is going to survive the coming decades it has to be different.' The question is, what form, exactly, will this difference take?( Sarah Gamble 2001 ) Can't we cross ?if it is permissible

With this aesthetic and spiritual treatment, we turn to the fourth feminism as well Where the spiritual reform of humanity has been perpetuated after the reform of human identity and race and the establishment of a new world on our second mother land appeared .

- 1.5 Energy Compound:

aesthetic perception :



some are for philosophers and scholars

Some are for believers, some are for ordinary people

A small amount of it is in the wicked

## 2/ Maedumi 's aesthetic :

### 2.1 Poetic examples:

-We will take the text of the poetic examples, and then we will Then we apply it:

#### 1-1: " *the forehead* " :

My forehead is kneeling with the intention of reaching my knees.

Because old age has come its time to be respected.

My body loves to kneel because the door of the grave this world is small

If I'm not kneeling, I can't walk in it

O Maedumi: Do not let your bad deeds have a thousand colors

My knees are paralyzed. Put your hopes high in the kindness of God

That God I know will cover my sins ,He is able to make the day

of your resurrection a night in order to cover your sins

May the whiteness of your hair and beard be a shield for you

He does not pretend to be a draft of the face on the Day of Resurrection

Aging and arching your body I hope it's like a bow

To be your defender so that you will not be tormented as a result of seeing the forbidden

Your body gets old and grovels, and your last notices are not equal to me

Arrogance in your worship during your youth,

, because with God repentance from sins and supplication is better than Arrogance because of worship

I would love to be tortured in Hell for a hundred years until

the blackness of my face that was covered by sins ends

Better to meet you with a white Noorani face

Oh my God, what I did in my youth because of ignorance

Now I regret

My death is near

My God, now is the time for repentance, O noble God, forgive me.

#### 1-2: Poetic examples:

"Night journey spiritually ascending :

( Israa and meraaj ) the night journey and ascension to heavens .":

Skay saw

engraving his legs

above the ground

He cried salty tears over his wounded face

The source of his fountain is mysterious and heartbreak

chanting (I wish I was dust)

With all she had of elevation, pride and feeling

He was redeeming him with nothingness and

bend and narrow The Truth disturb

The Truth, have mercy on that emotion and disturb

He pulled the curtains on that place

He made the dust of his feet on the ground like eyeliner in his eyes  
 Those eyes that are filled with the agony of distance and insomnia  
 Eye pain disappeared and full of sleep  
 Because the wisdom of the spiritual ascension made him another person  
 Humiliate ,Doctrine and philosophy of prematurity  
 Believe in the story of the spiritual journey  
 Avoid here the philosophy of Heoli and the image  
 For the stability of the part, we do not need to be tired  
 It is permissible to break and heal  
 Because there is a symmetry of the bodies  
 (Who can so? can last to happen  
 God's power over the possible is omnipotent)  
 What happened and what I have of grace is enough, praise be to Him  
 Glory be to the one who captured his servant by night spiritually  
 Apparently spiritual captivity  
 The spiritual journey, vigil and person, steadfastly  
 Not with sleep or good in spirit only  
 Because this is an unchecked claim, and it is destructive  
 How is that, (if in the spirit or in a dream)  
 This denial is only permissible for ordinary people  
 Editing sweet destination and right  
 Only in the hadiths of the Prophet is successful  
 Duplicate the spiritual journey  
 Once in the soul, once in the person  
 The night is a retreat between lovers  
 A place for the wishes and demands of those who suffer  
 This is a chance Booty, home assured  
 The world is asleep and the lover is awake  
 Not like the sun's shadow  
 From here and there  
 Or that the shade is under the feet at the time of equator  
 Like a newborn, the night became the journey of the heavenly soul for sure  
 It has become a mercy to the worlds  
 For basement and vast astronomical  
 A few of the first, a few of the others  
 From the mosque in which killing oneself is forbidden  
 To the holy Al-Aqsa Mosque  
 Here is a definitive thing and the text of the book / the Qur'an  
 Denying that thing is blasphemy and permanent torment  
 From there to the sky and from there to God willing  
 the essence of the highest  
 This is confirmed by the hadiths of the Prophet  
 and famous and lonely deny it  
 Heresy and corruption  
 Do not stay in the path of heresy and evil  
 Come to see a biography of the leader, the Prophet  
 He wanted to ascend to heaven with his human power  
 He tried and couldn't, even use his spiritual powers  
 He rose with such force ,Close to a hot windy area  
 Angel Gabriel could not bear to ascend any further

The human energy and the kingdom energy of Gabriel became silent  
 There are echoes of cups, to the divinity  
 When he offers his feet to come near  
 There is a sound / low  
 (After that, he approached and dangling, and he was around the corner  
 or below( And what is meant is Gabriel and the Messenger  
 Between Possibility and Obligation (Between the Messenger and God)  
 God revealed to his servant who wanted him from his revelation  
 And perfume it with a spiritual scent  
 The ark was crowded with angels  
 And the Sidra area had become a mob  
 No error of sight nor overwhelmed  
 The infinite nature of the Prophet  
 It does not affect her consciousness  
 Sacred things come from the heart  
 (Then you move from it to the sight  
 But for all senses and powers  
 Rather, for the world of creation and righteousness)  
 By what interface the heart had gratitude for  
 with that face For sight, a face illuminated by a vision  
 Insight as science, insight as vision  
 Insight of vision, neither his eyes nor his nose will lie  
 The path of thousands of heavenly years, folding how many veils  
 The same God who is true, talk to God, a question to God, an answer from God.  
 He went, he heard, he cried, he came back  
 However when he returned, the door hand ring that he had exited for the heavenly journey  
 The episode remains the same, moving /  
 (Because the time of a day in my land is equivalent to fifty thousand years with God)  
 oh calligraphy ,Can you understand or get it?No, you will not get  
 You are like a wounded snake  
 revolves around itself You clever sons of the age!  
 The difference between them (between calligraphy, and the journey to the spiritual)  
 Like the difference from earth to sky  
 Blessed be the full moon, in this area on that night  
 A drop of dew from that cloud  
 That kind on that night  
 He entered and hit the plains of hearts  
 all the pure ones  
 Own the life farm of the hearts of all God's faithful  
 Interpretation , The earth lit up again A hundred pills, interpret again  
 Drain the curtain of psychological darkness  
 The seed of the flower of knowledge and gratitude appeared over the water  
 The smile of roses is a cosmic and divine revelation sprouted vegetables, dignities, the infinite  
 Each of them has its own style  
 show himself adorned with it  
 God's Guardians Garden .

- 2.2 Meadumi's aesthetic vision:

The poet "Mawlawi Tawakozi", who lived in the eighties of the 19th century It came with the inclusion of a poem, for example, a poem by the French Knowing that he did not travel with them or see them. He was creative in mixing energy science, that is, negative and positive



energy in our time, and seeing and improving human auras. At a time when a mixture of physics and psychology worked in our time..Moreover, Maedumi combines physics and parapsychology, and in addition to them, manifestations of non-feminism are summarized in two points:

1.1: While the science of energy has concluded that the negatives are the cause of pain and difficulties scientifically. So that we get away from negative energies from everything around us Maedumi emphasized in his poetry and prose A positive energy illuminates the heart so that it sees the light of the Divine .As happened with the Prophet Muhammad, peace be upon him Where he ascended with the light of God and the ability to ascend and psychological empowerment to heaven. On the other hand, he has the hair of an arrow " *the forehead* ". Where he sees that negative energy surrounded him, but he bandoned it with repentance and worship, and now he does not want to return to it. Therefore, he says, I make the vertebrae of my body a bow shape so that my eyes do not see negative things, so my body and soul are immersed in them. Negative energy in order to be pure and meet God, the source of positive energy with it. While he says, "I must be tormented until the guilt ends." With this, the darkness of his face and soul will end and be illuminated, and he will have an illuminated face worthy of seeing God and the light of God as well.

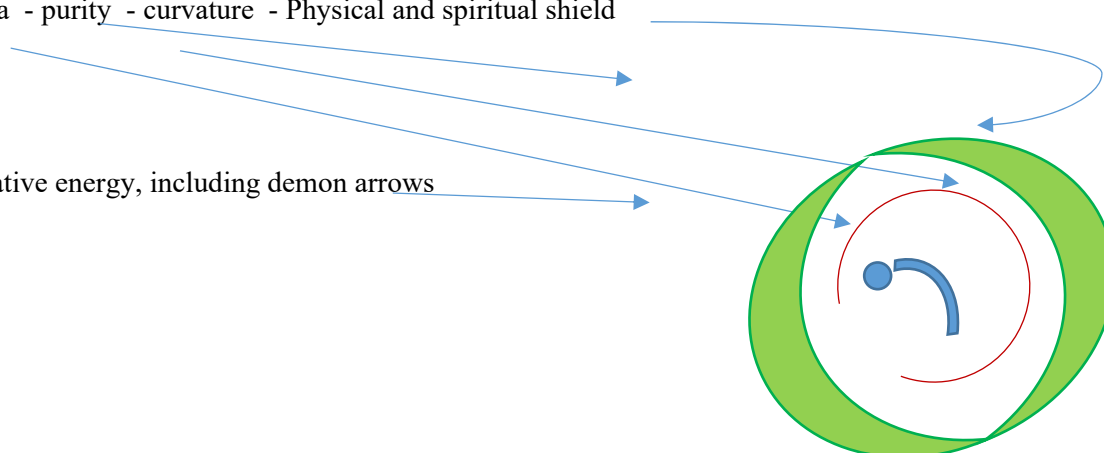
A. When he expresses this principle, he says explicitly that gray hair is the blessing that brings him to this, and he is with the orbit of guilt and pain, although he was aware and diligent there. It was taken from the Qur'an and the hadith of the Prophet Muhammad, where he said: Negative energy comes from the appearance of the eyes Forbidden.. and an arrow from the arrows of devils. Not only did he despair of gray hair and comply with it, but he took the image of the child when he was born for the first time and his shape becomes like an arc until he comes to our world as humans . And since it is the first poet in terms of formulating the aesthetics of poetry and taking it from nature and diligence so that it does not have any negative impact on life with this precise perspective, as it is calculated by the eyes' gaze! It is also according to an account of nature and its surroundings . We must not forget the bright side of Psycho in this issue so that every fear and every horror about death resolves if we have crossed those stages and were able to accurately reach our purity of negative energies, a talk that constitutes for us the ideology of peace and welcome to death if we are positive. This is on the one hand It also crystallizes from it that we say peace to humanity if we focus on the smallest virtuous details so that we think that the rays of our eyes and its negative energies do not harm any human being. This is the goal of the eco-feminist ideology, In addition to the third feminist that Sarah Gamble is referring to.

B. He focuses on the blackness of his face because of sins and hopes that he will be tortured in order to erase the blackness and be a white light so that he will meet his Lord and be the place of his meeting

There it becomes clear to us that Meadumi had the conviction of cleaning his aura and his illumination from sins, which is our subject.

- aura - purity - curvature - Physical and spiritual shield

Negative energy, including demon arrows



Energy aura diagram Poetry "*the forehead*"

1.2: So that he took from her a divine beauty comparable to any other beauty. In the poem "Isra and Miraj" Because when he said: The sky envies the earth and weeps because he saw an inscription on the foot of the Prophet Muhammad. By this, the beauty of the earth and the envy of the heavens became manifest to him: it becomes clear to us. The earth is low and weak, so it has become equal to all In the aspect of my knowledge that the earth contains the livelihoods and tombs of the prophets, so it is transcendent. But despite the holiness of the prophets, there is their humanitarian message and peaceful coexistence on the part of the worldly, where they strive for everything possible in order to populate the earth and keep all creatures away from humans, including animals, nature, races and beliefs. And raising the issue of the energy of nature and the universe when he ascended the Prophet was at that time as the sky had energy on it.

Where the presence and gathering of the angels, the prophets, the throne, and the prostration, the earth also had a supernatural positive energy in terms of goodness, agitation of water and bounties, beautifying themselves and filling them with positive energies that the Prophet brought from the highest heaven when he reached the throne. Other Thus, this knowledge discourse added a spiritual character as well, filled with positive capabilities and energies, solutions and responses to the questions of thinkers before them, including those who aim for the good of people. Because whoever feels the beauty of the text, where the best human speech on earth began, and from it utters the weeping of heaven, Here he begins with the earth, and this is what the non-partisans resort to.

Where the earth begins from the sky, and from it ascends to the highest heaven and the throne, and also returns to the earth after seeing, carrying, and being filled with the most positive and moral energy that humanity has known since the creation of Adam. After that, the soul was raised to heaven, and the body preserved in it remained until the afterlife. This ascension, return, and transcendence from the earth to the sky, and on the contrary, shows beauty to death, because it shows us the beauty of the spiritual journey if it is pure and abandons negative energies.

Remaining works to purify the soul and erase sins and sins From here it becomes clear to us the creativity of Maedumi when he said (The Prophet made his spiritual journey to the heavens With his energy, his strong positive spirit, not his body energy).

- 2.3 Applying the theory to Meadumi's poetry code :

Aesthetics, Virtue and Spiritual/Spiritual Energy:

Maedumi the poet when he explains the energy of ascension to heaven The Prophet, may God bless him and grant him peace, could not climb with any physical force I have tried a lot. But with spiritual strength he managed to ascend. And complete the spiritual journey.

Here we are mixed with myself + physic-

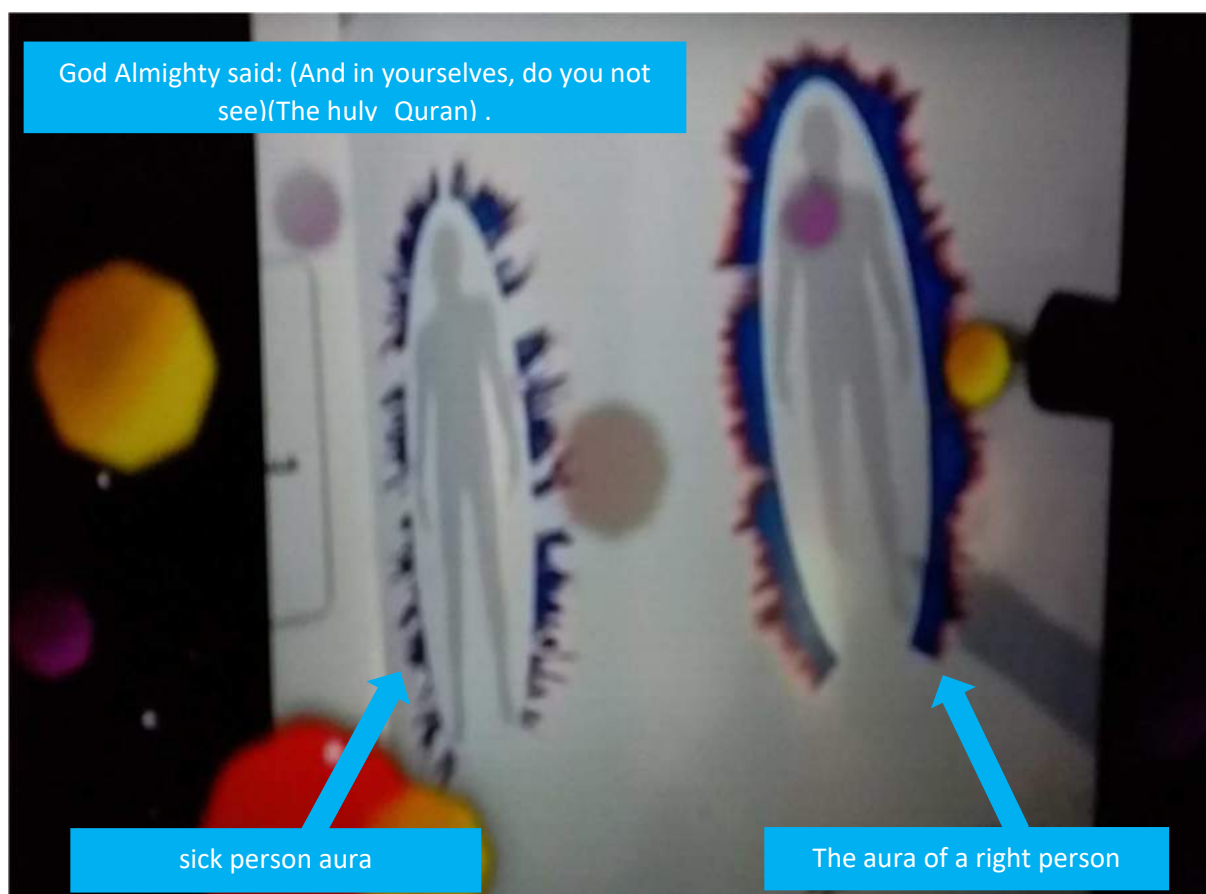
3.1 In terms of psychology, because he was strong in spirit.

3.2 From a physical point of view

The aura surrounding his body was pure and luminous. by this At the time of ascension even under the throne of God The luminous energy had an effect on

2.1 He was able to dissolve himself and come closer to the throne than Gabriel. At the time of ascension even under the throne of God The luminous energy had an effect on.

2.2 He was able to dissolve himself and come closer to the throne than Gabriel.



(Ahmad Emare , The concept of energy and its relationship to the Islamic religion<https://>.)

sick person aura

### 3.3 The ability to bear the vastness of the sky, the decrees and the praises of the angels and the mobs.

As a result, we reached the power of the luminous energy that opened the doors of the seven heavens for him. Because this aura that surrounds both humans while they are pure ,It will be with physical health and luminous energy health. But if a person is blameworthy and has many sins, then the aura that surrounds him will be affected by sins and disobedience. it will be Scratched and weak. (As we see in the equation:

Enhanced luminous energy + Pure and luminous aura = wise man pure soul

Malicious delusion energy + Weak and scratched aura = The indifferent person wicked self

Note: We must differentiate between the soul and the self,

The soul is pure and continues inevitably But the self is either reassuring or malicious

If the soul is reassured, then to God And if the soul is malicious, it will go to Hellfire

Prophet Muhammad did not have sins Because his heart did not remain in it the share of the devil , What we have in our hearts .Where the angels Gabriel took it out, the black part and slit his chest . when he was a kid. That's why he didn't have human negative energy ,Thus, he possessed a luminous, spiritual energy As stated in the authentic hadith of the Prophet and the scientific miracle of this incident.

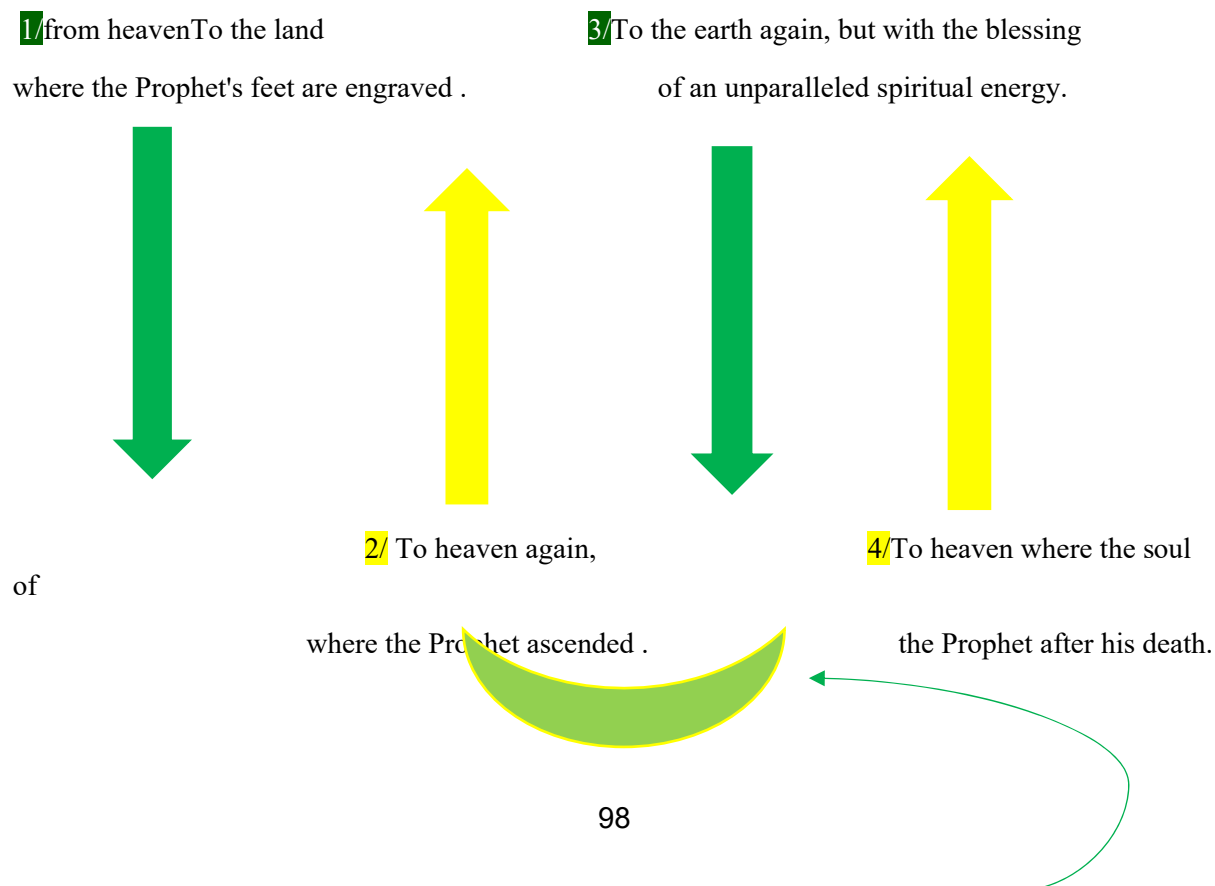
3.4 Maedumi explains to us the conditions and energies of the hearts of the believers ,At the time of returning their prophet from the spiritual journey As their soul has become like a blessed agricultural land ,It has become like a divine garden , Maedumi had a luminous aura and tremendous power In the same area Shakira Agna, which is the point of presence of the light of divine wisdom . Like David in wisdom ,Or whoever had this energy would be like David in his wisdom ,Or the hadiths of the Prophet that we talked about .As shown in the poetry of " The forehead ":

And the strange thing is Maedumi lived two hundred years ago ,In the high-rise mountainous region of Taokoz, Kurdistan , he only had the heavenly book and faith in this science .He was neither a doctor, nor a psychologist, nor a physicist ,Knowing that there were small schools called the room. But the students were learning the purest and hardest sciences , Including philosophical, Quranic and astronomical sciences, etc .So it was like a sophisticated scientific university!

3.5 There is another curve for the human being, The first of which is when he is born, God, with his wisdom, makes a bow so that he can emerge from his mother's womb.As stated in the noble hadith of the Prophet Muhammad" may God's prayers and peace be upon him": (Every child is born on instinct: Rather, his parents lead him to a Magus, or lead him to a Jew, a Christian, or a Muslim.And if we make the earth a second mother and serve him and feel that we live in peace in his arms and we love him and those who are upon him as we love our first mother, Thus, we have coexisted in the bosom of virtue, supported the change of the world for the better, and were immune from the evils of tyranny. The poet makes all of them a ring of the four code and make them and He discovers a lifeline for the exhausting human psyche. Which : Closeness to virtue, as Plato referred to So here we see Molloy as an ecofeminism of spirituality ,He shows us the path of salvation from distress, from the individual to the whole of humanity, a Jew, a Christian, or a Muslim. Thus, the poet becomes virtuous and wise ,So that he was able to collect in an aesthetic way ,Between (aesthetics of the soul, physics, spiritual energy and religion).

2.4The result of the Isra' and Mi'raj poetry we summarize in the following equation:

sky cryingstart:



5/ (The rest of mercy and spiritual energy between earth and sky)

5-1/ "Where there is the Qur'an, the House of God,  
and the shrine of the Prophet.

5-2/ "Where the  
pure soul of the Prophet is in heaven".

#### • 2.5 The validity of this spiritual journey :

1/ He cleans his aura to the extent that he is healthy and pure, close to the level of Paradise.

2 / The Quranic scientific miracles appear in Maedumi's jurisprudence ,Because the sources of his knowledge are the unseen divine books, including the Qur'an, for example :

A: In his talk about thousands of celestial years, so that a day is equal to a thousand years with God.

B: The presence of halos of the luminous bullet and the beautiful flowering gardens in the hearts of the believers on the night of the spiritual journey. (This is what has been proven by energy science now in our time).

C: Also in the telegraphic technology that was present at the time, where he urged the non-equality of radio with auras and spiritual communications / where he cannot transmit the purity of the soul's luminousness ,(Unless it is through poetry and literature in general).

The result :

1/ A person can live in Heaven/He is on earth with his soul,

By possessing sharp positive energy and a pure, clean aura to it.

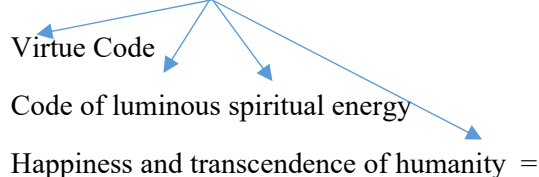
2 / Through the purity of the soul of the individual .

It forms a prosperous human ground with a bright, cheerful spirit, This is one of the third pillars of Feminism, which was urging to change the whole world. We summarize this idea in the following equation: Start with the eye of the sky ,Earth The aura is luminous, powerful and spiritual high heavens

A stronger luminous spiritual aura , The earth is stronger in terms of bliss and the positives of the hearts of believers Paradise at the top ,Spirituality and the Holy Quran. Thus, we arrive at the fact that ecofeminism not only has two codes . But by the equation:

Code of aesthetics + code of virtue = code of spiritual energy, which is the luminous aura  
Because if the person, the woman, or the earth and the sky They were virtuous and centered on aesthetics By this, they will have a luminous spiritual energy and the person with it would be a healthy and venerable person in the physical, psychological and pitrual terms, and thus goodness and happiness will return to all humanity and the earth. As in the equation:

aesthetics code



This is by blending literature, language, religion and many ideologies Which is the basis of ecofeminism.

## DISCUSSION

- Although Molloy did not study anything from today's sciences called energy, He was an ascetic knowing the source of teaching him the Qur'an, And religious and scientific books, as we mentioned before His spiritual side was strong. The reality of the universe was constant. In his life he went through the most severe trials, hardships and deprivations, Which exceeds the endurance of the human mind and psyche. With that, he was patient and enduring, and lived a happy and healthy life. This shows that his energy and spiritual ability were not as usual, Rather, he had a luminous, believing soul. This is what illuminated his soul, his mind and his work.

## CONCLUSION

- / Spiritual ecofeminism is a source for the treatment of the world and humanity. From Plato until today, all attempts stem from it to strengthen the energy of human thought and reason, that is, in the words of our day. Cleansing the spiritual aura of all human beings with this will be strong, healthy, away from indifference, get the virtue, And this is through "give and take" in order to avoid it and keep away from the negatives.

The most accurate, smallest thing possible, such as the look of the eye, and the removal of evil and negative energy from humans. Thus, if humanity follows and applies that theory, It enlightens us on the path of light to reform, psychological and conscientiousness, He makes the earth a paradise with a good talisman, Present, bewitching, and perfect aesthetics, So the human being with a kind of awareness will stay away from all evil and negativity. And the human being is afraid of hurting and scratching the psyche of human dignity. Thus, he will live in the hugs of his second mother, which is the earth. Thus, war and destruction are two things that have no place left, A land that extends with positivity and clean spiritual energies. All countries and the world will be a realistic paradise in which we live. In this way, the aura of the earth will shine like a pearl of spiritual light in the sky.

## ACKNOWLEDGEMENTS

Many thanks to all:

1. members of this Conference for this advanced scientific opportunity.
2. in particular/Dear coordinator: **Zhuldyz SAKHI** for her efforts with us.

## REFERENCES

1. A Holy Quran.
2. Ahmad Emara 2019. Vital energy and self-healing. p 13, 29, 30.
3. Ahmad Emare, The concept of energy and its relationship to the Islamic religion <https://www.youtube.com/watch?v=jXQSHFrJaQ8&t=5s>.
4. (Thomas Munro 2020) Aesthetics philosophy <https://www.britannica.com/topic/aesthetics> Munro, Thomas and Scruton, Roger. "Aesthetics". *Encyclopedia Britannica*, 6 Nov. 2020, <https://www.britannica.com/topic/aesthetics>. Accessed 5 August 2021.
5. hadeer said 2019. What is spiritual energy and its ruling in Islam? <https://www.almrsal.com/post/788144>.
6. Munro, Thomas and Scruton, Roger. "Aesthetics". *Encyclopedia Britannica*, 6 Nov. 2020, <https://www.britannica.com/topic/aesthetics>. Accessed 5 August 2021.
7. Meadumi 1988. Al Eqida Al Mardhya, research and investigation: Mala Abdul Kareem Al mudars. p348-358.
8. Meadumi. Collect and evaluate: Mala Abdul Kareem Al mudars, poetry book Kurdistan Publishing, Sna, 1391. P:134.
9. Sartwell, Crispin. 2017, "Beaty", The Stanford Encyclopedia of Philosophy, Edward N. Zalta (ed.) URL=><https://plato.stanford.edu/archives/win2017/entries/beaty/>.



10.Sarah Gamble 2001, The Routledge Companion to Feminism and Postfeminism  
London, Book :DOI<https://doi.org/10.4324/9780203011010> . p:44.

## ARKAİK İNSANDA KAOTİK DÜNYA ALGISI: SÜMER VE TÜRK MİTOLOJİLERİNDE İFRİTLER

### THE PERCEPTION OF THE CHAOTIC WORLD IN ARCHAIC MAN: DEMONS IN SUMERIAN AND TURKISH MYTHOLOGIES

**Dr. Öğr. Üyesi Begüm KURT\***

<sup>1</sup>Cag University, Faculty of Arts and Sciences, Department of Turkish Language and  
Literature, Mersin, Turkey.  
ORCID 0000-0002-4509-5125

#### Özet

Farklı düşünce evrenlerindeki mitolojik algıyı; ifade, kahraman ve motifleri, mütakabil biçimde ulusal ve evrensel düzenleriyle değerlendiren mitolojik incelemeler toplumların özgün yanlarını, birbirleriyle olan etkileşimlerini açığa çıkarmak bakımından önemlidir. Başka süreçler yaşamış, değişik yaşantılara sahip toplumlarda görülen benzerlikler insanoğlunun müşterek kıymetlendirme ve anlam verme serüvenini yansıtmaktadır. Bu anlam verme sürecinde insanoğlu doğayı ve her bir parçasını kutsal-kutsal olmayan, iyi ve kötü, sakıncalı-yararlı olarak ayırmıştır. Hükmedemediği, çözemediği esrarengiz olayların, doğaüstü durumların sebeplerini de bu düşünceyle ayıştırmıştır. Bu eksenle mitolojik düşüncenin bir parçasını demonolojik varlıklar teşkil etmektedir. Türk ve Sümer mitolojileri söz konusu varlıklar bakımından dikkat çekici sahalardır. Belirli özelliklerle öne çıkan bu olağanüstü yaratıklar Türk ve Sümer toplumunun anlamlandırma sistemlerinde zihinsel sembolik birer görüntü olarak otantik yönleri sahiptir. Bu bağlamda çalışmada karşılaştırmalı mitoloji yöntemi ile Türk ve Sümer mitolojilerinde demonolojik varlıklar incelenmiş, bu farklı mitolojik sahalardan tespit edilen ifritlerin ortaya çıkış biçimleri, varlık alanları, çeşitleri, özellikleri, etkileri ve bunlarla mücadele etme yöntemleri değerlendirilmiştir. Böylece insanoğlunun korku ve kaygı duygularıyla yarattıkları bu varlıklarla ilgili veriler ve kontrol altına alma istekleriyle biçimlendirdikleri bilgi sistemleri açığa çıkarılmaya çalışılmıştır.

**Anahtar Kelimeler:** Karşılaştırmalı mitoloji, Türk mitolojisi, Sümer mitolojisi, ifrit, şeytan.

#### Abstract

Mythological studies, which evaluate mythological perception, expression, hero and motives in different universes of thought, with their national and universal order in a mutable manner, are important in terms of revealing the original aspects of societies and their interactions with each other. The similarities seen in societies that have experienced other processes and have different lives reflect the adventure of human beings to value and give meaning. In this process of making sense, humanity has distinguished nature and every part of it as sacred-unholy, good and evil, objectionable-useful. He also parsed the causes of mysterious events, supernatural situations that he could not rule or solve with this idea. Therefore, demonological beings constitute part of mythological thought. Turkish and Sumerian mythologies are remarkable sites in terms of these beings. These extraordinary creatures, which stand out with certain characteristics, have authentic aspects as mental symbolic images in the meaning systems of Turkish and Sumerian society. In this context, demonological beings in Turkish and Sumerian mythologies were examined by comparative

mythology method, and the emergence forms, areas of being, types, characteristics, effects and methods of combating them were evaluated by ifrits identified from these different mythological sites. In this way, data about these beings created by human feelings of fear and anxiety, and information systems formed by their desire to control, were tried to be revealed.

**Keywords:** Comparative mythology, Turkish Mythology, Sumerian mythology, devil, demon.

## GİRİŞ

İnanma ihtiyacının yarattığı, dini ritüellerin sergilediği; insan zihnindeki boşlukları doldurmaya yönelik bilgi örgüsü ve etkinlikler dizisi olan mitler, arkaik toplumlar için bir ifade aracı olmuştur. Bu ifade aracı toplumların öz karakterine bağlı gelişim göstermiştir. Yaratılmalarındaki etkenler evrenselken, biçimlendirilmelerini sağlayan etkenler millidir. Dolayısıyla mitolojik bilginin gelişiminde esas olan milli kültürdür. Denilebilir ki “mitoloji toplumun bellek tarihi (Aliyev, 2020: 21), bir milletin kültürünün başlangıç noktasıdır. Ulusal kültürün en geniş anlamda kökleridir. Bu kökleri tanımadan günümüzdeki kültür olaylarını açıklamamız mümkün olamaz“ (Arda, 2013: 9).

Mitoloji, insanlığın ruh âleminin simgelerle ifade edilmiş bir aynası hatta yansımasıdır diyebiliriz. Bu yüzden mitoloji çalışmaları, insanların deneyimlerinin, bilgilerinin, hatta korkularının, arzularının doğa ve doğaüstü olaylarla harmanlanmasını, insani duyguların tanrısal varlıklara yansıtılması ya da tanrısallığın insanileştirilmesini de gündeme getirir. Çünkü söylenceler, yalnız eğlenmek ya da zihni meşgul etmek amacıyla aktarılan sıradan birer anlatı değildir. Tam tersine onlarda insanlığın bilebildiğimiz geçmişi içinde başlangıç noktası ya da ona yakın çok eski zamanlarda zihninin ve kültürün kuruluş biçimleri hakkında izler bulabiliriz (Ercan, 2013: 91).

Mitoloji sorulara açıklama getiren, olay ve yaşantıları sebebe bağlayan çalışma mekanizmasıyla, insanlığın ortak bilinçaltına dair bilgiler depolayan bir alandır. Bu alan içinde, değişik yapılarıdaki toplumlar tarafından yaratılmış mitolojik açıklamalar, toplumlar arası etkileşimleri ya da benzer düşünme biçimlerini karşılıklı olarak değerlendirme imkânı sunmaktadır. Bu yolla insanlığın düşünce üretme biçimlerinde görülen benzerlik ya da farklılıklar, insanoğlunun ortak ya da bambaşka tepkileri, mitlerle ortaya koyularak yaşamı anlamlandırma çabaları açığa çıkarılabilir. Bu açıdan karşılaştırmalı mitoloji yöntemiyle gerçekleştirilen çalışmalar insanlığın kültürel serüveninin, inanç ve değerlerinin anlaşılmasında önem taşımaktadır.

Türk mitolojisi ile diğer milletlerin mitolojileri arasında dikkat çekici benzerlikler söz konusudur. Bunu evren tasarımı, ilk insanın yaratılışında, olağanüstü kötücül varlıkların özellikleri ve işlevlerinde ya da kıyamet anlayışında görmek mümkündür. Benzerliklerin görüldüğü sahalardan biri Sümer mitolojisidir. Sümerler ve Türkler arasında kültürel ve dilsel açıdan görülen birtakım benzerlikler, aralarında köken ve kaynak bakımından ortaklık olduğuna dair bazı iddiaların ortaya atılmasına neden olmuştur. Sümerler ve Türkler arasında var olduğu düşünülen ve kesinlik kazanmamış olan bu bağlar bir yana, söz konusu alan mitoloji olduğunda dünyanın farklı toplumlarında olduğu gibi benzer düşünceler ve varlıkların olması olağandır.

## MATERYAL ve METOT

Dünyanın en eski uygarlığı olarak kabul edilen Sümerler ve dünya medeniyet tarihinde önemli yeri olan kadim topluluklardan Türkler, mitolojileri bakımından oldukça zengin bir yapı sergilemektedir. “Sümerler, Mezopotamya bölgesinde tarih sahnesine çıkan büyük medeniyetlerden birisidir. M.Ö. 3500’lerden itibaren Güney Mezopotamya’ya gelmeye başlamışlar ve bu bölgede Eridu, Ur, Uruk, Lagaş, Umma, Şuruppak ve Kiş gibi birçok şehir

devletleri kurmuşlardır. Ayrıca kendi dönemi içerisinde yaşayan birçok toplum ve devlete etkiye bulunmuşlardır. Sosyal ve siyasi hayata getirmiş oldukları önemli yeniliklerle kendilerinden sonra gelen devlet ve medeniyetlerin gelişimine öncülük etmişlerdir. Ürettikleri mitler vasıtasıyla hayatı anlamlandırmaya çalışmışlar, dini anlayışlarını bu şekilde temellendirmişlerdir” (Altuncu, 2014a: 142).

Sümer mitolojisi ile ilgili bilgileri “İÖ. Üçüncü bin yılın sonuna doğru Sümerleri ele geçirmiş ve Sümer öykülerini ve efsanelerini kendi mitlerinin gelişimi için kaynak ve çekirdek olarak kullanmış Babillerin geniş oranda değiştirdiği, düzelttiği ve bir anlamda tahrip ettiği değişikliklerinden elde ediyoruz” (Kramer, 2001: 64). “Türk mitolojisi ise Türk sanatında olduğu gibi Orta ve İç Asya’da paleolitik devirden beri gelişip bozkır kültüründe yeniden biçimlenen ve proto Türklerce farklı bir bütün haline getirilerek yeniden ortaya çıkan bir oluşum sürecine sahiptir. Bu nedenle Türklerden önceki devrelerin mitolojik karakterli arkeoloji ve sanat tarihi malzemesi, Türk mitolojisi için de önem taşır” (Çoruhlu, 2002: 12).

Bazı araştırmacılara göre; “Sümer toplumunun Türk etnik yapısı içerisinde yer almasıyla ilgili olarak birçok kanıt bulunmasına rağmen Sümerlerin Mezopotamya coğrafyasına nasıl geldikleri konusunda çok az bilgi bulunmaktadır. Sümerlilerin, Türklerin anavatanı olan Orta Asya’dan hangi yolu izleyerek Mezopotamya’ya geldikleri ile ilgili görüşler arasında Hazar Denizi’nin güneyinden batıya doğru ilerleyerek Mezopotamya’ya ulaştığı görüşü son zamanlarda ağırlık kazanmış olmasına rağmen Sümer toplumunun metinlerinde denizden geldiğine yönelik yaptığı imalar bulunmaktadır. Konu tam olarak açıklanamasa da dil ve yaşam tarzından evren anlayışına kadar büyük benzerliklerin olduğu açıktır (Yıldırım, 2017: 55). Sümer ve Türk mitolojilerindeki evren anlayışında görülen yoğun benzerlikleri aynı soya bağlılığa dayandıran araştırmacılar buna delil olarak; “Türk ve Sümer dilinde doğrudan ilintisi bulunan 400’e yakın kelime ile her iki dilde gramer yapıları arasında büyük benzerliklerin bulunmasını (Tuna 1990: 5–34, Landsberger, 1943: 93–95, Çığ 1994: 235–236; Akt. Yıldırım, 2017: 54) göstermektedir.

Sümer ve Türklerin ortak kaynağa bağlı dillerin oluşturduğu bir topluluğa mensup oldukları düşüncesinin beraberinde, inanca bağlı pratiklerinde görülen benzerlikler her iki toplumun soy kökenine dair bağlar olduğu kanaatini geliştirmiştir: “Dağların kutsallığına inanan Türkler gibi Sümer toplumunun da düz Mezopotamya ovalarında dağlar gibi yükselen zıuratlar inşa etmesi, yaşam coğrafyalarının farkına rağmen evreni algılayışlarındaki benzerliği ortaya koymaktadır. Mezopotamya’nın diğer halkları çevrelerindeki coğrafyalarda dağlar ile karşılaşmış olsalar dahi dağlara kutsallık atfetmemiş, gökyüzüne yaklaşmaya tanrısal bir anlam yüklememiştir. Yönetim anlayışı açısından da Türk ve Sümer toplumlarında birliktelikler görülmüştür. Bunun başında Türklerdeki kut anlayışının yansıması olarak Sümer toplumunda kralların tanrılar tarafından seçildiğini ya da atandığını belirten metinlerin varlığı örnek gösterilebilir” (Bilgiç 1982: 100, Hatiboğlu 1979: 29–45, Çığ, 2015: 1750–1753, Landsberger 1945: 130–141, Pekşen, 2016: 57; Akt. Yıldırım, 2017: 5455).

Sümer ve Türk mitolojileri arasındaki benzerliklerden biri başlı başına yukarıda sözü edildiği gibi tanrı anlayışında görülmektedir. Sümer mitolojisindeki Anu ile Türk mitolojisindeki Gök Tanrı gökyüzüyle ilişkilendirilen iki büyük yaratıcı olarak anlam bakımından da gökyüzünü işaret eden iki kavramdır. Yine Türklerde tanrıyı ifade eden tengri, tengir, tengere gibi kullanımlar Sümer mitolojisindeki tanrıyı ifade eden dingir kavramını çağrıştırmaktadır. Buna benzer ortaklıkları artırmak mümkündür. Ancak bu çalışma iki toplumun ortak kökene sahip olduğu iddiasıyla geliştirilmemiştir. Araştırma evreni olarak seçilen Sümerler ekseninde Anadolu mitolojisinin Türk mitolojisiyle ilişkisini karşılaştırmalı mitoloji yöntemiyle ortaya koymak amacıdadır ve her iki mitolojik sahada yer alan kaotik varlıklar üzerine odaklanmıştır.

## BULGULAR

“Mit, insanları tabîî hadiselerin sebebini araştırmaya sevk eden içgüdüsel bir ihtiyaçtan doğar. Nereden gelip nereye gittiğini; hayatın ve ölümün ne olduğunu, sonsuz gökte yıldızların hangi esrarengiz tesirlere uyup hiç yollarını şaşırmadan döndüklerini; bulutların niçin kararttıklarını; pınarların yerden nasıl fişkırdığını; fırtınaların niçin kopup yağmurun nasıl yağdığını bilmek ister. Her şey onun hayran olmasına, içinde bir korku duymasına sebep olur, ilmin ne olduğunu bilmez; bunun için bize, bugün en basit görülen şeylere, kendisini memnun edecek bir mana veremez. Nihayet kâinatta, birçok hususlarda insana benzemekle beraber kudretleri, faziletlerinin veya kusurlarının büyüklüğü itibarıyla insandan çok üstün birtakım tabiatüstü insanlar, hayvanlar bulunduğu kani olur. Bunlara, temsil ettikleri muhtelif tabîî hadiselerle uygun, az çok karışık maceralar izafe eder. O ilâhların, şeytanların, cinlerin yaptıklarını, sözlerini anlatan bu maceraların tümü o kabilenin mitolojisini teşkil eder” (Kökten, 2014: 262).

Toplumların mitolojik anlatılarında sembolik anlamlar yüklenen kutsalla olumlu ya da olumsuz ilişki içinde olan birtakım varlıklar vardır ve bu varlıklar, inancın bir parçası olarak işlevlere sahiptir. Olumlu ve kendilerinden yarar beklenen varlıklar, Tanrının iyiliğini, lütfunu, yaşamı ve huzuru; olumsuz ve sakınılan varlıklar ise Tanrının gazabını, öfkesini, kaosu ve ölümü işaret etmektedir. Eliade’nin ifadesiyle mitler “yersel ve göksel simgeler vasıtasıyla Tanrının tecelli etmesi ve tezahürleridir” (Eliade, 2003: 29). Bu türden yersel ve göksel simgelerin bazıları ifritlerdir.

Arkaik düşünce iyi ve kötünün ait olduğu aydınlık ve karanlık dünya tasavvurunu benimsemiştir. Bu zıt dünyalara ait varlıklar neredeyse bütün dünya mitlerinde dünyanın yaratılışından itibaren konu edilmiş ve mitlerin önemli unsurları haline gelmiştir. Karanlık ve zulümle ilişkilendirilen varlıklar yani ifritler, iyilik ve aydınlık dünyanın varlıklarıyla bir bütünün ayrı parçalarını oluşturmuştur. İyilerin takdirini, faydasını sağlamak için yapılanlar ile kötülerin vereceği zarardan korunmak için yapılanlar arkaik insanın yaşantısını düzenlemiştir.

Her toplumun kendine özgü düşünce dünyası ve bu farklılıkla biçimlendirdiği mitolojik öyküleri vardır. Sümer mitolojisi “Evrenin yaratılışı ve düzenlenmesi, tanrıların doğumu, tanrıların birlikteliği, evren üzerindeki etkileri, insanın yaradılış süreci gibi düşünsel olayları aktaran, dolayısıyla mantıksal akıl yürütmeden çok, imgesel hayal gücünün etkisi görüldüğü” (Şahan, 2011: 44); Türk mitolojisi ise belirli bir düzenin görüldüğü gökyüzü, yeryüzü ve yeraltı katmanları arasında soyut ve manevi olanın somut ve maddi olanla açıklanmaya çalışıldığı bir tasarıma sahiptir. Bu tasarımların bir parçası ise ifritlerdir.

Dünya mitolojisinde birçok toplumda insanüstü varlıklar olarak ifritler; destan, efsane ve masal gibi sözlü anlatım ürünleri ile çeşitli inanışlarda yansımalar bulmuştur. Arap-İslam mitolojisinde cinlerin şahı; şeytan olarak karşılık bulan ifrit, İslamiyet öncesi Türk düşüncesinde farklı biçim ve formlardaki varlıklarla günümüzde de halk arasında çeşitli kabul ve uygulamalarla karşılanmaktadır. İfrit kavramı genel olarak kendisinden zarar beklenen, korku duyulan gaybî varlıkları işaret etmektedir. İfritler şeytanın tebaasıdır.

“Şeytan dünya dinlerinde uluslararası bir mit olarak antik çağlardan günümüze dek varlığını sürdürmektedir. Şeytan ve Şeytan’ın temsil ettiği özellikler içinde en göze çarpan unsur olarak kötülük, tüm dünya mitlerinde müşterek bir şekilde karşımıza çıkmaktadır. Bu özelliğiyle hem sözlü hem de yazılı kültür metinlerinde kötülüğü temsilen kendisine mitik bir motif olarak önemli bir yer işgal etmektedir. Tek tanrılı dinlerde yaratıcı tek tanrının karşısında yer almakta olan Şeytan, çok tanrılı dinlerde de benzer bir şekilde kötülüğü temsil eden bir karakter olarak farklı adlandırmalar çerçevesinde karşımıza çıkmaktadır” (Özarslan ve Karataş, 2020: 1). Bununla birlikte adlandırma ne olursa olsun bu varlık insanı kandıran, zarara-ziyana uğratan, hasta eden ve öldüren olağanüstü bir güce sahiptir. Bu genel

anlamlandırmayla birlikte şeytan ya da diğer bir deyişle demonlar, kültürel kodlarla görevini yürütür ve işlevini yerine getirir.

Demonik varlıklar, mitoloji içinde bilinen en eski varlıklardır ve Türk sosyo-kültürel hayatında uzun ömürlü ve kalıcıdır. Değişime ve dönüşüme az maruz kalan bu mitolojik kategori, Türk halkları arasında oldukça geniş bir alana yayılmıştır (Bayat, 2018: 273; Acar, 2020: 218). Pek çok toplumda olduğu gibi Sümerler de “Teolojik olarak başlarına gelen felaketlerin büyük kısmının İblislerin suçu olduklarına inanmışlardır. İblis dinlerinin çok önemli bir yanını” (Messadié, 1999) oluşturmuştur.

İfrit denilince öncelikli algının kötücül varlıkları işaret etmesine rağmen demonolojik varlıklar aslında kendi içlerinde zümrelere ayrılmaktadır. Kötücül ve iyicil eğilimli demonolojik varlıklar sınıflandırması bu anlamda karşılaştırılan sahalardaki farklılıklardan biridir. Sümer mitolojisinin de içinde bulunduğu Mezopotamya mitolojisinde bu düşüncenin izlerinin Türk mitolojisine nispeten belirgin olduğunu söylemek mümkündür. Nitekim Jeremy Black ve Anthony Green; Mezopotamya mitolojisinde bu türden yaratıkların iyi ve kötü olarak gruplandırıldığı bilgisini iletmış; bunların iyilik ve kötülüğe gönderme yapmada kullanılabildiğini söylemiş, bunlardan kötü ifritleri; canavarlardan farklı olarak dik insan bedenli olup vücutlarının bir kısmı insan, diğer bir kısmı ise hayvan olan mitolojik karışık varlıklar (2003: 106) olarak açıklamışlardır. Udug, lama, alad ya da galla gibi bizim ifritler olarak adlandırdığımız ruhların çoğu köken olarak tarafsızdır ve bunların kötü biçimleri kötü uduglar, kötü gallalar olarak tanımlanır (Black ve Green, 2003: 122). Sümer mitolojisindeki kötücül varlıkların bu tarafsızlık durumuna benzer şekilde; Fuzuli Bayat, Türk mitolojisinde demonolojik varlıkların oluşum ve kökenlerini, arkaik iye inancı ile ilişkilendirerek açıklamıştır. Erlik’in niteliğindeki dönüşümü de tekrarlayan bu görüşe göre kötücül varlıklar başlangıçtaki iyilik vasıflarını kaybetmiş ve kötüler sınıflandırmasına girmişlerdir (2018: 72). Türk mitolojisinde büyük oranda kötü olanla ilişkilendirilen ifritlerin yeri, yer altıdır. “Şeytanlar ve kötü ruhlar hep yer altından çıkarlar. Bu eski Türk inanışlarının gereğidir” (Ögel, 2010: 541). Benzer şekilde kötülerin mekânı olan Kur denilen yer altı âlemi de Sümerler için olumsuzluğun kaynağı olarak gösterilmiştir. “Sümer inançlarına göre hastalıklar yeraltı dünyasının kötü cin ve ifritlerin insan bedenine girmesiyle meydana gelmektedir” (Atmaca, 2009: 155-162). Kötücül varlıklar kötü eylemlerin icracıdır. Kendileri bizzat kötülüğü yarattıkları gibi tanrının iradesiyle zulmün de aracısı olmuşlardır. Bu noktada “Kötü ifritlerin genellikle tanrıların isteklerinin sadece temsilcileri ve onları icra edenler olarak düşünüldükleri de görülür; onların rolleri günah işleyenleri cezalandırmak için belirlenmiş ilahi emirleri uygulamaktır. Bu gibi kötü ifritler çoğunlukla rüzgâr veya fırtına gibi hava ruhları olarak düşünülmüştür (Tayfur, 2019: 435).

Tanrının insana verdiği cezalardan biri hastalıktır. Şamanizm’de “İnsanlar insan ruhunun bir demon (kötü ruh) tarafından çalındığına veya esir alındığına inanmışlardır. Hastayı iyi edebilmek için çalınan ruhun tekrar sahibine geri dönmesi gerekmektedir. Şamanlar eksiklik ya da fazlalığı, hastalık nedeni olarak düşünmektedirler. Hastalığa neden olan eksiklik, ruhun kaçması, bozulması, değişime uğraması olabilmektedir. Hastalığa neden olan fazlalık ise bedene kötü, hastalık yapan ruhun girmesi olarak nitelendirilmektedir” (Demir, 2016: 21). Türk mitolojisinde ifritlerin en yücresi Erlik, hastalıkların temel nedenlerinden biridir. Hastalık ve ölümle ilişkilendirilmelerinin yanı sıra ifritler söz konusu olduğunda ortak bir biçimlendirmenin varlığı göze çarpmaktadır.

Genel olarak demonolojik varlıkların yeraltında yaşadıkları, çirkin bir görünüme sahip oldukları, hayvan kılığında oldukları, geceleri ortaya çıkıp dolaştıkları, insan kanı ya da organlarıyla beslendikleri düşünülmektedir. Bu tasviri Erlik anlatımlarında görmek mümkündür: “Şaman dualarında bir canavar olarak tasvir edilen Erlik, sağlam vücutlu bir ihtiyar olarak düşünülmüştür. Gözleri ve kaşları kara, çatal sakallı, yaban domuzuna



benzeyen azı dişli, kara ve kıvrıkcık saçlı, kara renkli bir ata ya da öküze binen, yılan kamçılı, kana benzer parlak yüzü” (Çoruhlu, 2002: 53) bir kötülük ruhu olarak betimlenmiştir.

Hastalıkla ilişkilendirilen kötücül ifritlerden biri olarak Sümer mitolojisinde karşımıza çıkan Asag ya da Asakku; “Tanrı Ninuuta/Ningirsu ya da Adad (İşkur) tarafından yenilgiye uğratılan korkunç bir ifrittir. Asag görünüş itibarıyla tiksindirici derece çirkindir; gücü balıkların nehirlerde diri diri kaynamasına neden olmuştur. An ve Ki’nin birleşmesinden doğmuş ve çocuk yapmak için Kur (dağları) ile birleşmiştir. Taşlardan oluşan (dağların taşları) bir ordu kendisine eşlik eder” (Black ve Green, 2003: 34-35).

Burada taşın kaotik varlığa yüklediği simgesel anlam dikkat çekicidir. Türk mitolojisinde kadim bir inanış olan taş kültü etrafında özel anlamlar geliştirilmiştir. Ruhu olduğu ya da ruh barındırdığı düşünülen taşlar, somut birer varlık olarak sembolik ve soyut değerler yüklenmiş, sonsuzluğu ve kuvveti temsil etmiştir. Dağ kültürle birlikte değerlendirilmiş olan taşlar, gizemli varlıklar olarak kabul edilmiştir. Farklı birçok mitolojide de ilk insanın ortaya çıkışıyla ilişkilendirilen taşlar; Sümer mitolojisinde Asakku’nun taşlardan oluşan bir orduya sahip olması ve Türk mitolojisinde şeytanın karşılığı olan Erlik’in taştan bir sarayda oturması benzer anlamlar içerdiğini göstermektedir. Taşın ölü ruhu ve kötülükle ilişkilendirilmesi ortak bilinçaltının yansımasıdır. Yaratılışla ilgili efsanelerin birinde; “Tanrı’nın öz kişisi olan Mandı-Şire Erlik’le mücadeleye girer ve yenilir. Bunun üzerine Tanrı’ya derdini arz eder ve sonunda Tanrı’nın yardımıyla bu kez Mandı-Şire Erlik’i yener ve göklerini parça parça eder. Bu parçalardan dağlar, kayalar ortaya çıkar (Çoruhlu, 2002: 102). Erlik’in göklerinin taşa ve kayalara dönmesi bu unsurların olumsuzla ve kötülükle olan ilişkisine işaret etmektedir.

Erlik, Bahaeddin Ögel’in aktardığı Altay mitolojisi verilerine göre Tanrı Ülgen’le birlikte kâinatın başlangıcında var olan iki varlıktan biridir. Başlangıçta Tanrının yardımcısı iken, sonradan şeytan olmuştur (Ögel, 2010: 421). “Erlik her zaman kendi istek ve yaratılışı gereğince, kötü şeyleri seçer ve kötü işleri yapmağı tercih eder. İyi şeylerin temelini ve köküne muhaliftir ve kendiliğinden onlara karşı çıkar. Bilgisizdir, yıkıcıdır, karıştırıcıdır. Düzen ile sulh ve sükûn istemez. Sonsuz karanlıkların bağrından kopar gelir ve Kuzeydeki karanlık ülkeler onun yurdudur. İradesi yoktur ve iradesizliğin timsalidir. Başiboştur, aklına ne gelirse onu yapar, örse vurur, domuz çıkar, deve çıkar, şeytan çıkar. Şeytanların hükümdarı ve yaratıcısı odur. Çok kuvvetlidir. Tanrının meleği Mandı-Şire’yi, püskürttüğü ateşle yakmış ve kaçırmıştır” (Ögel, 2010: 429). “Bıyığı memelerinden aşan, iki gözü deniz gibi Erlik’in sesi ve çığlıkları da en az görünüşü kadar korkunçtur” (Yıldırım, 2011: 1962). Erlik Han’ın dokuz yeraltı ırmağının ağızlarının da yer aldığı yedinci katta taş ve siyah balçıktan yapılmış, her taraftan sınıksız korunan sarayı vardır (Eliade, 2006: 233).

Taşın ilettiği anlam ortaklığının yanı sıra benzer bir ortaklık rakamları kutsallaştırmada öne çıkmaktadır. Bu açıdan yedi rakamı ezoterik anlama sahip rakamlardan biri olarak hem Sümer hem Türk mitolojisinde dikkat çekici bir anlam taşımaktadır. Önem atfedilen bu rakam evrenin yaratılışı ve düzeninden mitolojik varlıklara kadar özel bir yere sahiptir. “Harflerin insan zihninin ürünü olduğu gerçeğine karşın, var olan her şeyin temelinde ilahi güçten kaynaklı bir sayı sisteminin varlığı Sümerlilerden beri kabul gören bir realitedir. Sümerlerin ilk dönemlerinden beri Mezopotamya’da kutsal sayıların varlığı bilinmekte ve bu kutsalın da teolojinin içerisine yerleştiği görülebilmektedir (Kılıç ve Eser, 2016: 84). Yedi tanrı, yedi bilge, yedi gezegen, yedi kötü ruh, dünyanın yedi bölgesi, yedi deniz, yedi nehir, yedi rüzgâr, yedi başlı kozmik canavar gibi semboller birçok teolojik ve mitsel metin içerisinde yer almışlardır” (Kılıç ve Eser, 2016: 77). Türk mitolojisinde ise yedi gök, yedi yer altı, yedi ırmak, yedi yıldız, yedi başlı ejderha, yedi kişi (Ülgen’in yarattığı ilk yedi insan), yedi putak (şamanın Erlik’in eline geçmiş ruhu kurtarmak için aşması gereken engeller) gibi mitolojik ifade ve sembollerde karşımıza çıkmaktadır.

Türk mitolojisinde kötülerin şahı Erlik’in yedi oğlu ve yedi kızı vardır. Bu mitik inanış söz konusu özel sayıyla ilişkilendirilmiş kaotik bir varlık olarak Sümer mitolojisindeki Yedi’yi

akla getirmektedir. Sümer mitolojisindeki Yedi ile Türk mitolojisinde kötücül aile yapısı içinde yedili birlik sunan Erlik Han ve çocuklarının aile düzeni benzerdir. Yedi; “Sümer dilindeki iminbi sözcüğüne tekabül eden, Akad dilindeki sebittu sözcüğü, yedili grup anlamına gelen tekil bir addır. Yedi bir ifrit grubuna verilen bir addır. Bu ifritler An ve Ki'nin, tanrı Nergal'in (Erra) yardımcıları gibi davranan çocuklarıdır. Bir büyülü dualar koleksiyonu, Yediyi, bazen Yedi ve yedi ya da Yedi kere yedi diye de adlandırılan yedi adlı kötü uduglarla özdeşleştiriyor gibi görünmektedir” (Black ve Green, 2003: 227). Kolektif kötülüğü temsil eden bu ifritlerin sayıca yedi olması rakamın etki kuvvetini ifade etmektedir. Sümer Mitolojisindeki Gallalar da yedi sayısı ile ilişkilendirilmiş kaotik varlıklar arasındadır. Gallalar; “ölüler diyarının acımasız küçük cinleridir (Kramer, 2002, s. 467). “Galla'nın görevi bilhassa bahtsız insanları yeraltı dünyasına çekmektir. Kötü ifritlerin yedi türünün sıralandığı büyülerde adı sık sık geçen Gallalar, büyülü bir metinde kendilerini yedi sayısı ile belirtirler. Gallalar, yeraltı dünyasından dönüşünde İnana'ya eşlik eder ve talihsiz Dumuzi'yi alt katmanlara getirmek için bir grup halinde yola çıkarlar. Çeşitli Sümer şiirleri, gallalar Dumuzi'yi götürdükten sonra, onun ıssız kalan ağılını anlatır. İblislerin ve ruhların çoğu gibi, gallalar da uygun bir biçime girebilirler” (Black ve Green, 2003: 82). Gallalar; “Sümer tabletlerinde “Yemezler hiç yemek, bilmezler hiç su, yemezler serpilmiş kutsal unu, İçmezler hiç saçılmış kutsal suyu, Almazlar hiç yatıştırıcı armağanlar, ... Öpmezler hiç çocukları...” şeklinde tarif edilmektedir (Altuncu, 2014b: 138).

“Türk mitolojisinde yer alan Erlik dışındaki şeytan, cin vb. tasavvurlar eski Türk dinsel inanışlar, Budizm, Maniheizm gibi dinlerin etkileriyle şekillenmiştir. Kötü ruhlar Altaylarda kara neme, Yakutlardaysa abası denir. Bazen bunlara, çoğunlukla da Uygurca yekler de denilir. Bu sözcük aynı zamanda Uygurca şeytan sözcüğünün de karşılığıdır (Çoruhlu, 2002: 54; İnan, 1972: 41). Yek, yani Şeytan “İnsanoğlunu yoldan çıkarmıştır ve kötülüğün simgesidir. Tanrıya isyan etmiştir. Kısa boylu ve güçlü bir varlıktır. Âlemin karanlık güçlerini temsil eder. Yerin altında yaşar. Yaka adlı kötü ruh ile de bağlantılıdır. Çak (veya Çek) denilen yine Şeytan anlamını içeren sözcük ile de ilişkili görünmektedir. Ayrıca bu sözcükle bağlantılı hastalık adları vardır. Yiğ verem, Yiğnik ise dizanteri demektir. Kötü ruh, şeytanın yarattığı hastalık, zarar verme gibi anlamları da vardır. Yeg'in Tatar dilindeki anlamı açgözlü, doymak bilmeyen ruh demektir” (Beydilli, 2003: 607). Körmös, yeek, aza, şulmus, yetker gibi bütün kötü ruhlar Erlik'in yönetimi altındadır. Erlik'in karanlık âlemindeki bu kötü ruhlar yekler de denilmektedir” (Öger ve Altın, 2016: 18).

Abaası, kara neme ya da yekler adıyla bilinen bu kötücül ruh “o kadar çok bilinen bir ruhtur ki Türk sahasından çıkıp Balkanlar'a, Rusya'ya ve Çin'e kadar uzanır. İnsanlar bu ruhtan o kadar çok korkar ki sık sık bu ruh için kurbanlar verilir. Dünyada bulunan bütün kötü ve çirkinliklerden onun sorumlu olduğuna inanılır. Örneğin yılanların derilerinin soğuk olması, bazı hayvanların kısa ya da kör olması bu ruha bağlanır çünkü Tanrının bu şekilde herhangi bir şey yarattığı düşünülemez. Yılın belli dönemlerinde yeraltından çıkıp insanların arasına karışır ve genellikle yalnız dolaşan, korumasız ve hasta insanlara musallat olurlar. İnsanları deliliğe sürükleyen hatta bazen de öldürebilen hastalıklar bulaştırdığına inanılır” (Altıok, 2020: 37).

İfritler dünyasında dikkati çeken bir diğer husus kaotik varlıkların kadın cinsi ile ilişkilendirilmesi ve dişil kötücül ruhların kadınsı özelliklerinin ön plana çıkarılmasıdır. Bu açıdan değerlendirildiğinde Sümer mitolojisindeki Isıkıl-Lilla ve Lilith ile Türk mitolojisindeki alkarısı, eylem ve betimleme bakımından birbirine benzeyen şeytani dişî yaratıklardır. Demonik varlıklardan biri olarak; Hal, Hal enesi, Alg, Aleybani, Alarvadi, Almış, Albıs, Jalbastı, Alpata gibi isimlerle anılan Al, Türk mitolojisinde oldukça köklü bir inançtır ve derin bir etkiye sahip olarak çevre kültürlerde de yansımalar yaratmıştır. Al anası ile ilgili betimlemelerin eril demonik varlıklardan farklı olarak cinsiyet odaklı yapıldığı görülmektedir: “Mit, efsane ve memoralarda Al Karısı tasarımlarına dair bedensel

göstergelerin başında bu demonun cinsiyeti belirlemektedir. Al Karısı'nın bir insan olarak ortaya çıktığı metinleri içeren tüm anlatılarda bir kadın olarak beliren bu demonun kimi metinlerde kadınlığını pekiştiren uzuvlarının özellikle vurgulanması son derece dikkat çekicidir. Al Karısı'nın güçlü ve devasa bir bedeni bulunmaktadır" (Çelik, 2018: 72).

"Alkarısı, genellikle loğusalrı ve bebeklerini rahatsız eden korkunç bir yaratıktır. Bu ruhun üç çeşidinin olduğuna inanılır. Bunlar; ciddi ve ağır başlı bir ruh olan Kara Albastı; Çince metinlerde kırmızı kadın olarak adlandırılan ve insanlığın anası olan Kırmızı Albastı ve sarışın bir kadın suretinde, bazen de keçi veya tilki suretlerine de giren Sarı Albastı'dır. Sarı Albastı, Kara albastıya göre daha az yararlıdır. Hoppa ve şarlatandır. Kadınlar arasında hoppalığı sembolize eder. Doğum yapan kadının ve çocuğunun ciğerini söküp suya atar" (Şimşek, 2017: 100). Halk arasında iki tip alkarısı imajı yaşamaktadır. Birincisi ölüme sebep olmaz, sadece geceleri ahırda atlara binmek ve yelelerini örmekten zevk alır. İkinci tip alkarısının yeni doğum yapmış kadınlarla çocuklarına musallat olduğu, kadının böbrek, yürek ve ciğerini yemekten hoşlandığı söylenir (Küçük, 1989: 469). Sümerlerde bu varlığın karşılığı olarak gördüğümüz dişil ifritin de "insanların göğsüne zarar verip soluğunu kestiği ve bela yaydığı" (Karakurt, 2012: 66) söylenmektedir.

Sümerlerde zarar veren ruh Al, aynen Türk mitolojisindeki alkarısında olduğu gibi demonik özellik kazanır. Büyük ihtimal bu söz Sümerce'den Akkatca'ya Lamastu/Lamassu şeklinde geçer ve kadınlara zarar verici ruh özelliğini korur (Bayat, 2012: 322). Lamaştı Doğumla ilgili olarak hem düşüklerin hem de kundaktaki bebek ölümlerinin nedeni kabul edilmektedir. Hamile bir kadının evine sızarak, bebeği öldürmek için kadının karnına yedi defa dokunduğu veya çocuğu sütnineden kapıp kaçırdığı düşünülmüştür. Aslan başlı, uzun tırnaklı, saçlı ve aynı zamanda tanrıça olan Lamaştı kötü insanların kanını emer" (Yücel, 2019: 279-280). Lamaştı'nun iyilere ve kötülere karşı niteliğinin aynı olması ondaki habisliğini artırmaktadır.

Al'ın Sümer mitolojisindeki karşılığını Kramer Isıkl-Lilla'yı Lilith olarak adlandırmıştır. İlk bakışta hem Lilit'in hem de Almastı, Albastı ve Hal Anası'nın (Al garısı) dış görünüşünün tarifi aynıdır. Bazen çok güzel bazen de çirkin kadını sembolize eder. Hal Anası'nın da görünüşü korkunçtur, uzun memeleri vardır. Sağ memesini sol omuzuna, sol memesini sağ omuzuna atar, saçları da hep dağınık gezer. Diğer kaynaklarda gösterildiğine göre uzun alev kırmızısı elbisesi vardır. Lilit'in tarif edildiği metinlerde de aynı bilgiyi görebiliriz" (Gazanfergizi, 2019: 128-129).

Lilith sıklıkla uzun bukleli kızıl saçlı, bazen vücudunun belden aşağısı bir ateş sütunu, bazen bir yılan ama çok güzel ve baştan çıkartıcı bir kadın olarak tasvir edilir ve kızıl uzun saçlarıyla, güzelliğiyle bir dişi şeytan olarak sunulur" (Ercan, 2013: 97) ve ayrıca tüm şeytan ya da demonların annesi olarak bilinir (Yücel, 2019: 285). Ancak Isıkl-Lilla'nın karşılığı olarak verilen Lilith; "demonolojik imge olarak gösterilse de beyaz dişli, yüreği kaygısız bakire kız gibi betimlenir. Bu ise onun insanlara kötülük getiren varlık gibi negatif özellikleri hakkındaki düşünceleri şüpheli çıkarır (Qocayeva, 2003: 10) ve Isıklilla'nın Sümer metinlerinde demonolojik imge olduğu hiç bir faaliyet görülmez" (Gazanfergizi, 2019: 131). Bununla birlikte Sümercede kabaca fırtına ve rüzgâr anlamına gelen lîl kelimesi, Lilith'in herhangi bir şekilde hava unsuruyla irtibatını ifade eder. Lîl'in bir diğer anlamı ise zehir ve salgın hastalıktır. Eliade'ye göre Mezopotamya dinlerinde "şeytan" olarak tanımlanan lîl, hastalık getiren bir rüzgârdır" (Çınar, 2018: 365).

Türk mitolojisinde yer alan al karısı gerek adlandırması gerek işlevleri bakımından Sümer, Asur ve Babil medeniyetlerinin mitolojileriyle ilişkilendirilmiştir. Bu medeniyetlerde al kelimesi ortak olup bu adla anılan varlığın kadınlara ve yeni doğan bebeklere zarar veren bir ruh olarak tasvir edilmesi söz konusudur. Al karısı ile ilgili anlatımların pek çoğu Sümer mitolojisi kaynaklı tufan mitlerindeki tanrıça ve onun yarattığı dişi cinlerle paralellikler içermektedir. Türk sözlü kültüründe yaşamakta olan al karısı ve çevresinde şekillenen inançlar, çok eski tarihlere uzanan inanç parçacıklarının uzantısı şeklinde değerlendirilebilir.

Bu düşüncemizi destekleyen kanıtlardan biri al karısının, doğum yapan kadınlara ve bebeklerine zarar vermek suretiyle insanoğlunun çoğalmasını önlemek istemesi ve aynı işlevin Sümer ve Babil tufan mitlerinde olmasıdır (Karini, 2013: 71-75).

Demonolojik varlıkların betimlemesinde öne çıkan tasarımlar birtakım eksiklik içermektedir. İfritlerin mekânı olan yer altı dünyasının, ölümler âleminin birçok sakini vardır ve bu âleminin varlıkları bedensel bütünlüğe sahip değildir. Örneğin “Dağ ve yer objeleriyle bağlanan mitolojik bir varlık olan Al, Tuva mitolojik metinlerinde tek gözlü olarak tanımlanır ve sadece istediği zaman insanlara görünür” (Beydilli, 2003: 43). Bir diğer örnek Türk mitolojisindeki Yarımıtık; “hetonik konuma ait, değişken tabiatlı bir şeytan şeklinde görme imkânı verir. Tek kollu, tek gözlü ve tek ayaklı olmak, şeytanlığın başlıca işaretidir (Beydilli, 2003: 601). İnanca göre tek ayaklı, tek gözlü ve kel olan bu varlıklar, zararlı ve iğrenç görünümlü bitki ve hayvanları meydana getirmişlerdir. İnsanın aklını elinden alıp deliye çevirebilme güçleri bulunmaktadır (Altın, 2019: 164).

Bu noktada yine ortak dil ailesine bağlı olma düşüncesini hatırlatan bir kötücül varlık benzerliği sergilemektedir. “Türk mitolojisinde kötü varlık anlamına gelen Ker; çoğu zaman, kötücül varlıkların adlarının önünde yer alan bir sıfat olarak kullanılır. O varlığın kötücül bir özelliğe sâhip olduğunu gösterir. Tek ayaklı, tek gözlü, tek kollu, kel varlıklardır. Sümerlerde Kur adlı bir yer altı canavarı bulunur ki, yeraltında yaşayan varlıkların Ker sözcüğü ile tanımlanması bununla bağlantılı olabilir. Yeraltında yaşadığına inanılan Ötker adlı kötü varlıklar da bunların bir türüdür. Öteki âleme ait canlılar daima tek gözlü olarak betimlenir (Karakurt, 2012: 470). Eli ayağı olmayan, alınının ortasında tek gözü olan ve eziyet veren Duyar Han ile tek ayaklı, tek kollu, tek elli, tek gözlü ve o gözünü de uzun kirpiklerinin örttüğü Teyren bu varlıklara birer örnektir (Karakurt, 2012: 282-290).

İfritlerin olağandışılığı sadece eksik biçimde tasvirlerle değil, fazlalık içeren tasarımlarıyla da vurgulanmaktadır. Üç ayaklı, üç kollu, üç gözlü ifrit betimlemeleri, her iki biçimde gaybî varlıkların normal olandan farklı olması ve görünüşün aykırılığının getirdiği korkuya zemin hazırlamaktadır. Çirkinliğe vurgu yapan her türlü maddesel betimleme şeytaniliğin simgesi olur. Kara olmaları, kötü kokmaları, çirkin seslerinin olması, büyük kafalarının, uzun ellerinin ve dişlerinin olması, kuyruğa sahip olmaları, vücutlarının uzun tüylerle kaplı olması, hem Sümer hem de Türk mitolojisinde görüldüğü üzere tabiatlarındaki yıkıcılığa vurgu yapan ateşten yaratılışları bu türden varlıkların genel ifadeleridir. Aynı zamanda görünmezlik ve kılık değiştirmek, dönüşmek ifritlerin özellikleri arasındadır. “Türk mitolojisinde ateşten yaratılmış, görülmeyen soyut bir varlık olan Yelpin adlı cin, Sümerlerde şekil değiştiren Vilin adlı dişi kötücül ruhlar (Karakurt, 2012: 847) bu biçimdeki demonlardır.

Sümer ve Türk mitolojilerinde ifritlerin tasvirinde hayvan betimlemeleri söz konusudur. Öne çıkan hayvanlar köpek, yılan, ejderha, balıktır. Kaba, çirkin, kötü görülen hayvanlar kötülüğün simgesi olarak kolektif bilinçaltını yansıtan ve birtakım yıkıcı özellikleri olan varlıklar olarak ifritlere dönüştürülmüştür. İnsanoğlunun zihnine ayna tutan bu sembolik varlıklar mitlerde geniş yer teşkil etmektedir. Bunlardan yılan, şeytanla en çok özdeşleştirilen hayvan olarak öne çıkmaktadır. Şeytan ve yılan birçok toplumun mitolojik evreninde yakın ilişki içindedir. Dünya mitlerinde ortak bir simge olan yılan insanları günaha ve kötülüğe çağıran bir varlıktır. Türk mitolojisinde de Sümer mitolojisinde de benzer etkinliklere sahiptir.

Yılanın Türk mitolojisinde “Erlik’le ilgili olduğu, özellikle kara yılanın Erlik’i temsil ettiğine inanılır” (Çoruhlu, 2002: 157-158). Yılanın, Erlik’e yardımcı olup onu Cennet’e sokması ve bu nedenle de lanetlenmesi onun Erlik’le özdeşleştirilmesine neden olmuştur. Özellikle kara renginin seçilmesinin nedeni ise kara rengin; ölümü, kötülüğü ve karanlığı yani bilinmezliği çağrıştırmasıdır. Tanrı tarafından lanetlenip Cennet’ten kovulan yılan, Erlik’in karanlıklar ülkesi olan yer altı ülkesine gönderilmiştir (Gedik, 2020: 423).



“Türk mitolojisiinde Abura/Apra ve Yutpa olarak bilinen; bazen ayrı şekilde Ker Abra, Ker Yutpa ve Ker Doydu olarak bilinen üç kötücül ya da bazen hepsinin aynı varlık olduğu düşünülen yaratık, yeraltındaki Büyük Deniz (Tengiz)’de yaşayan ve ejdere benzeyen devâsa iki yilandan birisidir. Erlik’in hizmetlisi, timsah biçimli efsane yaratığıdır. Yeşil bir kumaştan yapılmış ve örgülerle süslenmiş Abra’nın tasviri, şamanın giysisine asılır. Abra’nın başı puhu tüyleri (ülberk) ile süslenir. Gözü, parlak bakır düğmelerden, ayakları da genellikle kırmızı kumaşlardan seçilmiş yamalardan yapılır. Bunlara, örülmüş dokuz püskül eklenir” (Karakurt, 2012: 26).

“Başkurt masallarında ve destanlarında en çok rastlanan biçimi olan acdaha, acdaha yılanın varyantıdır. Başkurlara göre acdaha göllerde, dağ yarıklarında yaşayan, insanları ve hayvanları yutan devasa bir yilandır. Acdaha, yılan, boğa, köpek kılığına girebilmekte, sık sık kurban istemekte ve ancak onu aldıktan sonra sakinleşmektedir. Bugün bile, acdahanın Başkurdistan’ın Maiubbu ve Talqaf gibi yutan, dipsiz göllerinde, Jramäl, Jrandek Raz, Maşaq, Maaş, Ola acdaha tavu gibi dağ yarıklarında yaşadığı tasavvur edilmektedir” (Hisametdinova ve Şaripova, 2014: 34).

Yılan biçimli demonlardan biri Sümer mitolojisiinde Muşhuş adıyla karşımıza çıkmaktadır. Muşhuşu veya Sirruş mitolojik bir yılan ya da ejderha (Kramer, 2002, s. 472) olarak Mezopotamya mitolojisiinde en çok bilinen kötücül demonlardan biridir. Kaynaklarda şöyle betimlenmiştir: “Bir kartalın pençelerine benzeyen arka ayakları, kedi gibi ince ön bacakları, uzun boynu ve kuyruğu, boynuzlu bir kafası, yılan benzeri bir dili ve tepesi pullu olan bir ejderhadır” (Yücel, 2019: 288).

Çoğunlukla yılanla karıştırılan ejderha, olumlu ve olumsuz anlamlar içeren bir hayvandır. “Erken Altay mitolojisiinde, bereket, refah ve güç simgesi olarak algılanan bir konumdadır. Ancak bu olumlu algıyı Türkler, Ön Asya kültürleriyle iletişime geçince yitirir. İnsanı kötü yola sevk eden, çoğu zaman canına kasteden, kötülük simgesi, efsanevi bir varlık olarak yoluna devam eder” (Türkan, 2016: 220). Sümer ve Türk mitolojilerindeki hayvan biçimli ifritlerde ortak bir görünüm ejderha biçimidir. “Sümerlerin Enuma Eliş (Vaktiyle Göklerde) adlı yaratılış destanlarında Tanrı Marduk, Ejderha Tiamat’ı öldürerek evreni yaratır. Gılgamış Destanı’nda Kahraman Gılgamış, Ejder Hubaba’yı (Huvava) öldürerek ülkesini bu korkunç yaratıktan kurtarır” (Duman, 2019: 485).

Türk mitolojisiinde ise Yelbegen “Devle ejder arası bir varlık olarak tasavvur edilmiş bir demonik yaratık” olarak insanları yutması ile dikkat çeker. Yutup çıkarma mitlerde arındırma işlevini yerine yetirir” (Bayat, 2009: 75). Yelbegen,”insan biçiminde, insan yiyen, çok büyük; üç, yedi veya on iki başlı, siyah ve sarı renkte (Ögel, 1995: 561) bir ifrit olarak tasvir edilmiştir. Buna benzer diğer bir ifrit Badraç’tır. “Türk mitolojisiinde Badraç/Padraç’ın yedi tane başı vardır. Ölmesi için yedisinin de kesilmesi gerekir. Bazı söylencelerde tek tek kesilen baş geri yerine gelir bu durumda yedi başın da aynı anda kesilmesiyle ancak öldürülür. Ağzından ateşler çıkar. Kuyruğu bir kamçı gibi şaklar. Derisi zırh gibi pullarla kaplıdır” (Karakurt, 2012: 146).

Sümer mitolojisiindeki bir başka ifrit Namtar da yine hayvan biçimli demonlardan biridir. “Namtar; kader veya ölüm, ölümler diyarının bir cini (Kramer, 2002, s. 742) olarak tanımlansa da Sümerlerce kader ve yazgıdan sorumlu tanrı olarak tanınmıştır. Akad inancında ise Asig adlı bir hastalığa neden olan ölümler ülkesinin cinidir. Köpek veya dolanan bir varlık olarak tasvir edilmiştir. Enki’nin çoğu zaman büyülerinde kötü niyetli bu cini kullandığı belirtilmiştir” (Altuncu, 2014b: 137).

Türk mitolojisiinde görülen inanca göre kötücül varlıklar yeraltından kara bir tilki biçiminde çıkar. Bu inanış İslamiyet sonrası halk inançlarında kurnazlığın sembolü haline gelmiş bu hayvanın İslamiyet öncesi inanışlarda yine kötücül anlama sahip olduğunu göstermektedir. Tilki formu demonlar, kötücül ruhların insanları aldatıcı oluşuna, hilekârlığına gönderme yapmaktadır. Kara renk vurgusu da yine Erlik’in ismine bir atıftır. Evrenin henüz kozmos

düzene geçmediği kaos zamanlarında yani yaşamın olmadığı zaman diliminde dünya kapkaranlıktır. Kötülüğün simgesi olan bu renk, ifritlerin tasvirinde öne çıkan tanımlamalardan biridir. Yeraltı dünyası ve oraya bağlı olanlar kara renkle ilişkilendirilmiştir. Dolayısıyla hastalıkların, ölümün ve kötülüğün simgesi kara renkli ifritler olmuştur.

Su mitolojik önemli bir motiftir hem yaratılış hem de eskatolojik mitlerin ana unsurudur. Kutsaldır; yaşam kaynağı olarak düşünüldüğü gibi ölümün ve yıkıcılığın da sebebi olabilir. Gizemli bir yönü vardır. Hem kötücül varlıkların yaşam alanı hem de onlarda korunma alanıdır. Türk mitolojisinde genellikle dişil kötü ruhlarla ilişkilendirilmiştir. Sümer ve Türk mitolojilerinde deniz, nehir gibi su kaynaklarıyla bağlatılı kötücül bazı varlıklar vardır. Örneğin “Lahama; bir deniz canavarı türü” (Kramer, 2002, s. 470) olarak Sümer mitolojisindeki fantastik varlıklardan biridir. “Okyanusların derinliklerinde yaşadığı anlatılır. Babasının sarhoşluğundan yararlanan tanrıça İnanna kutsal Me’leri (kader tabletleri) alınca; baba vezirine; Enkum, Uru, Lahama ve Kugalgal adlı cinlerini alarak İnanna’dan kutsal Me’lerinin geri getirilmesi emrini verir. Lahama bu cinlerden biridir. Enki’nin (Sümerlerde Su Tanrısı) 500 lahaması olduğu belirtilir” (Narçın, 2007: 245).

Türk mitolojisinde ise Doydu isimli dev ölüm balığı, karanlıklar aleminin bir üyesi olarak kötücül yönleriyle öne çıkmaktadır. “Yeraltındaki büyük denizde yaşadığına inanılan efsanevi devâsa balığın, ağzı gırtlığının altında, gözü ise ensesindedir. Belkemiği ters çevrilmiştir. Zincirlerle bağlı tutulur. Başını ve vücudunu oynatınca depremler olur, tufanlar kopar. Ker Balık da denir. Ker sözcüğünü Kör olarak anlamlandıran bir görüşe göre, bu onun öte âleme ait olduğunun ilk belirtisidir” (Karakurt, 2012: 485). Görüldüğü üzere eylemsel kötülüğün yanı sıra bahsi geçen hayvan biçimli ifritlerin öne çıkan yönleri maddesel betimlemelere konu olmuştur.

## SONUÇ

Türk mitolojisinde karanlıklar dünyası ve kötülüklerle ilişkilendirilen ifritler çok geniş bir sembol dünyasını içermektedir. Denilebilir ki Sümerliler ne olduğunu bilmediği olay ve varlıkları kendi akıl yürütücülüğünde konumlandırırken zihinsel görüntü tasarımı yapmıştır. Bu düşsel tasarımın bir parçası ifritler olmuştur. Türk mitolojisinde de inançlar bu türden varlıklar aracılığıyla eylem oluşturmakta, bu varlıkların etki gücü, geçmişten günümüze halk inançlarında yaşamaktadır. Her iki mitolojik saha bu varlıklar açısından değerlendirildiğinde son derece zengin bir içerik sunmaktadır. Evrenin yaratılışından kıyamet gününe kadar çeşitli biçimlerde içerik oluşturan ve eylemde bulunan bu ruhlar, benzer bir inanç katmanı oluşturmuşlardır. Başlangıçta ana yaratıcıya bağlı olup ona hizmet eden, ancak doğasında var olan karşıtlıkla kötülüğün timsaline dönüşen şeytan ve ona bağlı ruhlar, iyilikle ilişkilendirilebilecek hiçbir olayın içinde yer almazlar. Türk mitolojisinde kötücül ruhların bağlı olduğu Erlik Han, eril kötücül bir ruh olarak her türlü ifritin hâkimidir. Sümer mitolojisinde ise karşılığı olarak düşünülebilecek Ereškigal yer altı dünyasının yöneticisi aynı konumdadır. Burada dikkati çeken nokta Ereškigalın bir tanrıça olarak dişil kötücül ruhların ya da tanrı olarak eril kötücül varlıkların hükümdarı olarak nitelendirilmesi; yani cinsiyet belirsizliğidir. Fiziki ve ruhsal hastalıkların, ölümlerin, kazaların, zararın sebebi olurlar. Her yönüyle kötü ve çirkin olan, uğursuzluk ve zarar odaklı bu demonolojik varlıklar Sümer mitolojisinde Lilith, Isıkıl-Lilla, Asag, Yedi, Udug, Lahama, Alad ya da Galla, Vilin, Lamaştu, Muşuş, Namtar isimleriyle Türk mitolojisinde Yarımtık, Yelpin, Abura, Teyren, Doydu, Alkarısı, Duyar Han, Badraç gibi isimleriyle karşımıza çıkmakta ve yer altı dünyasının üyeleri olarak yeryüzüne felaket saçmaktadır. Dolayısıyla Türk ve Sümer mitolojilerinde yer alan ifritlerde önemli benzerlikler söz konusudur.



**REFERANSLAR**

1. Acar, Oğuzcan (2020). Göçebe Kültürünün Türk Demonolojisine Etkisi, Uluslararası Halkbilimi Araştırmaları Dergisi, 6, 214-230.
2. Aliyev, Ramil (2020). Türk Mitolojisi, Ankara: Astana Yayınları.
3. Altın, Kübra Yıldız (2019). Hastalık Adları Bağlamında Kötü Ruhların Dönüşümü: Türkistan'dan Anadolu'ya, Türk Dünyası İncelemeleri Dergisi, 19 (1), 159-180.
4. Altıok, Ayfer (2020). Türk Mitolojisinin Türk Kültürü Üzerindeki Etkisi, Göçebe Dergisi, 4, 36-38.
5. Altuncu, Abdullah (2014a). Sümer Mitolojisi Bağlamında Otorite Tarafından Şekillendirilen İbadet ve Törenler, Kilis 7 Aralık Üniversitesi İlahiyat Fakültesi Dergisi, 1 (1), 141-165.
6. Altuncu, Abdullah (2014b). Sümerlerde Tanrı Anlayışı ve Tanrılar Panteonu, Kilis 7 Aralık Üniversitesi Sosyal Bilimler Dergisi, 4 (7), 118-142.
7. Arda, Zeki Cemil (2013). Anadolu ve Avrupa Mitolojisinde İçerik ve Motif Karşılaştırması, Türk Kültürü ve Hacı Bektaş Velî Araştırma Dergisi, 9, 9-14.
8. Atmaca, Veli (2009). Tarih Boyunca İnanç ve Tıp, Ankara: Gündüz Eğitim ve Yayıncılık.
9. Bayat, Fuzuli (2009). Geçiş Ritüeli Bağlamında Arınma, Uluslararası Sosyal Araştırmalar Dergisi, 2 (9), 74-78.
10. Bayat, Fuzuli (2012). Folklor Dersleri. Bakı: Elm və təhsil.
11. Bayat, Fuzuli (2018). Türk Mitolojik Sistemi 2, İstanbul: Ötüken Neşriyat.
12. Beydili, Celal. (2003). Türk Mitolojisi Ansiklopedik Sözlük, Yurt Kitap Yayın, Ankara.
13. Black, Jeremy ve Green, Anthony (2003). Mezopotamya Mitoloji Sözlüğü, İstanbul: Aram Yayıncılık.
14. Çelik, Adil (2018). Türk Toplumunun Sözel Belleğindeki Al Karısı Tasarımları Üzerine, Doğaüstü Varlıklar ve Anlatılar Üzerine İncelemeler içinde, s. 71-86, İstanbul: Kesit Yayınları.
15. Çığ, Muazzez İlmiye (1994). Sümerlilerden Zamanımıza Ulaşan Kültür İzleri, XI. TTKB (Ankara 5-9 Eylül 1990), (ss. 235-246), Ankara: Türk Tarih Kurumu Basımevi.
16. Çığ, Muazzez İlmiye (2021). Orta Asya Türk Efsanelerinde Sümer Efsanelerinden İzler, <http://turkoloji.cu.edu.tr/GENEL/27.php>, Erişim tarihi: 31.05.2021.
17. Çınar, Aynur (2018). Lilith: Yahudi Mitolojisinde Ana Tanrıça'nın Düşüş Ve Şeytana Dönüşüm Serüveni, Bilimname XXXV, 1, 361-393.
18. Çoruhlu, Yaşar (2002). Türk Mitolojisinin Ana Hatları, İstanbul: Kabalcı Yayınevi.
19. Demir, Müge (2016). Şamanizm'de Hastalık Kavramı ve Tedavi Yaklaşımları, Lokman Hekim, 6 (1), 19-24.
20. Duman, Harun (2019). Türk Mitolojisinde Ejderha, Uluslararası Beşeri Bilimler Ve Eğitim Dergisi, 5 (11), 482 – 493.
21. Eliade, M. (2003). Dinsel İnançlar ve Düşünceler Tarihi. İstanbul: Kabalcı Yayınevi.
22. Eliade, Mircea (2006). Şamanizm, (Çev. İsmet Birkan), İstanbul: İmge Kitabevi.
23. Ercan, Cemile Akyıldız (2013). Mitolojide Çocuk Katili Kadınlar: Lilith, Lamia, Medea, Zeitschrift für die Welt der Türken, 5 (1), 89-103.
24. Gazanfergizi, Aynur (2019). Köpek Kadın'dan Lilit, Alkarısı ve Isıkl-Lilla'ya Kadar Uzanan Mitolojik Hat, Uluslararası Halkbilim Araştırmaları Dergisi, 2 (3), 125-134.
25. Gedik, Seda (2020). İnanç Dünyasında Yılanın Ele Alınışı, İnsan ve Sosyal Bilimler Dergisi (JOHASS), 3 (1), 420-430.
26. Hisametdinova F. G. ve Şaripova, Z. J. (2014). Başkurt Demonolojisi (Şeytan Bilimi) Terimleri, Türk Dünyası, 37, 33-40.
27. İnan, Abdülkadir (1972). Tarihte ve Bugün Şamanizm-Materyaller ve Araştırmalar, Ankara: Tür Tarih Kurumu.

28. Karakurt, Deniz (2012). Türk Mitoloji Ansiklopedisi, <http://www.genelturktarihi.net/wp-content/uploads/2012/05/Turk-Mitolojisi-Ansiklopedik-Sozluk.pdf>, (Erişim tarihi: 30.06.2021)
29. Karini, Gülcan (2013). Halhal (İran) Efsanelerine Eş Zamanlı ve Art Zamanlı Yaklaşımlar: Al Karısının Kolyesi ve Sümerler, Türk Dünyası İncelemeleri Dergisi, 13 (2), s.67-76.
30. Kılıç, Yusuf ve Eser, Elvan (2016). Eskiçağ Düşüncesi ve Kutsal Kitaplarda Yedi Sembolizmi, Turkish Studies, 11, 77-98.
31. Köktan, Yavuz (2014). Mitoloji Dans ve Müzik, Türek, 3, 261-271.
32. Küçük, Abdurrahman (1989). Al Karısı. TDV İslam Ansiklopedisi, 2. Cilt içinde s. 469, İstanbul: Diyanet Vakfı Yayınları
33. Kramer, Samuel Noah (2001). Sümer Mitolojisi, İstanbul: Kabalcı Yayınevi.
34. Kramer, Samuel Noah (2002). Tarih Sümer’de Başlar, İstanbul: Kabalcı Yayınevi.
35. Messadié, Gerald (1999). Şeytanın Genel Tarihi. (Çev. I. Ergüden), İstanbul: Kabalcı Yayınları.
36. Narçın, Ali (2007). A’dan Z’ye Sümer, İstanbul: Ozan Yayıncılık.
37. Ögel, Bahaeddin (1995). Türk Mitolojisi, C. 2, Ankara, Türk Tarih Kurumu Basımevi.
38. Ögel, Bahaeddin (2010). Türk Mitolojisi, C. 1, Ankara: Türk Tarih Kurumu
39. Öger, Adem ve Altın, Kübra Yıldız (2016). Uygurlarda Şamanizm’den İslam’a Kötü Ruhların Dönüşümü, Uluslararası Uygur Araştırmaları Dergisi, 7, 14-28.
40. Özarslan, Metin ve Karataş, Hicran (2020). Altay Türk Destanlarında Şeytan, Türek, 23- 1-14.
41. Qocayeva G.G. (2003). Lilit-qız və Oğuz xatunu. // Elmi Araştırmalar, No: I-IV.
42. Şahan, Deniz (2011). Sümer Mitolojisinin Yunan Mitolojisine ve Felsefesine Etkileri, Ankara Üniversitesi Sosyal Bilimler Enstitüsü Yayınlanmamış Yüksek Lisans Tezi, Ankara.
43. Şimşek, Esmâ (2017). Türk Kültüründe Alkarısı İnancı ve Bu İnanca Bağlı Olarak Anlatılan Efsaneler, Akra Uluslararası Kültür Sanat Edebiyat ve Eğitim Bilimleri Dergisi, 5 (12), 99-115.
44. Tayfur, Enisa (2019). Lamashtu ve Pazuzu Kültürünün Anadolu’ya Etkisi. Arkeoloji ve Sanat Araştırmaları içinde (ss. 435-459), İstanbul: Van Yüzüncü Yıl Üniversitesi Edebiyat Fakültesi Yayınları.
45. Türkan, Kadriye (2016). Balkan Türk Masallarında Mitolojik Bir Figür: Ejderha, Uluslararası Sosyal Araştırmalar Dergisi 9 (45), 219-225.
46. Yıldırım, Ercüment (2017). Türklerdeki Evren Anlayışının Mezopotamya Mitolojik Anlatımlarıyla Mukayesesi, Bilig, 81, 51-77.
47. Yıldırım, Nilüfer (2011). Türk Halklarının Destan Yaratılarında Üç Dünya, Turkish Studies, 6 (3), 1951-1965.
48. Yıldız, Naciye (2008). Sibiryâ Türklerinin Mitoloji ve İnançlarında Kötü Ruhlar, Modern Türklük Araştırmaları Dergisi 5 (4), 84-93.
49. Yücel, Çağatay (2019). Eski Mezopotamya’da Öfkeli Tanrıların Mitosu, 3. Uluslararası Sanat ve Estetik Sempozyumu Tam Metin Kitabı içinde (ss. 276-191), Elazığ: Asos Yayınevi.

## КОМПЛЕКСНЫЙ ПОДХОД В ОБУЧЕНИИ ДИРИЖИРОВАНИЮ КАК ОСНОВА РАЗВИТИЯ ТВОРЧЕСКОЙ ЛИЧНОСТИ БУДУЩИХ УЧИТЕЛЕЙ МУЗЫКИ

### INTEGRATED APPROACH IN TEACHING CONDUCTOR AS THE BASIS FOR THE DEVELOPMENT OF THE CREATIVE PERSONALITY OF FUTURE MUSIC TEACHERS

**Aliyeva Maralkhanim Tofig gizi**

*Doctor of Philosophy in Pedagogy, Senior Lecturer*

*Azerbaijan State Pedagogical University*

*Faculty of Arts and Physical Education*

*Department "Music and technology of its teaching"*

*Azerbaijan, Baku city, Uzeyir Hajibeyov street, 68*

#### Аннотация

В статье указывается на необходимость развития творческих способностей у будущих учителей музыки на уроках дирижирования. Отмечается, что воспитание творческой личности становится одной из важнейших задач, стоящих перед музыкальной педагогикой. Решение этой проблемы требует комплексного подхода к обучению, т.е. применения традиционных, специфичных музыкальных и инновационных методов преподавания с опорой на общепедагогические принципы обучения. В статье предлагается ряд методов и технологий в сочетанном виде по формированию творческих способностей студентов дирижёрского класса.

Среди современных методов обучения с большим успехом на уроках дирижирования может применяться интегративный метод с использованием компьютерных музыкальных программ, которые привлекают внимание студентов к богатой информации о различных видах искусства. В тоже время они дают возможность прослушивать изучаемую в классе музыку и просматривать фрагменты концертов, фильмов, проводить сравнительный анализ различных исполнений.

Для развития творческого потенциала студентов необходимо высокое интеллектуальное развитие, определённый объём знаний, уровень интеллектуальных способностей, наследственные и врождённые задатки. Следовательно, обучение в дирижёрском классе должно идти по пути развития интеллектуальных способностей, увеличения объёма знаний, которые желательно, чтобы студент добывал самостоятельно, а преподаватель подталкивал его к этому различными вопросами и заданиями. Так, большое значение для адекватной интерпретации произведения имеет историческая и биографическая информация об авторах произведения. Поэтому студентам нужно предложить самостоятельный сбор информации (проблемно-поисковый, исследовательский методы). Также при аналитической работе над хоровой партитурой нужно использовать проблемно-поисковый метод. Давать такие задания на дом, чтобы у студента развивались исследовательские качества.

В статье указывается на необходимость развития дивергентного мышления при формировании технических навыков. Например, обучая навыкам аффтакта, синкопы или других технических приёмов необходимо сначала показать студенту все виды этих приёмов, а для конкретного произведения он должен уметь сам выбрать нужные из них. Творческая самостоятельность в учебной деятельности студентов формируется путем применения ранее полученных навыков и умений в новой форме и новых условиях. В этом аспекте самостоятельную работу над новым музыкальным произведением можно рассматривать как способ вовлечения студентов в самостоятельную учебно-художественную деятельность.

**Ключевые слова:** дирижирование, творческие способности, инновационные методы

**Abstract:**

The article points out the need to develop the creative abilities of future music teachers in conducting lessons. It is noted that the upbringing of a creative personality is becoming one of the most important tasks facing musical pedagogy. Solving this problem requires an integrated approach to learning, which implies the use of traditional, specific musical and innovative teaching methods based on general pedagogical principles of teaching. The article proposes a number of methods and technologies in a combined form for the formation of creative abilities of students of the conducting class.

Among modern teaching methods, with great success in conducting lessons, the integrative method can be applied using computer music programs, which draw the attention of students to a wealth of information about various types of art. At the same time, they make it possible to listen to the music studied in the classroom and view fragments of concerts, films, and conduct a comparative analysis of various performances.

For the development of the creative potential of students, high intellectual development, a certain amount of knowledge, the level of intellectual abilities, hereditary and innate inclinations are necessary. Consequently, training in a conductor's class should go along the path of developing intellectual abilities, increasing the amount of knowledge that it is desirable for the student to acquire on his own, and the teacher pushed him to this with various questions and tasks. Thus, historical and biographical information about the authors of the work is of great importance for an adequate interpretation of the work. Therefore, students need to be offered an independent collection of information (problem-search, research methods). Also, during analytical work on a choral score, it is necessary to use the problem-search method. Give such homework assignments so that the student develops research qualities.

The article points out the need to develop divergent thinking in the formation of technical skills. For example, teaching the skills of autotact, syncope or other technical techniques, it is necessary to first show the student all types of these techniques, and for a specific work he should be able to choose the necessary ones himself. Creative independence in the educational activities of students is formed through the application of previously acquired skills and abilities in a new form and new conditions. In this aspect, independent work on a new piece of music can be viewed as a way to involve students in independent educational and artistic activities.

**Key words:** conducting, creativity, innovative methods

После вхождения Азербайджана в Болонскую Конвенцию в республике начался принципиальный пересмотр существующих подходов в подготовке специалистов различных отраслей, в том числе и учителей музыки. В обществе уже сложилось понимание того, что основным капиталом является человек, способный к творческому поиску и освоению новых знаний. Общеобразовательной школе нужны специалисты высокого класса, умеющие не только творчески вести урок музыки, но и самим воспитывать и развивать творческое начало у подрастающего поколения. От того, как мы воспитаем будущего учителя музыки, зависит во многом уровень образованности, воспитанности и духовной культуры наших школьников. Воспитание творческой личности становится также одной из важнейших задач, стоящих перед музыкальной педагогикой.

Решение этой проблемы требует выявления воспитательного потенциала каждой учебной дисциплины, в том числе и предмета дирижирования, призванного содействовать овладению студентами-музыкантами профессиональным педагогическим мастерством, дирижерским искусством, а также развитию творческой, самостоятельно мыслящей личности и лидерских качеств будущих руководителей детских коллективов. В системе профессиональной подготовки учителей музыки предмет «дирижирование» занимает одно из главных мест. Поэтому внесение новых методов и технологий в образовательный процесс с точки зрения профессиональной компетентности имеет огромное значение в подготовке учителей музыки.

Процесс формирования творческих способностей будущих учителей музыки на уроках дирижирования требует большой кропотливой работы, прежде всего по овладению практическими профессиональными навыками. Однако задачи предмета не исчерпываются только воспитанием у студентов умений и навыков дирижирования, главная его задача – подготовить их к самостоятельной творческой деятельности на основе развития у них креативного нестандартного мышления, выработки аналитических и исследовательских качеств. А для этого нужна тяжелая, напряженная работа всех психических и интеллектуальных сил человека. Как отмечает А.М.Новиков, «...взлеты творчества являются результатом длительного кропотливого труда по накоплению впечатлений и материала» (6,11).

Музыкально-исполнительская деятельность является сложнейшим видом человеческой деятельности. Она требует концентрации всех психических процессов: воли, внимания, восприятия, мышления, памяти, воображения, а также точности и согласованности мельчайших физических движений. Являясь самым сложным видом исполнительской деятельности, дирижирование включает в себя много различных аспектов. Поскольку в процессе дирижерского исполнительства требуется решать обширный и многогранный круг вопросов, деятельность дирижера приобретает полифункциональный характер. Так, дирижеру нужно обладать целым рядом качеств, знаний и умений. Его деятельность включает в себя анализ, поиск, исполнительство, управление, коммуникативную, педагогическую, психологическую и организационную функции.

Как же научить всему этому студентов педагогов-музыкантов? Недостатком сегодняшних подходов в музыкальном обучении является то, что педагоги зачастую используют пассивные, «сообщающие» методы, которые не дают полной возможности подготовить будущего учителя музыки как творчески активную, самостоятельно мыслящую личность. В связи с этим возникает необходимость нового подхода к педагогике дирижирования, поиска новых путей. Сегодня назрела необходимость комплексного подхода в обучении, т.е. умелого сочетания традиционных, специфичных музыкальных и инновационных методов обучения с опорой на известные общепедагогические принципы.

А.А.Скрынников (8, 77-78) классифицирует традиционные методы по двум направлениям – словесный и наглядный методы. Словесный метод включает в себя следующие приемы: прием концентрации внимания; прием объяснений, комментариев; прием наводящего подсказа; прием поправочных остановок-замечаний; прием воображаемой аудитории и т.п. В наглядном же методе используются следующие приемы: наблюдение; иллюстрация и демонстрация; приемы позитивного и негативного показа, прием «замедленной киносъемки» и т.п.

Помимо этого существуют специфичные методы музыкальной педагогики: метод интерпретации, метод целостного образа, метод интонационной поддержки, методы ассоциаций, аналогий и сопоставлений. Всё это используется с опорой на общепедагогические принципы: демократичность, гуманизм, преемственность, доступность, индивидуальный подход и т.д.

При изучении хоровых произведений работа над одним и тем же произведением с каждым студентом должна вестись по-разному: следует менять тон и лексикон уроков, изменять указания, относящиеся к трактовке хорового произведения, т.е. к каждому студенту нужно применять свой подход. Различным должен быть также и подход к самому произведению. Вообще индивидуальный подход нужно использовать не только при работе над произведением, но и при подборе репертуара. При этом следует учитывать индивидуальные психологические и физиологические особенности каждого студента. «Заторможенным», скованным студентам предлагаются произведения более подвижного характера или



произведения с разнообразным ритмическим строением в каждой руке, что требует быстрой реакции. А излишне эмоциональным и суетливым студентам можно предложить произведения спокойного, даже аскетического характера, чтобы приучить их к культуре выражения своих чувств, к сдержанности.

Для развития творческих способностей студентам можно предложить следующие задания:

- Подобрать ассоциативные сравнения к определенным выразительным местам в произведении;
- Передать образное содержание таких фраз жестами и мимикой;
- Сравнить использованные композитором средства выразительности в двух произведениях различного характера и стиля;
- Про себя пропевая различные фразы из хорового произведения, продирижировать их так, чтобы можно было узнать какая это фраза;
- Сравнить произведения различных композиторов на один и тот же текст и объяснить средства выразительности, используемые каждым композитором для раскрытия образного содержания.
- Сравнить произведения различных композиторов на одну и ту же тематику (например, «Осень»). Разъяснить средства выразительности, используемые каждым композитором для раскрытия одного и того же образа.
- Дать полный анализ хорового произведения с привлечением компьютерных технологий (с использованием наглядных иллюстраций или слайдов – графических, текстовых, видео, аудио).

Очень эффективен для развития творческих способностей студентов метод аналогий и сопоставлений. Музыкальные аналогии позволяют заострить внимание студентов на средствах выразительности в произведении: мелодии и гармонии, агогических изменениях, темпе и ритме, паузах и ферматах, тембрах и тональности, драматургии и стилистике. При помощи метода аналогий и сопоставлений все эти элементы музыкальной звучности глубоко изучаются и анализируются с точки зрения художественного воплощения авторского замысла.

При анализе сходств и различий происходит накопление богатой и яркой информации, расширяющей запас специальных знаний студентов, развивающей их общий и музыкальный интеллект, мировоззрение, что в дальнейшем стимулирует у них развитие дирижерских исполнительских навыков.

При решении творческих задач сравнительный анализ произведений должен производиться по разным признакам или элементам, например по стилю, жанру, фактуре, ладу и т.п. Чтобы учащийся мог сразу понять основную идею произведения, проникнуться его образным строем, полезно сопоставлять различные сочинения одного и того же автора. Такой подход создает целостную картину о творчестве данного композитора, одновременно конкретное, в данный момент изучаемое произведение становится более понятным, его художественный смысл проявляется более выпукло и ярко. Сопоставление произведений, близких по эмоциональной окраске и идейному содержанию, но написанных разными композиторами также развивает образное мышление и воображение студентов. Сравнение образного ряда произведения с картинами природы, жизненными явлениями тоже полезно для развития ассоциативного мышления студентов.

Если с традиционными и музыкальными методами всё более или менее понятно, то использование инновационных методов в практике обучения дирижированию не очень распространено. Однако мы считаем, что в современную эпоху это необходимо. К инновационным методам относятся: проблемно-поисковый, эвристический, исследователь-



ский, дивергентный методы, интерактивные и интегративные технологии, мульти-медиа технологии (ИКТ).

Среди современных технологий подготовки специалистов наиболее эффективными для развития творческих способностей студентов являются проблемно-поисковые и исследовательские технологии обучения. Привлечение студентов к исследовательской деятельности несёт в себе широкие возможности для формирования творческого поведения. Такой подход формирует творчески мыслящих профессионалов, обладающих навыками научной деятельности, умеющих самостоятельно анализировать и использовать современные научные достижения. Преподаватель дирижерского класса должен формировать у студентов умение распознать проблему, сформулировать её на вербальном уровне, пробовать различные пути ее решения варьированием разных подходов (дивергентный метод), версий, комбинаций и в конечном итоге уметь делать четкие и ясные выводы.

Любой музыкант-исполнитель, а тем более дирижер при работе над произведением неминуемо должен пройти через три стадии:

а) становление замысла исполнения; б) аналитическая работа над средствами исполнения; в) реализация замысла исполнения. Однако существенным отличием дирижерского исполнительства является особое значение первой стадии, т.е. работа над партитурой, которая в свою очередь осуществляется в три этапа:

- 1) работа над музыкой и текстом: исторические сведения о создании произведения, об авторах и т.п.;
- 2) музыкально-теоретический и вокально-хоровой анализ, выявление ладотональной основы произведения, средств выразительности, темпа, ритма, динамики, агогики, вокальных и дирижерских трудностей и т.п.;
- 3) осмысление исполнительской интерпретации и выбор дирижерских технических средств исполнения.

Отсюда напрашивается вывод, что проблемно-поисковый и исследовательский методы являются очень важными в становлении творческой индивидуальности студентов. Существенным при этом является то, что знания не передаются студентам в готовом виде, преподаватель ставит задачу, т.е. создает проблемную ситуацию, что подталкивает студентов к самостоятельному поиску информации для ее решения, это, в свою очередь, активизирует познавательные функции и формирует у них творческое мышление.

Большое значение для адекватной интерпретации произведения имеет историческая и биографическая информация об авторах произведения. Поэтому студентам нужно предложить самостоятельный сбор информации (проблемно-поисковый, исследовательский методы). Необходимо задавать студентам наводящие вопросы:

- Как эпоха, в которой жили композитор или поэт, могли повлиять на создание, особенности стиля данного произведения?
- Каким образом индивидуальные черты личности авторов отражаются на характере произведения?

Для того чтобы ответить на эти вопросы, студентам придётся провести большую самостоятельную работу по сбору информации, что стимулирует их исследовательские качества. Такая аналитическая работа над произведением углубляя познания студентов, даёт представление о его идейно-художественном содержании, делает его ближе и понятнее для последующего исполнения.

Формирование творческих способностей находится также в тесной взаимосвязи с процессом овладения профессиональным техническим мастерством студентов. Причем связь эта двоякая: с одной стороны без развитой техники невозможно осуществлять творческий процесс, с

другой стороны процесс освоения дирижерской техники протекает быстрее и интереснее при творческом подходе к преподаванию дирижирования. Так, необходимо развивать дивергентное мышление при формировании технических навыков. Например, обучая навыкам ауфтакта, синкопы или других технических приёмов необходимо сначала показать студенту все виды этих приёмов, а для конкретного произведения он должен сам уметь выбрать нужные из них.

Обучение в дирижерском классе должно идти по пути развития интеллектуальных способностей, увеличения объёма знаний, которые желательно, чтобы студент добывал самостоятельно, а преподаватель подталкивал его к этому различными вопросами и заданиями. Однако мы считаем, что для развития творческих способностей одного интеллекта недостаточно. В своей педагогической практике мы не раз наблюдали, как достаточно развитые в интеллектуальном отношении студенты, обладающие хорошим багажом знаний, порою не могут справиться с элементарными творческими задачами по раскрытию образа произведения при помощи дирижерских жестов и мимики. Бывает и такое, что вдохновенно дирижирующий в классе студент при практической работе с «живым» хором не может проявить себя как волевой руководитель и хор «навязывает» ему свою манеру исполнения. Конечно же, в обоих случаях, ни о каком творческом процессе речи идти не может. Поэтому во время обучения в классе дирижирования, при разучивании музыкальных произведений, студент должен приобретать не просто хаотичные, отрывочные сведения, а глубокие знания, логично выстроенные в систему. Постоянное сознательное применение теоретических знаний при работе над раскрытием идейно-художественного содержания исполняемого произведения служит более эффективному развитию музыкального мышления студентов. Усвоение знаний должно быть построено по принципу дедукции, т.е. от общего к частному. При таком методе у студентов развиваются аналитические способности и исследовательские качества, а также умение оперировать знаниями, применять их в самостоятельной творческой деятельности.

Творческая самостоятельность в учебной деятельности студентов формируется путем применения ранее полученных навыков и умений в новой форме и новых условиях. В этом аспекте самостоятельную работу над новым музыкальным произведением можно рассматривать как способ вовлечения студентов в самостоятельную учебно-художественную деятельность. Стимулируя самостоятельность мышления учащихся, следует создавать такие условия, при которых они не смогут выполнять определенные действия прежними способами и будут вынуждены искать новые способы действия. После того как студентами будет освоен весь арсенал дирижерских технических приемов (в данном случае слово «весь» применяется условно, т.к. имеются в виду приемы, необходимые по учебной программе в каждом семестре), поэтапно должен происходить переход к самостоятельному подбору нужных жестов в соответствии с необходимым исполнительским планом в каждом конкретном произведении. Творческая самостоятельность в данном случае может рассматриваться, как умение самостоятельно осуществлять весь комплекс работы над произведением: изучение и анализ партитуры, выбор дирижерских средств и приемов, создание образа и характера исполнения музыкального произведения.

Среди современных методов обучения с большим успехом на уроках дирижирования может применяться интегративный метод с использованием компьютерных музыкальных программ, которые привлекают внимание студентов к богатой информации о различных видах искусства. В тоже время они дают возможность прослушивать изучаемую в классе музыку и просматривать фрагменты концертов, фильмов, проводить сравнительный анализ различных исполнений. Изображение и звук включают воображение и образное мышление, тем самым помогая студенту целостно воспринимать предлагаемый материал. Появляется возможность совмещать теоретический и демонстрационный материалы. Кроме того,

задания, задаваемые студентам на дом для самостоятельной работы, тоже могут, не ограничиваясь словесной формулировкой, состоять уже из целого видеосюжета. Например, при изучении в классе дирижирования хора «Чанлибель» из оперы «Кероглу» У.Гаджибейли полезно просмотреть фрагменты фильма с участием известного азербайджанского оперного певца и актера Бюльбюля и прослушать этот хор. Студенту задается самостоятельное задание по сбору максимальной информации об опере (история создания, сюжет, действующие лица, анализ партитуры и т.д.). После того как студент полностью изучил и проанализировал данное произведение, просмотрел и прослушал, проникся его духом, можно приступить к отработке технических дирижерских приемов. В данном случае происходит интеграция музыкального и актерского (кино) искусства, а также истории и литературы (изучение исторического дастана). И все это на основе компьютерных технологий.

Восприятие видов искусств помогает возникновению в сознании студента целой цепи ассоциативных связей, которые приводят к развитию новых образов, так или иначе связанных с непосредственно воспринимаемыми. Ассоциативность является неперенным условием в процессе синтеза и комбинирования имеющегося опыта, в преобразовании данных, полученных путем восприятия. По этому поводу Г.М.Цыпин пишет, что «благодаря ассоциациям психическая деятельность человека становится полнее, глубже, многокрасочнее; мышление, в частности художественно-образное мышление, делается богаче и многомернее» (9, 123). В музыке можно передать эмоциональное переживание, рожденное живописью или литературой. В то же время музыка своими обобщенными образами создает в сознании исполнителей и слушателей зрительные картины мира, ассоциации с предметами и явлениями реальной действительности.

Например, хоровое произведение «Осень» Кара Караева является своеобразным откликом на одноименное стихотворение Низами Гянджеви. Оба произведения оказывают на нас сходное эмоциональное воздействие. Причем различие между видами искусства, их выразительными возможностями совершенно не препятствуют художественному воплощению идентичных событий и явлений реальной действительности в разных видах искусства. Как отмечает Т.А.Багирова, «...слово – есть первооснова культур, объединяющая людей, соединяющая их общением. В контексте с музыкой данное соединение становится гораздо более значимым, доходчивым, усиленным эмоциональным воздействием» (3, 9).

Применение проектной методики также способствует развитию творческих способностей. Здесь проблема, предлагаемая студентам должна так формулироваться, чтобы возникла необходимость привлечения информации из смежных предметов. Самостоятельный выбор содержания и способов деятельности способствует развитию эмоциональной сферы и творческого воображения личности. Каждому студенту можно предложить задание с учетом его склонностей, способностей и уровня подготовки. Это могут быть рефераты, презентации, драматические сценарные проекты (для общеуниверситетских мероприятий), лектории на кафедре с использованием демонстрационного материала, концерты, конкурсы и т.п. Могут быть также творческие проекты, такие как создание видеоклипа в программе Movie Maker. Также при изучении какого-либо хорового произведения можно соединить красочные изображения по близкой тематике с текстовой информацией на фоне звучащей музыки, что окажет сильное эмоциональное воздействие на студентов, будет развивать их художественный вкус и способствовать получению новых знаний, в том числе и в смежных областях искусства.

Использование графических редакторов выводит на качественно новый, профессиональный уровень оформления творческих (самостоятельных) работ, способствует возможности самовыражения студентов и, соответственно, их положительной мотивации к выполнению

самой работы и использованию компьютера. Программы для создания компьютерных презентаций (например, «Power Point») играют аналогичную роль для устного представления результатов работы. Они также очень эффективны для наглядного представления материала: иллюстраций (графических, текстовых, видео, аудио). При чтении лекций, проведении семинаров, открытых уроков, конференций с помощью графических редакторов появляется возможность создавать анимации, студенты могут самостоятельно проектировать компьютерные модели, иллюстрирующие различные музыкальные произведения. Такая работа не только дает дополнительный демонстрационный материал педагогу, но и полезна для самих обучаемых, поскольку кроме владения компьютерной программой требует глубокого понимания сути изображаемого. Однако главным положительным моментом использования данных программных средств является то, что работа студентов в графическом редакторе выявляет уровень развития образного мышления, воображения и помогает их совершенствованию.

Однако следует отметить, что применение компьютера и других технических средств на уроке дирижирования – это не самоцель. Очень важно не превратить урок дирижирования в урок общения с компьютером, в урок информатики. Как бы преподаватель не был увлечен новой методикой, его задача использовать только те открытия информатики, которые помогут раскрыть, развить и реализовать творческие способности студента. Применяя новые информационные технологии на уроке, нельзя забывать о том, что это урок общения с искусством, с музыкой.

Таким образом, как видно из всего вышесказанного, сочетание различных традиционных и современных инновационных методов проведения уроков дирижирования, т.е. комплексный подход в обучении является основой для формирования творческих способностей студентов.

### **Литература:**

1. Алиева К.Р. Психологические проблемы формирования творческой личности. Баку: «Тахсил», 2007, 176 с.
2. Алиева М.Т. Формирование творческих навыков студентов на уроках дирижирования. / Журнал «Dil və Ədəbiyyat», Баку: БГУ, 2011, № 1 (77), с. 293-295
3. Багирова Т.А. Зарождение и проблемы синтеза музыки и слова в истории педагогической мысли. / Дис-я на соискание уч. степени доктора пед-х наук, Баку, АГПУ, 2007, 250 с.
4. Гилфорд Дж. Три стороны интеллекта: Психология мышления. Москва, 1965, с. 433-457
5. Дадашева М.Р. Вопросы творческой фантазии в психологии, педагогике и музыке. Баку, АГПУ, 1995, 57 с.
6. Новиков А.М. Профессиональная педагогика. Москва: «Эгвес», 2009, 456 с.
7. Сеидов С.И. Феноменология творчества. Баку: «Çaşıoğlu», 2009, 301 с.
8. Скрынников А.А. Методы педагогического воздействия в структуре управления деятельностью учащегося-музыканта. / Искусство и образование. 2004, № 3, с. 75-84
9. Цыпин Г.М. Формирование активного, самостоятельного творческого мышления учащегося-музыканта. / Психология музыкальной деятельности. Москва: «Академия», 2003, с.355-361

## THE CONNOTATIONS OF JAPANESE WORDS WRITTEN IN KANJI ALPHABET: A “COLOR”FUL REPRESENTATION

**Lec. Turgut KALAY<sup>1\*</sup>, Asst. Prof. Dr. Dilşah KALAY<sup>2\*\*</sup>**

<sup>1</sup>*Mimar Sinan Fine Arts University, Inst. of Science & Tech., Dep. of Interior Architecture,  
İstanbul, Turkey.*

*ORCID <https://orcid.org/0000-0002-8532-1203>*

<sup>2</sup>*Kütahya Dumlupınar University, School of Foreign Languages, Kütahya, Turkey.*

*ORCID <https://orcid.org/0000-0003-0681-3179>*

### Abstract

Similar to the other Asian societies such as Korean and Chinese, Japanese people have a different and unique way of expressing themselves when it comes to written communication. To explain, the Japanese writing system is composed of three alphabets: Hiragana, Katakana, and Kanji. These alphabets are differentiated not only by their appearances but also by their practical use. Hiragana (ひらがな) and Katakana (カタカナ) are pure Japanese inventions whereas Kanji (漢字) is derived from Chinese language (Jones & Aoki, 1988). Hiragana alphabet is utilized primarily for representing Japanese words and regarding the foreign vocabulary such as television (テレビ) or radio (ラジオ), katakana alphabet is applied for word representations. On the other hand, kanji symbols, consisting of more than 8,000 characters, are used in order to represent an abstract concept, a name, and/or a general word. Each kanji symbol may have multiple meanings, and they can also be combined to create another concept or word. Within the scope of this study, the connotative meanings of Japanese words with kanji representations are discussed. Three beginner-level Japanese language learners as well as three students of interior architecture, deeply enthusiastic about learning Japanese culture, have participated in the study. The first group has determined some Japanese words and explained how kanji symbols are related to the word meanings, and the second group has represented these words using “colors”. As a result, three works of art are presented with this interdisciplinary study.

**Keywords:** Japanese language, kanji representations, colors

### Özet

Yazılı iletişim, Kore ve Çin gibi Asya kültürlerinde olduğu gibi, Japon kültüründe de farklı ve eşsiz bir yapıya sahiptir. Açıklamak gerekirse, Japonca yazı sistemi 3 farklı alfabeden oluşmaktadır: Hiragana, Katakana ve Kanji. Bu alfabeler hem yazım şekilleri, hem de kullanım alanları bakımından birbirlerinden ayrılırlar. Hiragana (ひらがな) ve Katakana (カタカナ) tamamen Japon kültürüne ait alfabeler olarak bilinirken, Kanji alfabesi (漢字)Çince’den türetilmiştir (Jones & Aoki, 1988). Hiragana alfabesi sadece Japon kaynaklı kelimelerin yazımı için kullanılırken, Katakana farklı dillerden Japonca’ya geçmiş televizyon, radyo gibi kelimelerin yazımı için tercih edilir. Bu iki alfabeden tamamen farklı olarak kullanılan Kanji alfabesi 8000’den fazla karakterden oluşmaktadır. Her bir kanji karakteri soyut bir konsepti ya da özel/genel bir ismi sembolize eder. Ayrıca, kanji sembolleri farklı anlamlar da taşıyabileceği gibi, birden fazla kanji sembolünün birleşmesi anlamlarından bağımsız yeni bir sembolün türemesine de sebep olabilir. Bu çalışma kapsamında, kanji sembollerinin çağrışımsal anlamları üzerinde durulacaktır. Üç başlangıç seviye Japonca öğrencisi ve 3 iç mimarlık bölümü ikinci sınıf öğrencisi ile yürütülen bu disiplinlerarası çalışmada, Japonca öğrencileri



belirledikleri kanji sembollerini diğer gruptaki öğrenciler ile paylaşacaklar, o öğrenciler de bu kanji sembollerinin çağrıştırdığı duyguları “renk” kullanımı ile yansıtacaktırlar.

**Anahtar Kelimeler:** Japon dili, kanji harfleri, renkler

## INTRODUCTION

Japanese is called *Nihongo*, which is a word that started to be used after the Meiji Restoration (Meiji Ishin), in Japanese but the word itself (as utilized in English, Turkish, etc.) is derived from the Portuguese word “Japones” (Yavuz & Ergenç, 2006).

Unlike English or Turkish which use a sequence of simple alphabetic characters – Latin Alphabet – Japanese have a different way of written communication. The Japanese writing system is composed of three alphabets: Hiragana (ひらがな), Katakana (カタカナ), and Kanji (漢字). These alphabets are differentiated not only by their distinct appearances but also by their use.

Hiragana and katakana – collectively referred to by the generic term “Kana” (Yavuz & Ergenç, 2006) – are syllabic alphabets composed of 47 characters. In both of these alphabets, each character represents a sound. That is to say, both forms have an almost perfect one-to-one relationship between character and pronunciation, which means that one character always represents one particular syllable or more (syllable like unit) of the Japanese language, and its sound value does not change whether the character appears in the first, the middle, or at the last position of a multi-syllable word (Sambai et al., 2011). Additionally, some of the characters between the two alphabets even represent the exact same sounds and look quite similar to one another. On the other hand, the major difference between hiragana and katakana is the fact that hiragana is primarily used to represent Japanese words, whereas katakana represents foreign loan words. As Japanese is a language including many borrowed words, katakana highlights what is coming for the readers.

Different from Hiragana and katakana, the relationship between Kanji characters and their pronunciation seems to be much more opaque (Kaiho, 1983). This opacity is caused by the fact that “each Kanji character is a morphographic element that cannot phonetically be decomposed in the way that an alphabetic word can be. There are no separate components of a character that correspond to the individual phonemes” (Wydell et al., 1993, p. 492). This means that Kanji characters can be acknowledged as symbols/representations with various connotative meanings.

As can be understood, Japanese learners appear to rely more on visual information in second/foreign language word processing. Especially with Kanji representations, all different meanings of symbols are to be known/memorized in order to be able to understand the message. With all these in mind, the main purpose of the current study is to reveal the connotative meanings of specific kanji symbols in a concrete, visual way, that is through colors. Accordingly, the research question is determined to be as follows:

“How do colors reflect the connotative meanings of Kanji representations?”

## MATERIALS & METHODS

As the primary goal of this research is to indicate what connotations kanji symbols may have via the interaction of colors, six participants have been determined through the random sampling method (Creswell, 2012). Three of the participants are beginner-level Japanese language learners (Group 1) whereas the other three are first-year students from the department of interior architecture (Group 2) who have taken the course named “Basic Art Education”. In this specific departmental course, students are expected to be knowledgeable about the chromatics which is related to the scientific aspects of color and light.

The research process is illustrated in Table 1 in detail:



The study has taken two weeks. During this two-week period, five online meetings have been carried out (The meetings have to be conducted online because of the COVID-19 precautions.). In the first session, the researchers explained what the research is about and provided the participants with the relevant information about the process. Following that, each Japanese language learner is paired with an interior architecture student so that they could work together. What is expected from each pair is that they will determine a Japanese word and do research about the connotative meanings of that word with a specific focus on its kanji representation. Group 1 is supposed to provide all the information about the Japanese language concerning the kanji symbols (they have selected) while Group 2 is to make a design of the symbol highlighting its connotative meanings.

In the following three sessions, pairs come together in order to specify the details of their work of art.

In the final session, the pair have presented what they have designed.

Sessions	Interaction	Course
S1	Researchers $\Rightarrow$ ALL	Introduction – Explanation of the Research Goal
S2	Student Pairs	Detailed Analysis of Kanji represent.
S3	Student Pairs	Detailed Analysis of Kanji represent.
S4	Student Pairs	Detailed Analysis of Kanji represent.
S5	Researchers $\Rightarrow$ ALL	Presentations of the Work of Arts

**Table 1.** Research Process

## RESULTS

Each of the three pairs has reflected the connotations of Japanese words, which they have selected themselves, as indicated below:



**Figure 1.** “Hi (火)” Fire, “Mizu (水)” Water (Chipboard with Acrylic)

The first pair provides an explanation of their work of art with these Turkish words: “İki zıt kavramın Kanjileri’nin yer aldığı bu çalışmada kırmızı ve mor renkleri güç ve asaleti temsil ederken, mavi ve beyaz ise huzuru temsil etmektedir. Ancak bu iki zıt kavram birbirinden bağımsız olmaksızın bir bütünlüğü ve dengeyi de vurgulamaktadır. Tıpkı zıtlıklar felsefesi olarak bilinen Yin-Yang arasındaki denge-uyum ilişkisi gibi.

Çalışmadaki duygusal ifade ise:

‘Su güç ve mevki hırsıyla yanan ateşi söndüremediği gibi; ateş de huzur ve mutlak rahatlığa ulaşmış suyu buharlaştırıp yok edemez’ dir.”

To explain in English, the pair express that fire and water are two opposite concepts, because of which they are reflected with colors red, purple, blue, and white. Red and purple indicate power and nobility whereas blue and white symbolize peace. However, these two conflicting concepts are not totally independent of one another as it is in Yin-Yang (the relationship of balance and harmony).

The emotion the art piece presents is that “Water cannot put out the powerful fire while fire cannot demolish water with comfort and peace.”

The second pair have selected the Japanese words “Ryujin (龍神)” and “Yomi (黄泉)”. Ryujin (龍神) means the God of the Oceans and Yomi (黄泉) is the Avernus.



**Figure 2.**“Ryujin (龍神)” The God of the Oceans, “Yomi (黄泉)” The Avernus (Work of Watercolor)

The pair reflects the connotative meaning of these Japanese words as follows:

“Japon Mitolojisiinde Ryujin (Okyanus Tanrısı); yağmur ve gök gürültüsü getiricisi olarak da bilinmektedir ve okyanusun gücünü simgelemektedir. Bu çalışmada ise sıcak ve soğuk renkler Ryujin Kanjisi’nin hissettirdiği duyguları yansıtmaktadır.



Çalışmada yer alan bir diğer Kanji ise Mitolojide Yeraltı Dünyası olarak bilinen Yomi'dir. Yomi'nin karanlık ve kasvetli ortamını yansıtan renkler ise siyah ve mor olarak belirlenerek ifade edilmiştir.”

To translate into English, in Japanese mythology Ryujin (the God of the Oceans) is considered as the welcomer of rain and thunder and symbolizes the power of the oceans. In this artwork, bright and cold colors reflect the emotions that Ryujin Kanji evokes.

The other kanji is Yomi, known as the Avernus. As it means darkness and melancholy, the kanji is reflected by the colors of black and purple in the present work of art.

The final pair have determined the words “Sakura (桜)” and “Komaru (困る)” for the current study and the connotations of these words are presented with the explanation below:



**Figure 3.** “Sakura (桜)” Cherry Tree, “Komaru (困る)” to Hard up (Canvas with Acrylic)

“Sakura; meyve vermeyen bir tür ‘Kiraz Ağacı’ olarak bilinmektedir. Çiçekleri ağır açar ve çabuk dökülür. Hem hayatın başlangıcını yani baharı, hem de baharın kaçınılmaz sonunu simgelemektedir. Bu sebeple edebiyatta ölüm ile yaşamın birlikteliğini ifade etmektedir. Bu çalışmada kullanılan renk geçişleri ise zıtlıkların yaşamın her anında olduğunu göstermektedir.

‘Zor Durumda Kalmak’ anlamına gelen Komaru ise çalışmada kapalı bir yerde bulunan bir ağacın zor durumda kalarak büyüemeyeceğini ifade etmektedir. Bu sebeple kullanılan renkler yukarıdan aşağı canlılığını kaybetmektedir.”

What this explanation means in English is that Sakura is known as a kind of cherry tree without fruits. It has some flowers which blossom slowly and come down very fast. The tree not only symbolizes the upcoming spring but also signals the inevitable end of the same season. Therefore, in literature death and life is described together with Sakura trees. Color transitions in this work show that conflicts take place in each and every moment of life.

On the other hand, the kanji Komaru meaning to hard up expresses the fact that a tree cannot grow if it is stuck. As a result, in the present work, the colors fade from bottom to top in this work of art.

## DISCUSSION & CONCLUSION

Within the scope of this interdisciplinary research, the goal is to reflect the connotative meanings of Japanese kanji symbols by the use of colors. For this purpose, Japanese language learners and students majoring in the department of interior architecture work collaboratively and bring out the aforementioned work of arts.

Interdisciplinary studies come out of two or more academic disciplines that work together to facilitate a powerful learning experience and emphasize integrative learning, critical thinking, and creative problem-solving. What is evident is that there are many difficulties inherent in creating interdisciplinary collaborations especially in terms of research processes (Gill et al, 2015). However, incorporating interdisciplinary thinking into the body of “researchers” appears to be crucial for the future of both education and science.

## REFERENCES

1. Creswell, J. W. (2012). *Educational Research Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (4<sup>th</sup> ed.). Boston, MA Pearson.
2. Gill SV, Vessali M, Pratt JA, Watts S, Pratt JS, Raghavan P, DeSilva JM. (2015). The importance of interdisciplinary research training and community dissemination. *Clin. Transl. Sci.* 2015; 8(5):611–614. doi: 10.1111/cts.12330.
3. Jones E.A., Aoki C. (1988) The Processing of Japanese Kana and Kanji Characters. In: de Kerckhove D., Lumsden C.J. (eds) *The Alphabet and the Brain*. Springer, Berlin, Heidelberg. [https://doi.org/10.1007/978-3-662-01093-8\\_17](https://doi.org/10.1007/978-3-662-01093-8_17).
4. Kaiho, H. (1983). Ningen wa kanji o doo shori shite iruka [How do people process kanji?] In H. Kaiho (Ed.), “Kanji o kagaku suru” [Sciencing Kanji] (pp. 35–66). Tokyo: Yuhikaku.
5. Sambai, A., Uno, A., Kurokawa, S., Haruhara, N., Kaneko, M., Awaya, N., Kozuka, J., Goto, T., Tsutsumori, E., Nakagawa, K., & Wydell, T. N. (2011). An investigation into kana reading development in normal and dyslexia Japanese children using length and lexicality effects. *Brain and Development*, 34, 520-528. <https://doi.org/10.1016/j.braindev.2011.09.005>.
6. Yavuz, N., Ergenç, İ. (2006). Japon Yazı Dizgesinin Öğretimine İlişkin Bir Araç Geliştirme Denemesi. Unpublished MA Thesis. Derived from: <https://dspace.ankara.edu.tr/xmlui/handle/20.500.12575/27964>. (Date: 01.08.2021).

# RUSSIAN IN KAZAKHSTAN: LANGUAGE IDEOLOGIES, LINGUISTIC PROCESSES, AND REACTIONS OF THE CHECHEN-INGUSH DIASPORA ON LINGUISTIC CHANGES

**Kheda MAMYSHEVA**

*Nazarbayev University, Department of World Languages, Literature and Culture, Nur-Sultan city, Kazakhstan*

## Abstract

In this project, I study and analyze discourses of the Kazakh-speaking online users about the Russian language and its speakers in Kazakhstan, review language-related trends and their reflections in changing linguistic landscapes and movements aimed at promotion, use, and strengthening Kazakh as a state language. I also examine reactions of the local Chechen-Ingush speaking minority to the anti-Russian discourses and linguistic changes currently happening in Kazakhstan. I argue that the Kazakh-speaking online users as representatives of a majority group and the Chechen-Ingush diaspora members as representatives of a minority group in Kazakhstan have different views on the role and status of the Russian language due to the difference in ideologies associated with linguistic, historical, social and political factors. I made an overview of current linguistic trends and news associated with local linguistic situation and governmental actions; collected discourse examples in Kazakh and Russian from the public posts or comment sections online; conducted interviews with the representatives of the Chechen-Ingush minority in Kazakhstan. The results show that the language-related processes include Russian language and Cyrillic script erasure, language downgrading, replacement of Russian by English, online language regulation, Latinization of Kazakh and its branding, which are based on and supported by the paper of Aneta Pavlenko (2009). As for the ideologies, the Russian language is mostly viewed as an aggressor and a threat to Kazakh identity, to the stability and development of the Republic. Also, Russian is equated with Russian political aggression, but implying the aggression of the Soviet regime. The reactions of Chechen-Ingush interviewees on linguistic changes show that people want the Kazakh language to develop, but no one wants Russian to be eliminated since it plays a major role in their lives as a language of international communication and as a connection to other Kazakhstani citizens.

**Keywords:** Russian in Kazakhstan, language ideologies, online language use.

## INTRODUCTION

Recently, the language situation in Kazakhstan has escalated, especially in the online space, where people can openly support a particular point of view, enter discussions, start or intensify conflicts. Many conflicts based on ethnicity and language repeatedly occur online as well as offline, undermining the long-standing policy based on the agreement and friendship of the numerous ethnic representatives of the state. Online discussions in the forms of comments and posts about language usage in Kazakhstan contain and evidence certain points of view and perspectives that align with particular *language ideologies*. We can define language ideologies as “the ideas with which participants and observers frame their understanding of linguistic varieties and map those understandings onto people, events, and activities that are significant to them” (Irvine and Gal 2000, 35). Other definitions provided by Woolard and Schieffelin (1994) include: “sets of beliefs about language articulated by users as a rationalization or justification of perceived language structure and use”; “self-evident ideas and objectives a group holds concerning roles of language in the social experiences of members as they contribute to the expression of the group”; and “the cultural system of ideas about social and linguistic relationships, together with their loading of moral and political interests” (57).

In this former Soviet space, many people associate “Soviet” with “Russian language and culture” (Pavlenko 2008b, Slezkine 1994, Wertheim 2012), and so debates often entail strong beliefs about the Russian language and bilingualism in the state. Being a multilingual and ethnically Chechen citizen of Kazakhstan, I have personally witnessed online and offline conflicts based on language, nationality, and ethnicity, changes in linguistic situation, and linguistic landscape in Kazakhstan. Thus, I wanted to study and see how these discourses are perceived by a linguistic and ethnic minority of Kazakhstan, namely the Chechen-Ingush diaspora. In this project, I answered the following research questions: 1. What linguistic processes are taking place in Kazakhstan, considering the Anti-Russian discourses online as a background? How can we understand this situation as part of a broader post-Soviet ‘linguistic landscape’ (Pavlenko 2009)? 2. What different language ideologies and attitudes concerning the Russian language are present in the discourse of the Kazakh speaking majority online users in Kazakhstan? What policies and changes are associated with these debates and discourses? 3. What are the reactions of the Chechen-Ingush speaking minority in Kazakhstan to those changes in language discourses, policies? In this project, I argue that the Kazakh-speaking online users as representatives of a majority group and the Chechen-Ingush diaspora members as representatives of a minority group in Kazakhstan have different views on the role and status of the Russian language due to the difference in ideologies associated with linguistic, historical, social and political factors.

As elsewhere in the former Soviet Union, the language-related processes happening in Kazakhstan include Russian language and Cyrillic script erasure, language replacement from Russian to English, language upgrading and downgrading, language regulation, Latinization of the Kazakh language, and language branding, which are based on and supported by the paper of Aneta Pavlenko (2009). As for the ideologies and attitudes, the Russian language is viewed not as a language of interethnic communication, but as an aggressor and a threat to Kazakh identity as well as to the stability and development of the Republic. Also, Russian language is equated with Russian political aggression, but pointing out to the aggression of the Soviet regime. Lastly, the reactions of Chechen-Ingush interviewees on linguistic changes differ, but, generally, people want the Kazakh language to develop, and no one wants Russian to be eliminated since it plays a major role in their lives as a language of international communication and as a connection to other Kazakhstani citizens.

## CONTEXT

This project focuses on the change in linguistic processes in Kazakhstan, as a part of former Soviet Union and as an independent state. In the Soviet Union, as Yuri Slezkine (1994, 443) in his article titled “The USSR as a Communal Apartment, or How a Socialist State Promoted Ethnic Particularism” writes Russian was not only a lingua franca, but a language of self-identification of a Soviet person: “...in 1938, after a three-year campaign, Russian became an obligatory second language in all non-Russian schools. The Soviet past was becoming progressively more Russian and so were the upper echelons of the Party and state.” With the collapse of the Soviet Union, all former Soviet states experienced the process of derussification and language policies change. Aneta Pavlenko’s articles provide a comprehensive overview of changing language policies in the Post-Soviet states, and contextual information and revision of the Central Asian states, primarily Kazakhstan.

In the article titled “Language Conflict in Post-Soviet Linguistic Landscapes.”, Pavlenko (2009) talks about the processes and trends of derussification and language shift in Post-Soviet states, highlighting and discussing the following five indicators in detail. *Language erasure*, or deliberate removal of signage in a particular language, in Post-Soviet states is reflected in elimination of Russian and Cyrillic script as a whole, including replacement of old signs, deletion of sign parts (painting over), and modification of single letters. *Language replacement*, a process of a new language taking over the functions of an eliminated language, in most of the Post-Soviet countries lies in replacement of Russian into English – language of globalization. *Language upgrading and downgrading* include changes in visual presentation (font size, color, order, or amount of information) of certain language. *Language regulation* involves using signs that directly or indirectly regulate the use of certain



language. *Transgressive signs* reflect the tensions of imposed language shift – they violate conventions or official norms in the language or script use. In our case, Kazakhstan is still in the beginning of the process of derussification, but we can trace some important patterns highlighted in the article, like a transition of the Kazakh language from Cyrillic to Latin script, introduction of English to the landscape, and even deletion of Russian in certain cases.

As for the language ideologies themselves, Irvine and Gal (2000) in their paper “Language Ideologies and Linguistic Differentiation” view language ideologies as “the ideas with which participants and observers frame their understanding of linguistic varieties and map those understandings onto people, events, and activities that are significant to them” (35). Woolard and Schieffelin (1994) provide a group of definitions for language ideologies. A neutral one is defined as “sets of beliefs about language articulated by users as a rationalization or justification of perceived language structure and use” (57). The second and third definitions involve the social and cultural perspectives: “self-evident ideas and objectives a group holds concerning roles of language in the social experiences of members as they contribute to the expression of the group”, and “the cultural system of ideas about social and linguistic relationships, together with their loading of moral and political interests” (57).

Going back to Irvine and Gal (2000), they identify three semiotic processes of ideological structure, namely *iconization*, *fractal recursivity*, and *erasure*. *Iconization* “involves a transformation of the sign relationship between linguistic features (or varieties) and the social images with which they are linked” (37), or a misrecognition of indexical relationships. Indexical relationships, in their turn, involve direct relationships between a language and certain activity, identity, attitude, etc. A belief that certain language indexes ethnicity or nationality is an instance of iconization, since language and ethnicity/nationality are not inherently linked. Another example of iconization is a view that German speakers are rude because their language seems to be rude. *Fractal recursivity* “involves the projection of an opposition, salient at some level of relationship, onto some other level” (38). In other words, some kind of difference appears in one level of language use/situation, repeating itself in another level of language use/situation. The difference, or opposition, includes actors attempting to divide identities, roles, statuses, etc., for instance, defining what is standard (official, correct, prestigious, etc.) and what is non-standard (vernacular, wrong, local, street, etc.). Last but not least, *erasure* involves an ideology making a sociolinguistic phenomenon concealed (38), e.g., some dialects may not be acknowledged at all in a discourse on standard languages, or minority speakers’ rights.

## **MATERIALS AND METHODS**

The methodological approach of this work is qualitative since it implies a sociolinguistic case study. The first research question involved general overview of current linguistic trends, actions of the government and private organizations, news and interviews related to the linguistic situation in Kazakhstan. The examples of linguistic processes found during the overview were sorted out into categories as well, which are Russian language and Cyrillic script erasure, language replacement from Russian to English, language upgrading and downgrading, language regulation, Latinization of the Kazakh language, and language branding.

In order to answer the second research question regarding the language ideologies and attitudes, I collected around 40 discourse examples in Kazakh and Russian from the public posts or comment sections in the social networks and news websites, such as Instagram, Zonakz.net, and Online.zakon.kz archive with open access (Appendix I). Zonakz.net and Online.zakon.kz are regular news sites with the ability to comment publicly on the news articles through the process of registration. Instagram is a social network, the initial idea of which is to share photos in a personal account, like and comment photos of others. Today, it has become a platform for business, exchange of information, activities of different activists, and various public discussions on various topics. All these sources were selected according to the content of the relevant materials on languages and speakers, particularly the articles about linguistic changes in Kazakhstan, outflow of the Russian speakers, conflicts over the Kazakh and Russian languages and their speakers, etc. After finding and collecting the materials, I sorted them out by the categories.

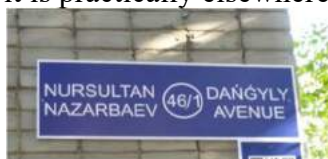
The last question on the reactions of the Chechen-Ingush minority required conversations with its representatives, so I created interview questions (Appendix II), asking for their personal information such as name, age, place of birth, etc., their opinions on language and ethnicity topics, and reactions to certain changes and comments found online; contacted the possible participants, and conducted the interviews with audio-recording. Overall, there are seven interviews, two of them conducted online, and the rest done face-to-face, following all safety measures. The interviews were transcribed and analyzed, extracting the main similarities and differences from the responses, language ideologies and reactions. Participants were found through my personal connections and with the help of diaspora members. Participants of the interviews are citizens of Kazakhstan, mainly from the Nur-Sultan city, Pavlodar and Taraz, and are members of Chechen-Ingush diaspora. All interviewees identify themselves ethnically as either Chechen or Ingush.

## RESULTS AND DISCUSSION

### Post-Soviet Linguistic Landscape in Kazakhstan

Starting with the analysis of the section answering the first research question, it is based on the work of Aneta Pavlenko (2009) discussed earlier, expanding the modes for analysis online. Overall, I highlighted six processes, some of which are closely connected to each other, namely: Russian language and Cyrillic script erasure, language replacement from Russian to English, language upgrading and downgrading, language regulation, Latinization of the Kazakh language, and language branding. All these processes reflect gradual derussification of public space, online and offline, happening in Kazakhstan.

Latinization of the Kazakh language, a major and most debatable process going on in Kazakhstan, penetrates all spheres of society. Top-down and bottom-up signs are changing, Kazakh in Latin script is used more often and in greater quantities. The main official mission behind Latinization is to modernize the Kazakh language and push the country to the international arena; the future possibility of learning English better and faster with the existing knowledge of the Latin alphabet is also being discussed. Latinization, however, can also be seen as an escape from the Soviet past and change of political orientation from Russia to the West. The erasure of the Russian language with the Cyrillic alphabet in Kazakhstan implies a departure from Russian cultural influence, Soviet history, and an approach to the West, globalization and the world in general. Erasure of Russian in this case is followed by its replacement to the English language, which is expected to replace Russian as a new lingua franca in post-Soviet space as it is practically elsewhere in the world.



**Figure 1.** Russian language/Cyrillic script erasure and its replacement to the English language/Latin script in Pavlodar city, Kazakhstan.

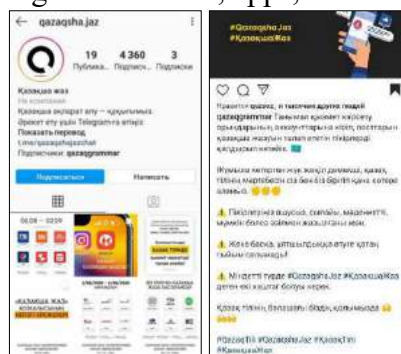
Language upgrading and downgrading are reflected mostly in the top-down signs. The Kazakh and/or English languages are given priority in font and location, whereas Russian is downgraded, and sometimes can be barely found, as in the example given in Figure 2. This is connected to the Russian language erasure since the name of the street itself is not written in Russian.



**Figure 2.** Kazakh and English language upgrading in a street sign, Nur-Sultan city, Kazakhstan.

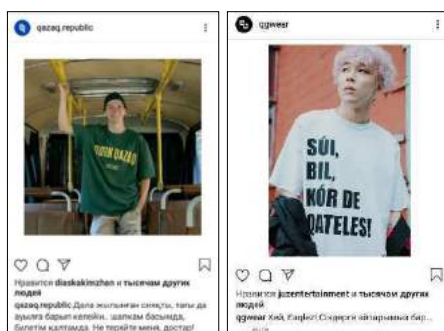
Language regulation is the process that has not yet been reflected in the linguistic landscape in Kazakhstan, but exists in the online space, specifically in Instagram. It appears as a movement known as “qazaqsha jaz” which regulates the use of the Kazakh language by online service providers. The

movement does not aim to eliminate Russian and its use, but to promote the use of Kazakh in public space and in service providers' Instagram accounts, apps, or web-sites.



Figures 3, 4. Language regulation trend in Instagram.

The last process, which was not discussed in the article of Pavlenko (2009) but can be considered as a part of linguistic landscape, is language branding through clothing. Some recent clothing brands use Kazakh in Latin script, thereby building the very idea of their brand, reviving it on a new, “modern Qazaq” identity.



Figures 5, 6. Kazakhstani clothing brands promoting the Kazakh language and Latinization.

As we see, all the processes described by Pavlenko and found here contribute to the derussification of Kazakhstan, promotion of Kazakh, and its move to the globalization through the increased use of Latin script and the English language. The ideology here does not possess but is aimed at erasure of Russian as well as Cyrillic script. Also, we see an iconization process of equating the Cyrillic script to the Russian language, which is, as further described, equated to nationality, ethnicity, history, aggression, etc.

### Discourses on Russian Language and Speakers by Ethnic Kazakhs in Kazakhstan

Proceeding with the second research question, the following discourse examples were collected to show the attitudes of the Kazakh speakers, changes in language policies, current trends, and identified language ideologies and attitudes. The discourse examples were sorted out by main themes.

*People in the comment sections set conditions for other ethnic representatives/ Russian-speaking Kazakhs living in Kazakhstan to know “national language”, which is Kazakh:* The Kazakh speakers online offer to fine people who do not know the Kazakh language, particularly ethnic Russians, to collect more taxes from them, or to confiscate their property if they move from Kazakhstan. This is against the constitution due to the ethnic and linguistic discrimination, but still people encourage government to implement certain actions against those who do not speak Kazakh. Even though there is an outflow of the non-Kazakh ethnic representatives, the number of ethnic non-Kazakhs is still significant, constituting 31.49 percent of the overall population of Kazakhstan (Statistics Committee under the Ministry of National Economy of the Republic of Kazakhstan 2020). Such discourses, in addition to the goal of supporting the state language, show anti-Russian sentiments and the need for control and dominance over the state in terms of the country's titular nation. Being subordinate and minoritized (Melich and Adilbayeva 2013) under the Russian Empire and the USSR, with the acquisition of independence and the status of the titular nation, people want to get linguistic and

cultural independence. Since the Russian language and the Russian people in general evoke a collective memory of repressions, hungers, and overall racism without race in the USSR (Tlostanova 2018), getting rid of the "colonial aggressors" implies a better life for the Kazakh people, especially in economic and social aspects. Here we find the ideology that language is an aggressor, like people who speak it, and getting rid of the language means getting rid of the colonial aggression that has been and is felt by people until now. The process of iconization also takes place in this case: the Russian language and those who speak it are equated with precisely Russian aggression, which, in turn, is equated with aggression on the part of the political regime of the USSR in general.

*Instagram accounts dedicated to controlling other Instagram accounts in terms of their use of the Kazakh language:* Russian language in Kazakhstan is not only the language of interethnic communication, but sometimes it is a sole language used by the personnel of businesses and services. This became problematic for the users of Kazakh language who cannot be served in their native language, the state language as well, which raised a wave of discontent in the Kazakh-speaking society. An online movement 'qazaqsha jaz' was created, which requires online representatives of certain businesses or service providers to use Kazakh on a par with Russian in advertising, providing information and services, in applications, and so on. Pages/websites and establishments/brands that do not fulfill these requirements are either bombarded with complaints and angry comments or ignored by the Kazakh-speaking population. The movement does not demand an elimination of the Russian language. In this case, there is a struggle for the support and use of the Kazakh language, as well as the protection of the linguistic rights of Kazakh-speaking consumers.

*A trend of speaking/answering to other ethnic representatives and Russian-speaking Kazakhs only in Kazakh:* People online are encouraged to speak and answer in Kazakh, even though their interlocutor speaks Russian. The purpose of this movement is to strengthen the role of the Kazakh language in society, and it is very celebrated among the Kazakh speakers. People imply that in this way they will force Russian speakers to speak Kazakh, but it has led to some conflict situations that are widely discussed on the Internet. Here, the Russian language is unofficially deprived of the status of the language of interethnic communication, replacing it with Kazakh. However, this can be considered linguistic discrimination against Russian speakers, leading to conflicts and other negative consequences in society. Also, in some examples, there is a hostile tone and a compelling mood of Russian-speakers to adapt to the new conditions, since they "understand [in Kazakh] when needed."

*People use national symbols in the comment sections, particularly flag of Kazakhstan:* The flag of Kazakhstan, which conventionally symbolizes national independence of the state, plays as a representation of linguistic, national independence, linguistic, ethnic, and national identity and a connection between these three. People use it in their discussions to symbolize their independence and identity. Also, they use the flag to unite, to increase the authority of their statements symbolically, and show that "the need to learn Kazakh" is not only expressed by the participants, but by the government as well, referring to the law.

*People use religious discourse (help of God) when speaking about revitalization of the Kazakh language, and it being the only language of the state in the future:* This trend proposes the connection of "God" and "superior force" with formation of monoethnic/monolingual nation and promotion of Kazakh. Religious references, God, and Muslim discourse symbolize the pre-Sovietness, connection with other Muslim Turks (Turkish or Tatar people for example), and Muslim identity. Using religious discourse is one of the ways to separate Kazakhs from Russians and the Russian language, what in their turn associate with atheistic Soviet regime, anti-Islamic and "anti-Kazakh" tendencies. It is also a way to revive cultural elements existent before the Soviet era in terms of religion, such as Arabic script, religious schools, etc. (Wertheim 2012), and to incorporate them to the present culture construction of the independent Kazakhstan.

*Elimination of the Russian language and its role as a language of interethnic communication:* This is the most frequently used topic within a language-related discourse, connected to the other ones, such as setting conditions for Russian speakers, and encouragement of Russian-speaking population emigration. Along with evident anti-Russian aggression and expression of the need to "demolish" the Russian language, they use inaccurate statistics to support the fabricated view about Kazakhstan being

monoethnic. The official statistics shows that there is 68.51 % of Kazakhs and, accordingly, 31.49 % of other ethnic representatives, with Russians constituting 18.85% (Statistics Committee under the Ministry of National Economy of the Republic of Kazakhstan 2020). This indicates a significant portion of Kazakhstani residents as well as tourists or foreign workers using Russian as a language of interethnic communication, not to mention the languages used by ethnic minorities. Thus, such discourse tries to erase non-Kazakh languages and residents of Kazakhstan, and the status of the Russian language as a tool for interethnic communication, developing “one language-one nation” ideology. It also is noted by some participants that such anti-Russian discrimination did not exist before, and everyone could speak the language they wanted, and that it was a key characteristic of Kazakhstan.

*Pride for not knowing/speaking/learning the Russian language:* Some people express a sense of pride that they do not know Russian, and they are not going to learn it. Such discourse is usually goes in an anti-Russian context. It can be regarded as a reaction to the assumption that Kazakhs do not want to learn Kazakh, preferring Russian. This way, and through the expression of identity, the participants of this discourse want to raise the prestige and status of Kazakh above Russian in Kazakhstan for both practical and symbolic purposes. In addition, they operate within the framework of the "one language - one nation" ideology, equating ethnic identity with linguistic and national ones.

*Failure to set appropriate Kazakh language policies:* This topic of discourse is connected to the linguistic capital (Bourdieu 1986). The discourses are mostly produced by dominantly Russian-speaking people. They talk about the failure of the government to create this capital, meaning the lack of appropriate Kazakh language teaching and education overall, shortage of literature in Kazakh, poor promotion and development of Kazakh, and poor socio-economic situation in Kazakhstan. They want to get something in return for learning Kazakh for which, in their opinion, nothing is fixed.

*Encouragement of “Russian speaking” emigration:* Emigration of the Russian-speaking population became a huge topic for news producers. Within this quite aggressive and fundamentally anti-Russian discourse we can find many other, such as the failure of the government to create appropriate conditions for the Kazakhstani citizens and to develop the language, elimination of the Russian language, and demand setting for the Russian speakers. People support the departure of the speakers of the Russian language, telling them “not to come back”; encourage to “kick out” Russian speakers if they do not learn or speak Kazakh, and brand those who has already left as traitors. By this, people believe that the state will become more “Kazakh”, and it will get rid of the Russian aggressors. Such discourse segregate and discriminate Russian speakers, charging them with responsibility for all the bad that happened and is happening to the Kazakh people, and accusing them of disrespect for the Kazakh language and the country.

*Shaming Russian-speaking Kazakhs:* This case is one of the common “ұят” strategies used in nation building. The participants believe that being Kazakh means knowing Kazakh language, and if a person, who identifies as Kazakh, does not speak Kazakh language, he or she is less “Kazakh” than those who speak it well; it is shameful and disapproving. Here, the Kazakh speakers again link up the language with ethnic identity, stating that “you cannot be called Kazakh if you do not know the Kazakh language”, presenting the ideology of equating ethnicity and language of a speaker.

*Russian political aggression:* The Russian language is often associated with political aggression of Russia and Soviet Union, brutal Soviet policies, repressions, coloniality, etc. This way the Russian language as well as the Russian Federation as its major representative are seen as a threat to Kazakhstan, its autonomy and freedom. Moreover, such Soviet historical cases as famine in 1932-33 is now results in blaming ethnic Russians as well as the Russian language.

*Pro-Russian Discourses:* Pro-Russian discourses are often produced by the Russian speakers trying to solve conflicts online and to support the use of Russian by Kazakhstani citizens, especially as a language of international and interethnic communication. They are concerned with internationality, current constitutional role of the Russian language, and “Kazakhs trying to blame Russians for their socio-economic problems”. Also, some online users note on still quite influential role of Russia in politics and economy of Kazakhstan, thus showing the need in keeping the Russian language as it is, focusing on Kazakh promotion. On the other hand, we can find the discourse about Russian speakers

being more “pleasing”, well-mannered and educated, whereas Kazakh speakers are called to be rude and mocking. Moreover, Russian is seen as a much more practical language in terms of education and science, literature, business, whereas Kazakh is still in need of development. Here we see examples of iconization, where people link qualities and states with linguistic variations/languages. In general, the discourses and attitudes of the Kazakh speaking online users as a majority representative in Kazakhstan show us the will to promote the use of the Kazakh language as a national language as well as a language of the Kazakh identity. This, however, happens through the aggressiveness towards the users of Russian and a desire to get rid of the Russian language from the public space and general use. Also, Russian is either not considered to be a language of interethnic communication anymore or being removed and replaced by the Kazakh language. In terms of language ideologies, Kazakh language is presented as a symbol of independence, “Kazakhness”, and nation. Russian, on the other hand, is seen as a threat, as a political aggression, as a reminder of the Soviet repressions and destructive policies. All these present iconization processes happening within the discourse, which construct language ideologies.

### **Interviews with Chechen-Ingush ethnic group members about Russian Language in Kazakhstan**

Regarding the third research question, the interviewees are older than 30, five out of seven are from the Nur-Sultan city, one is from Aksu, a small city located in Pavlodar oblast', and one from Taraz, South Kazakhstan. Everyone is associated with the Chechen-Ingush diaspora community to varying degrees. Almost all of them were born in Kazakhstan, living here in the first, second or third generation. Everyone speaks Russian very well, whereas the language skills of their ethnic identity, either Chechen or Ingush, are a bit different, but used in a daily basis to communicate with family and other Chechen/Ingush people. Everyone identifies themselves as Ingush or Chechen, and as a citizen of Kazakhstan. Almost all of them know and use basic phrases in Kazakh, but only one interviewee claims to speak Kazakh well, studying and taking Kazakh courses.

Overall, the reactions to changes in language related discourse, linguistic situation, and language policies vary from completely negative to positive, but all interviewees are surely against the removal of the Russian language in Kazakhstan. They point out to the impossibility of rapid elimination of Russian since it is still a language of interethnic and international communication in Kazakhstan and the Post-Soviet space; key literature is written in or translated into Russian, and it is costly and time-consuming to translate everything into Kazakh. They view Russian to be a language of much more opportunities in general. Also, they claim that not all Kazakhstanis know or speak Kazakh, so, if Russian is eliminated from official use, it would be hard for them to readjust; many key specialists in the country speak Russian only, so they would leave Kazakhstan, leaving it without professional staff, their knowledge and skills. Some told that it would be a “chaos” in the country if a decision about Russian removal is made, riots and migration will begin. Some participants suggest that the removal shall be done slowly, step by step, “painlessly”, taking into account the opinion of the people.

Continuing with the topic of Russian elimination reactions, several interviewees call attention to the key role of Russia in politics and economy of Kazakhstan, which makes the Russian language essential in knowledge and use among Kazakhstanis to keep a normal relationship with Russians. They mention that Kazakhstan has the longest border with Russia, and in Russian border regions, there are a lot of ethnic Kazakhs, as well as in Kazakhstan – ethnic Russians, so it is “wrong” to remove Russian if they want to maintain good relations. Also, most of the participants believe that majority of Kazakhs themselves do not know Kazakh, “their own” language, so Russian elimination will affect Kazakhs too. They note that their Kazakh friends or colleagues do not speak Kazakhs well, or if they do, they are against the Russian language removal as well. As for the knowledge of the Kazakh language, almost all the participants indicate that everyone living in Kazakhstan undoubtedly needs to learn Kazakh, but only one participant states that she speaks Kazakh well and keeps studying it and practicing it enthusiastically every day. Another participant said that, in case if Russian is eliminated, he would not like it, but he would study Kazakh actively.



When giving their opinion about current Latinization of the Kazakh language, three out of seven interviewees said the latinization was “a waste of money”, claiming that it is not beneficial for the country and language at all. It is possible that they do not feel any connections or relations to the Kazakh language itself, they do not see any practical value and significance in ethnic or any other identity. Others support it and believe that it is beneficial for the future of the language and for the relations with other Turkic nations and the West in terms of globalization. They indicate that it is uncomfortable to read in the beginning, but they will get used to it with time.

As I have mentioned, everyone from the interviewees consider Kazakhstan as their homeland, but most of them divide themselves from the Kazakhs, using “we” – “they” separation. This is especially evident when the talk about language policies and the role of Kazakh in Kazakhstan – they suppose that only ethnic Kazakhs can decide how to solve linguistic issues of the Republic because it its “their” country, and they are the hosts. Even living in Kazakhstan since the very birth, diaspora members feel isolated in Kazakhstani society. In the question of Russian elimination, one participant says that if Kazakhs want to remove it, it is their right to do so, since “Хозяин - барин” [literary “the host is a master”, or “the boss calls the shots”]. He had the same reaction for the Latinization – “if they want, let them transliterate... the boss calls the shots”.

This brings us to the next part about migration. Majority of interviewees do not consider moving out from Kazakhstan in the nearest future. Those who do, or are already in the process of moving out, tend to use “I don’t care” when talking about language policies and linguistic future of Kazakhstan, what adds to the “we” – “they” separation. These participants think that the linguistic changes will not affect them, they even may not feel themselves to be a part of the Kazakhstani society anymore. In addition, a few interviewees expressed a desire to move from the country if the Russian language is removed from official use without the consent of the people. Another detail is that some participants discussed and indicated an increased aggressiveness of people in Kazakhstan, especially directed towards other languages and ethnic representatives. Majority of the interviewees state that they did not face any discrimination towards them, but some did not consider neglect and ignoring as a discrimination. A few of them had relatives and/or friends discriminated and told to leave “their” country, but only one participant claims to face discrimination directly.

## CONCLUSION

In conclusion, I reviewed a linguistic situation happening in Kazakhstan in terms of linguistic processes as in Pavlenko (2009), majority views and discourses by Kazakh-speaking online users, and minority reactions of Chechen-Ingush diaspora members. The language-related processes happening in the state include Russian language and Cyrillic script erasure, language downgrading, replacement of Russian by English, online language regulation, Latinization of Kazakh and its branding, reflecting the attitudes of a linguistic majority group in Kazakhstan. As for the ideologies and attitudes, the Russian language is mostly viewed by Kazakh speakers online not as a language of interethnic communication, but as an aggressor and as a threat to Kazakh identity as well as to the stability and development of the Republic. Also, Russian language is equated with Russian political aggression, but implying the aggression of the Soviet regime. The reactions of Chechen-Ingush interviewees as a minority group of the country on linguistic changes differ, but, generally, people want the Kazakh language to develop, and no one wants Russian to be eliminated since it plays a major role in their lives as a language of international communication and as a connection to other Kazakhstani citizens. Generally, we can find an active process of derussification not only in linguistic landscapes and public space, but in discourses and ideologies possessed and produced by the people in Kazakhstan. It complicates the state of interethnic relationships and causes the conflicts online as well as offline, demonstrating a curious case of language conflict in post-Soviet country. This paper faced a few limitations, particularly with a number of interviewees. Due to the situation with Covid-19, I could not interview more participants from the Chechen-Ingush diaspora. Also, this project does not consider viewpoints and attitudes of other diasporas, which can be a topic for further research within this domain.

## Appendix

## I. Discourse Example Sources:

Instagram, social network: [instagram.com](https://www.instagram.com)

Online journal "Zona": [zonakz.net](https://zonakz.net)

News Sources Archive: [online.zakon.kz](https://online.zakon.kz)

Время, Общественно-политическая газета: [time.kz](https://time.kz)

## II. Interview Questions:

- General information (name, age, residence, job, etc.)
- Language knowledge (Chechen, Russian, Kazakh?)
- How long have you been living here in Kazakhstan? What about your parents, or grandparents?
- How many relatives of yours live here in Kazakhstan?
- Living here in Kazakhstan, how do you identify yourself, and with whom?
- Do you speak Kazakh? What about you children, etc?
- Do you use Kazakh in your everyday communication?
- What role does the Russian language play in your life and communication?
- Do you plan to leave KZ (migration)? Why, why not?
- What are your thoughts in general about current situation (Kazakh-speaking people trying to erase Russian in KZ)?
- How do you think, why is this happening right now?
- Do you think this linguistic situation has changed over time? What about ten years ago?
- Russian is considered to be a language of interethnic communication in Kazakhstan. Do you think this is still the case?
- Do you support the Russian language erasure in KZ? Why/why not?
- Have you ever encountered any discrimination against you or other Chechen or Russian speakers? Why/how/when/what happened?
- What do you think about Latinization of Kazakh?
- If it happens that Russian is erased in KZ, what would you do?
- This is a comment from the internet: ... What are your thoughts about it?

## REFERENCES

- Bourdieu, Pierre. 1986. "The Forms of Capital." In: Richardson, J., *Handbook of Theory and Research for the Sociology of Education*. Westport, CT: Greenwood: 241–458.
- Irvine, J.T., and Gal, S. 2000. "Language Ideology and Linguistic Differentiation." In: Kroskrity, P.V., *Regimes of Language: Ideologies, Politics, and Identities*. Santa Fe: School of American Research Press: 35-84.
- Melich, Jiri, and Aigul Adilbayeva. 2013. "Nation-Building and Cultural Policy in Kazakhstan." *European Scientific Journal* 2: 265–279.
- Pavlenko, Aneta. 2008a. "Multilingualism in Post-Soviet Countries: Language Revival, Language Removal, and Sociolinguistic Theory." *Multilingualism in Post-Soviet Countries*, 1–40. <https://doi.org/10.21832/9781847690883-001>.
- Pavlenko, Aneta. 2008b. "Russian in Post-Soviet Countries." *Russian Linguistics* 32: 59–80. Doi: 10.1007/s11185-007-9020-1
- Pavlenko, Aneta. 2009. "Language Conflict in Post-Soviet Linguistic Landscapes." *Journal of Slavic Linguistics* 17 (1/2): 247-274. <http://www.jstor.org/stable/24600143>.
- Slezkine, Yuri. 1994. "The USSR as a Communal Apartment, or How a Socialist State Promoted Ethnic Particularism." *Slavic Review* 53 (2): 414-452.
- Statistics Committee under the Ministry of National Economy of the Republic of Kazakhstan. 2020. Population of the Republic of Kazakhstan by Individual Ethnic Groups.
- Tlostanova, Madina. 2018. "The Postcolonial and Postsocialist: a Deferred Coalition? Brothers Forever?" *Postcolonial Interventions: An Interdisciplinary Journal of Postcolonial Studies* 3: 1-37.
- Wertheim, Suzanne. 2012. "Chapter 4 'Reclamation, Revalorization, and re-Tatarization via changing Tatar Orthographies'." In: Jaffe, Alexandra, Jannia Androutsopoulis, Mark Sebba, and Sally Johnson, *Orthography as Social Action: Scripts, Spelling, Identity and Power*: 65-102.
- Woolard, Katherine A., and Bambi B. Schieffelin. 1994. "Language Ideology." *Annual Reviews in Anthropology* (23): 55-82.

## PNOISE AND THE IMPORTANCE OF WIND TURBINE NOISE PREDICTION

Sara Rodriguez<sup>1\*</sup>, Joseph Youssif Saab Junior<sup>2\*\*</sup>, Alexandre Martuscelli de Faria<sup>3\*\*\*</sup>, Marcos de Mattos Pimenta<sup>4\*\*\*\*</sup>

<sup>1</sup>Sao Paulo State University (Poli-USP), Department of Mechanical Engineering, Sao Paulo, Brazil.  
ORCID 0000-0002-8913-0375

<sup>2</sup>Maua Institute of Technology (IMT), Department of Mechanical Engineering, Sao Paulo, Brazil.  
ORCID 0000-0003-3450-4285

<sup>3</sup>Sao Paulo State University (Poli-USP), Department of Mechanical Engineering, Sao Paulo, Brazil.  
ORCID 0000-0003-1540-6057

<sup>4</sup>Sao Paulo State University (Poli-USP), Department of Mechanical Engineering, Sao Paulo, Brazil.

### Abstract

The concern with the environment led to the need to change the global energy matrix so that the search for renewable energy sources encouraged the expansion of the wind industry. Due to the strong incentive and generating potential, wind energy has become a strong competitor against pollution generated by fossil fuels. With the growth of the wind market and the expansion of cities, some onshore wind farms approached the surrounding populations in order to negatively impact the health of the local population, mainly due to the aerodynamic noise emitted by the wind turbine blades. The impact on local fauna of wind turbines installed offshore has also been researched. This paper presents the main impacts caused by noise in the vicinity of wind farms and the need to carry out noise prediction studies in the initial phases of the design of these wind farms. Related legislation is also presented to minimize this impact. Aerodynamic noise can be divided into five types, according to BPM studies, as well as this can be mitigated with the contribution of turbine efficiency improvement. Thus, the noise prediction module PNoise, integrated with the QBlade application, has become an important tool for researchers in order to design quieter and more efficient wind turbine blades. This paper also introduces the PNoise module and its functionalities.

**Keywords:** Wind Turbine Noise, QBlade, PNoise, BPM, Self Noise, Noise Sources

### INTRODUCTION

As renewable energy grows, wind energy is becoming the backbone of energy systems in many countries in order to replace polluting energy sources, such as burning fossil fuels, with cost-benefit advantages (Dyrholm M. and B., 2019). With the rapid growth of the wind market in the last decades, the onshore wind farms are getting closer to populated areas, commonly rural areas, where the perception and annoyance of the noise emitted by the Horizontal Axis Wind Turbine (HAWT) blades is high, and causes health problems in the surrounding population of wind farms. Impacts with the local fauna were also observed. Thus, some wind farms have interruptions or total stoppage of their activities and strict regulations were created to minimize this impact, as happened in the USA and Europe.

Offshore wind farms are being expanded and, due to their location, little has been studied about the noise emitted in submerged regions, as well as this has not been taken into account in the design of these wind farms. However, some studies point to an impact on marine animals like mammals and fish (Bailey *et al.*, 2014, 2010; Thomsen *et al.*, 2006).

Fortunately, advances in Wind Turbine (WT) designs can adequately predict the noise emitted with the advantage of efficiency gains. The next sections address these challenges in the wind sector, where the design of new turbines is no longer focused only on efficiency. The free software QBlade (Marten

*et al.*, 2021) and its noise module PNoise are also presented, in order to contribute to the research and development area for a new generation of WTs, more efficient, quieter and, therefore, sustainables.

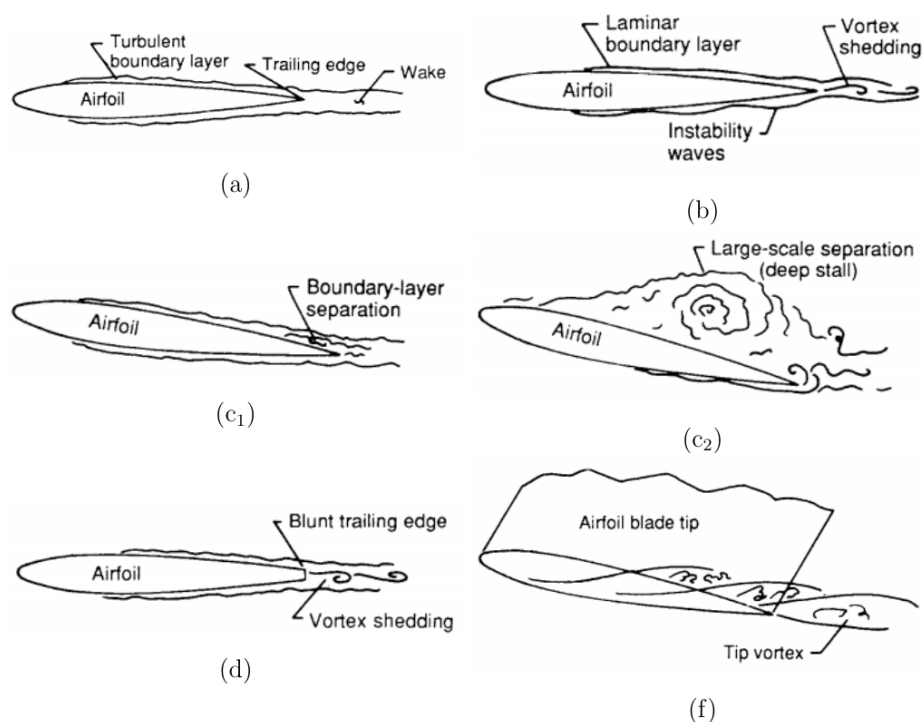
## NOISE SOURCES FROM WIND TURBINES

There are two main types of noises from a WT: mechanical noise and aerodynamic noise. The mechanical noise is mainly generated by the gearbox and other parts as the generator (Lowson, 1996), this source may contain tonal components and has a dominant energy below 1000 Hz (Pedersen, 2003). The use of the direct drive system and innovations in the wind market made it possible to reduce mechanical noise efficiently (Wagner *et al.*, 1996). Due to the fact that the size of the turbines increased significantly, the mechanical noise became insignificant compared to the aerodynamic noise. The aerodynamic noise is considered a self-noise or noise interaction (Blake, 2017) and it has a high emission level and great difficulty of control. It can be subdivided into low frequency, incoming noise and airfoil self-noise.

The low frequency noise is generated by the changes in wind speed on the blades due to the presence of the tower or wind oscillations. The spectrum of this noise is dominated by the frequency of the rotation blades (up to about 3Hz) and their harmonics (up to about 150 Hz), this values are outside the audible range (roughly 10 Hz to 20 kHz) (Lawton, 2001; Jenkins *et al.*, 2001).

The turbulent inflow noise occurs because of the atmospheric turbulence, the turbulent air interacts with the turbine blades and generates eddies, this frequency is influenced by the speed of the rotating blades, the shape of the airfoil and of the leading edge and the intensity of the turbulence.

The airfoil self-noise occurs even if there is no turbulence flow. The turbulence produced in its own boundary layer and near wake and the airfoil surface consists in the total noise produced when an airfoil encounters a smooth turbulent flow. It is commonly broadband but some imperfections on the surface of the blade may generate tonal components. The main self-sources are illustrated in Figure 1, considering a subsonic flow conditions they are the turbulent-boundary-layer trailing-edge (TE) noise, the laminar-boundary-layer vortex-shedding noise, the trailing-Edge-Bluntness-Vortex-Shedding noise, the separation-stall noise, and the tip vortex formation noise (Brooks *et al.*, 1989; Zidan *et al.*, 2014).



**Figure 1.** a) Turbulent-boundary-layer - trailing edge noise b) Laminar-boundary-layer - vortex-shedding noise c<sub>1,2</sub>) Separation-stall noise d) Trailing-Edge-Bluntness-Vortex-Shedding noise f) Tip vortex formation noise (Brooks *et al.*, 1989).

## THE IMPACT OF ONSHORE WIND TURBINE NOISE (WTN)

The search for increasingly efficient turbines started to create WTs with ever larger dimensions, which resulted in greater noise generation and consequent annoyance in the vicinity of wind farms. Three negative impacts of the large scale HAWT equipment are frequently listed as the most relevant for the advancement of the technology: wildlife impacts, visual pollution and noise generation (Wagner *et al.*, 1996).

### Wildlife

The impact of wildlife was considered low (<1 out of 30,000) compared to other human-erected structures and causes (NREL, 2005). Turbine blades can harm wildlife due to reports of blade collisions with birds and bats, many of these problems can be minimized with technological developments, such as the use of radar systems to reduce or stop the WT operation for birds and to paint one single blade in dark color reduce bird fatalities by 70% (May *et al.*, 2020). For bats, ultrasound acoustic deterrents can be used, thus avoiding the death of wild animals (Martin *et al.*, 2017; Arnett *et al.*, 2013).

### Visual Pollution

The visual pollution problem may be minimized by careful site planning and also by repowering, modern turbines are larger and more efficient, so it is possible to reduce the number of turbines and the size of the wind farm to supply a given area (Hansen, 2008).

### Annoyance and Health Problems for Humans

The Wind Turbine Noise (WTN) might affect people psychologically and physiologically, the effect is entirely subjective, this is, to people who are aware of it, it is annoying. As the effect of noise is subjective, it is difficult to measure this impact. The difficulty is compounded because people are annoyed by the peak noises that more or less randomly intrude into the background noise, mainly due to the noise oscillations emitted by the movement of the WT blades (Noise Abatement and Control, 1972). People handle the noise in different ways, for many residents may be unfazed by the WTN and for others the situation may be unbearable, and the design of a wind farm must consider the impact caused for those who live next to the turbines.

The communication with the locals is important, because if the project does not analyse accurately the variation of the noise emitted, the potential for backlash may be terrible, as happened in the Maine island of Vinalhaven that residents that lives near three turbines complaint against the manufacturer about the lack of communication about the noise impacts in the rural area. All WT create unwanted sound, or noise witch are typically foreign to the rural settings and it can be very disturbing

Some symptoms and disorders arising from the WTN have been reported, the WTN can lead to more than 155 symptoms according to Chapman (2012), like dizziness, nausea, the sensation of ear pressure, tinnitus, hearing loss, sleeping disorders, headache and other symptoms. According to Schmidt and Klokke (2014) the WTN increases the risk of annoyance and disturbed sleep in exposed subjects in a dose-response relationship, also was estimated at a tolerance limit of 35dB. In addition, the medical literature concludes that the noise annoyance and sleep disturbance are related and this can lead to adverse health effects (Schmidt and Klokke, 2014).

The WTN problem is a crucial challenge for the wind energy industry. A detailed survey made in the Netherlands concluded that noise is often cited as the most annoying aspect of Wind Energy (Bowdler & Leventhall, 2011). According to Gipe (2004), all WT create unwanted sound, or noise which are typically foreign to the rural settings and it can be very disturbing.

## THE IMPACT OF OFFSHORE WIND TURBINE NOISE (WTN) FOR WILDLIFE

Bibliographies related to the sound evaluation of wind turbines for marine mammals and fish can be found, observed in the work of Thomsen *et al.* (2006). Each work adds knowledge, however a noise emission limit value has not yet been consolidated. With new installations of offshore wind farms,



which have several advantages over onshore ones, the gap in the assessment of the environmental impacts of these installations may become a risk. The complexity and diversity of underwater species make this study complex, mainly due to the intrinsic hearing sensitivity of each species.

For Thomsen *et al.* (2006), there is further evidence that WTN has the potential to affect the physiology and behavior of porpoises and seals over considerable distances. The audibility zone tends to extend beyond 80 km, perhaps hundreds of kilometers from the source. Behavioral responses are possible over many kilometers, like even 20km ranges. Masking can occur in harbor seals for at least 80 km and hearing loss is a concern, considering a regulatory approach this can happen at 1.8 km in porpoises and 400 m in seals. Furthermore, serious injuries because of collisions can occur, such happens in onshore wind farms with the difficulty of estimating, as the injured animals fall into the water and not the land.

Fish such as cod, herring, dab and salmon are sensitive to noise over long distances, such as up to 80 km from the sound source. These species are predominantly sensitive to the movement of particles and not to pressure, as well as behavioral changes, such as stress, masking of intraspecific communication, deafness and death, even in the erection stage of the offshore wind farm, considering pile-driving noise (Thomsen *et al.*, 2006).

Another factor is that the dimensions of offshore turbines are larger than onshore ones (Saab Jr., 2016a) and there are no published noise studies for this type of WT, and the main objective of the manufacturers is to increase efficiency and not consider the noise emitted. Larger turbines are noisier and water propagates noise much more effectively than air. Making this aspect important in offshore wind farm installation analysis.

## REGULATIONS ON WIND TURBINE NOISE

WTN regulations are intended to limit and set acceptable standards for measuring and evaluating WTN. While in countries with a well-developed wind industry there are specific rules and regulations on WTN, in others general noise regulations and limitations apply. Also, regulations can vary from state to state or even be different in each county or city. Noise limitations set out in regulations exist to protect people's health and well-being and can have a strong economic impact on the wind market. The WTN levels for Europe and USA are similar, with the exception of the exceedance levels (Gipe, 2004). In Minnesota we have 65 dB(A)  $L_{10}$  for daytime in a rural environment, that means that 65 dB(A) should be observed 10% of the time. For Palm Springs the limit of 60 dB(A)  $L_{90}$  is applied for day and night in a rural area, so the noise level cannot exceed for over 90% of the time. Table 1 shows a comparison for the WTN limits for different countries and USA states.

**Table 1.** Selected Noise Limits for different countries and USA states (Gipe, 2004).

		Commercial	Mixed	Residential	Rural
<b>Germany</b>					
Day		65	60	55	50
Night		50	45	40	35
<b>Netherlands</b>					
Day	$L_{eq}$		50	45	40
Night			40	35	30
<b>Denmark</b>	$L_{eq}$			40	45

<b>England</b>					
High speed	L <sub>50</sub>				45
Low speed	L <sub>50</sub>				40
<b>Minnesota</b>					
Day	L <sub>10</sub>	80	70	65	65
Night	L <sub>10</sub>	80	70	55	55
Day	L <sub>50</sub>	75	65	60	60
Night	L <sub>50</sub>	75	65	50	50
<b>Kern County, Calif</b>	L <sub>8.3</sub>			45	45
<b>Riverside County, Calif</b>	L <sub>90</sub>			45	
<b>Palm Springs, Calif</b>	L <sub>90</sub>			50	60

Many regulatory standards impose a penalty for pure tones, commonly 5 dB, in Brazil and many other countries generic noise standards apply. According to the NBR10151 (2000) for rural areas the allowed limits are 40 dB during the day and 35 dB at night.

Therefore, the existence of specific rules that consider the irregular and oscillating characteristics of the WTN and the presence of the nearby population and wildlife is important to minimize the negative impacts of wind farm installations from the conceptual design stage.

## RELEVANCE OF THE WIND TURBINE NOISE PREDICTION IN THE EARLY DESIGN PHASES

The lack of noise analysis in the initial phases of the WT project can result in disastrous and costly situations, as the further progress is made in the project and especially after construction and start of operation, circumventing this problem can bring serious losses.

One example occurred when the Wisconsin Public Service (WPS) began receiving noise complaints after installing 14 WTs in 1999. The WPS conducted a series of noise studies and finally had to make proposals to buy six homes to fix the problem, but only two owners accepted the offer. The initial project cost investment was overrun and the problem was not solved.

According to Gipe (2004), a Danish WT manufacturer spent US\$750,000 to fix the noise levels coming from a 21-unit, 180 kW (each) wind farm near Kyndby, Denmark. Despite many siting precautions and reducing operational speed below ideal, the noise at the nearest residence, the farm 220 m away, exceeded permissible levels and included a pure tone component. After four years of correction, the WTN emissions were reduced from 102 dB(A) to 95 dB(A), resulting in an acceptable noise level at the dwellings. Curiously, the engineers found that they could gain 4 dB(A) simply by sharpening the trailing edge of each blade, providing one of the most convincing demonstrations that trailing edge thickness is a significant factor in aerodynamic noise.

Another important fact is that a decrease of the sound pressure level by one decibel would increase the annual energy production by 20% (Oerlemans and Fuglsang, 2012). Therefore investing in developing new quieter aerofoil profiles is also improving the efficiency of the WT.

The above examples and the advantages presented help to make the point that WTN should be dealt with in the beginning of the development phase of a new design, not later, in the field.

## THE PNOISE

The QBlade (Marten *et al.*, 2021), is an open source GNU General Public License (GPU) software developed at the Technische Universität Berlin (TU-Berlin) for help researchers and designers to make quick pre project of wind turbine (WT) blades with an user friendly interface based on Qt (The Qt Company, 2021). The software integrates the XFOIL (Drela and Youngren, 2021) to design customized or standard airfoils, calculates the boundary layer with the XFLR5 (Deperrois, 2021), performs extrapolations in an angle of attack range of 360° and integrates these values for a WT rotor through the Blade Element Momentum (BEM) (Branlard, 2017) and Double-Multiple Streamtube (DMS) (Beri and Yao, 2011) correction algorithms.

For its aerodynamic and structural modules and in order to update the software for to the new demands of WT manufacturers, due to noise complaints that result in health problems, a partnership was made with Poli-USP for the inclusion of the wind turbine noise (WTN) module called PNoise, and it was created the group Poli-Wind.

The 2D noise simulation was based on the simplified or semi-empirical theoretical models of modified-BPM (Brooks *et al.*, 1989) and based on Von Kármán and modified-Lowson models and it was also used for the implementation of quasi-3D noise prediction. The quasi-3D methodology was implemented in the PNoise module, based on the works of Glegg (1987), Brooks *et al.* (1989), Moriarty and Migliore (2003), Fuglsang and Bak (2004), Zhu (2004), da Conceição Vargas (2008), Kamruzzaman *et al.* (2011), being possible to predict the noise emitted by the WT for the full blade or the complete WT rotor. The method encompasses the models from the 2D method, makes a quick-simulation of the blade or rotor noise emission and gives flexibility for the observer position, so the simulations can be easily compared with the SPL spectra from the manufacturers, bringing to a next level the prediction of the WT noise.

The quasi-3D method developed for the PNoise module was predicted in some Poli-Wind group publications (Saab Jr. and de Mattos Pimenta, 2015, 2016; Saab Jr., 2016a; Saab Jr. and de Mattos Pimenta, 2017; Saab Jr. *et al.*, 2018, 2019), and the module includes the following features:

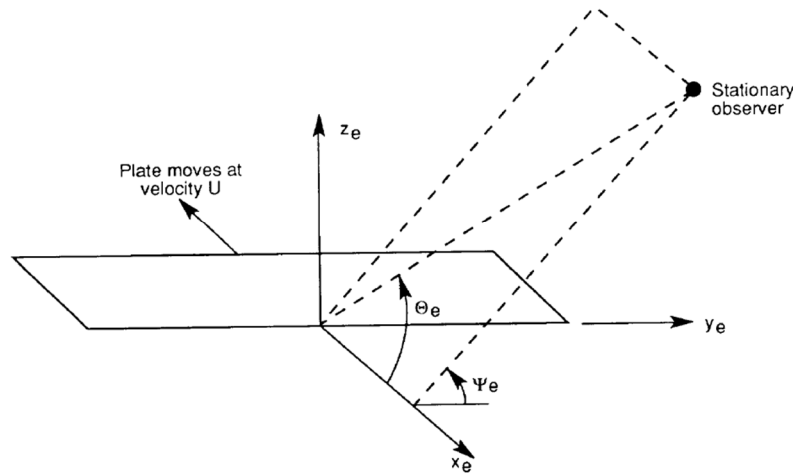
- User selection of airfoils self-noise sources to be modeled, according to the BPM method;
- Inflow noise source selection;
- An auto-adjustment for the BEM and XFOIL polar calculations with a warning for the user to verify errors considering the validity limitations in a table view;
- Arbitrary, user-defined observer position;
- Overall and spectral sound pressure level quick estimate;
- User selection of flow conditions specifications and calculation according the noise models validity range;
- Application for any airfoil, blade and rotor geometry;
- User input of the source of the vertical turbulent scale to predict some of the noise sources;
- Open-source, free software download, under GPL.

## METHODOLOGY

The PNoise bidimensional (2D) module calculates the noise emitted by a given airfoil, which is a segment of the blade and the quasi-tridimensional (3D) module calculates the noise from different spanwise blade segments, with quantitative-rotation positions or angles in the azimuthal plane.

For each noise source selected by the user it will be calculated the spectrum in 1/3 octave band for blade segment, considering a fixed observer position related to the corresponding segment. The PNoise uses BEM (Branlard, 2017) to obtain input data such as angle of attack (AOA), Mach and Reynolds numbers, and iteratively calculates for each blade segment the radial and axial induction factors and other factors, like tip loss, 3D rotational augmentation and others, to correct the WT self-noises calculations.

For the 2D noise prediction method, the observer position is referenced in relation to a position postponed to the trailing edge (TE), and the observer rotates according to the rotational movement of the blade, shown by Figure 2.



**Figure 2.** The coordinate system postponed to the TE considering a moving plate of a velocity  $U$  in the opposite direction of the abscissa  $x_e$  and position angles  $\Theta \rightarrow \theta$  and  $\Psi \rightarrow \phi$ . Source: Brooks *et al.* (1989).

The PNoise quasi-3D method is subdivided into blade and rotor, for the first the observer moves according to the blade and for the second the base of the observer's coordinate system is fixed in relation to the ground which can be changed with the user input data and using transformation matrices that gives this flexibility.

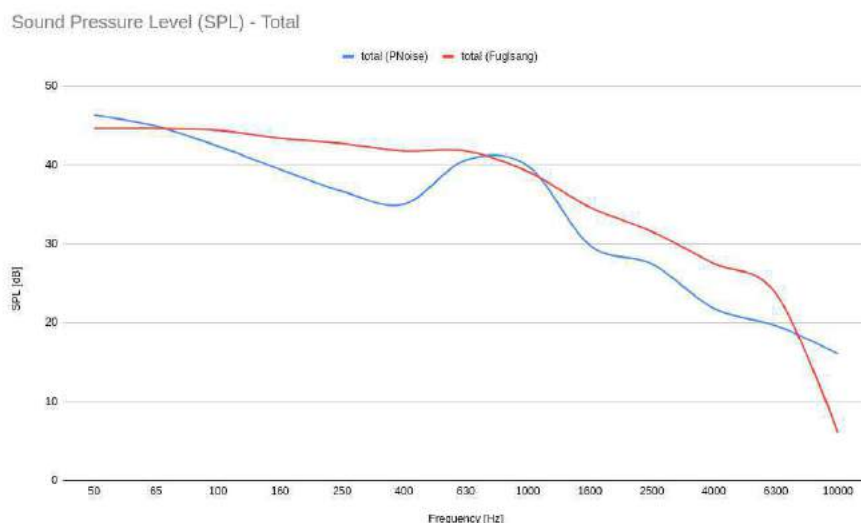
The total Overall Sound Pressure Level (OASPL) spectrum for the quasi-3D method is calculated according to the directivity factors. For the quasi-3D blade case the OASPL is obtained by the sum of all noise spectrum contributions of each blade segment and for the quasi-3D rotor it will be applied for all of the moving blades, according equation 1. If the observer position is distant, in the far-field, a propagation model shall be employed.

$$SPL_{total} = 10 \cdot \log \left( \frac{1}{n} \left( \sum_{i=1}^n 10^{SPL_i/10} \right) \right) \quad (1)$$

## RESULTS

The simulations performed by the PNoise module are fast and do not require large computational capacity. The implementation and validation of the 2D version of this tool was performed by Saab Jr. (2016a) for the trailing-edge noise for pressure and suction sides and for separation-stall and the leading-edge noise source was implemented by Faria *et al.* (2019a).

The quasi-3D is in a final phase of implementation of the PNoise module, to validate the code was performed a simulation of a Bonus Combi 831/300 WT with a rated power of 300 kW and compared with the experimental data from the work of Fuglsang and Bak (2004) the result of the quasi-3D rotor simulation for the five self-noise sources according to the BPM model and the inflow noise source Amiet based using Von Kármán parameters is presented in Figure 3.



**Figure 3.** Comparison between [14] and PNoise quasi-3D rotor noise for the total noise..

## DISCUSSION

Given the positioning of the largest manufacturers of WT's that indicate that the WT project is only focused on efficiency, the noise analysis has become a concern due to the negative impact on the complaints of the populations neighboring the wind farms because of the noise emitted, so the importance of conducting a noise study in the early stages of wind farm projects has become important in order to avoid negative impact and financial losses.

The use of semi-empirical models contributes to the realization of fast and low-cost simulations, so that they can be used in the conceptual design phase of wind farms, in this way it was made the PNoise module that is a tool that integrates the QBlade software which gives flexibility to the user to simulate a noise prediction of a WT for 2D or quasi-3D, according to their needs in a didactic way and help to improve the research and contribute to the wind industry in order to help in the development of quieter wind turbine blades.

The area of wind turbine noise prediction also has other challenges, the lack of experimental data due to the confidentiality of manufacturers, especially for large modern turbines, hinders the research and development area. The challenge of evaluating the environmental impact of offshore wind farms in order to determine limits on emitted noise, in addition to the fact that these turbines, being larger, are noisier should also be considered.

## CONCLUSION

The progressive replacement of the energy matrix by renewable energy sources significantly expanded the wind market growth in many countries, which resulted in technological advances and cost reduction.

This work presented the main impacts observed with the installation of onshore and offshore wind farms. Due to the lack of data from manufacturers for reasons of corporate secrecy, the research and development area of HAWTs suffers from lack of data to get experimental values to validate the aerodynamic noise emission models from large modern WT's.

In view of this situation, and to contribute to the design area of WT's and the features of the QBlade application, the PNoise module, which is an integrated tool of this software, that has been developed by the Poli-Wind group, was presented. The PNoise module has 2D noise simulation functionalities and quasi-3D noise prediction is currently being implemented, where the user can select the observer's position and the different types of noise sources he wants to simulate. There are still several future possibilities to implement new tools in the PNoise module, whether these are new self-noise sources, propagation models for the far-field, underwater noise prediction for offshore WT's and others.

## REFERENCES

1. Arnett, E., Hein, C., Schirmacher, M., Huso, M. and Szewczak, J., 2013. "Evaluating the effectiveness of an ultrasonic acoustic deterrent for reducing bat fatalities at wind turbines". *PloS one*, Vol. 8, p. e65794. doi:10.1371/journal.pone.0065794.
2. Beri, H. and Yao, Y., 2011. "Double multiple stream tube model and numerical analysis of vertical axis wind turbine". *Energy and Power Engineering*, Vol. 03. doi:10.4236/epe.2011.33033.
3. Blake, W., 2017. *Mechanics of Flow-Induced Sound and Vibration: Complex Flow-Structure Interactions*. AP Books.
4. Branlard, E., 2017. "The blade element momentum (BEM) method". In *Research Topics in Wind Energy*, Springer International Publishing, pp. 181–211. doi:10.1007/978-3-319-55164-7\_10. URL [https://doi.org/10.1007/978-3-319-55164-7\\_10](https://doi.org/10.1007/978-3-319-55164-7_10).
5. Bowdler, D., & Leventhall, G. (2011). *Wind Turbine Noise*. Brentwood: Multi-Science Publishing Co Ltd.
6. Brooks, T., Pope, D. and Marcolini, M., 1989. *Airfoil Self-noise and Prediction*. NASA reference publication. National Aeronautics and Space Administration, Office of Management, Scientific and Technical Information Division. URL <https://books.google.com.br/books?id=4B4CAAAAIAAJ>.
7. Chapman, S., 2012. "Wind turbine syndrome: a classic 'communicated' disease". URL <https://theconversation.com/wind-turbine-syndrome-a-classic-communicated-disease-8318>.
8. da Conceição Vargas, L.F., 2008. "Wind turbine noise prediction". Instituto Superior Técnico, Lisboa.
9. Deperrois, A., 2021. "Xflr5". URL <http://www.xflr5.tech/xflr5.htm>.
10. Drela, M. and Youngren, H., 2021. "Subsonic airfoil development system". URL <https://web.mit.edu/drela/Public/web/xfoil/>.
11. Dyrholm M., A.B. and B., B., 2019. "Global wind report 2019". Global Wind Energy Council (GWEC).
12. Faria, A.M., Saab Jr., J.Y., Rodriguez, S. and de Mattos Pimenta, M., 2019. "Airfoil le noise prediction supplement for pnoise code". INCE Europe - Wind Turbine Noise. URL [https://www.researchgate.net/publication/333732198\\_Airfoil\\_LE\\_Noise\\_prediction\\_supplement\\_for\\_PNoise\\_Code/references](https://www.researchgate.net/publication/333732198_Airfoil_LE_Noise_prediction_supplement_for_PNoise_Code/references).
13. Fuglsang, P. and Bak, C., 2004. "Development of the risø wind turbine airfoils". *Wind Energy*, Vol. 7, No. 2, pp. 145–162. doi:10.1002/we.117. URL <https://doi.org/10.1002/we.117>.
14. Gipe, P., 2004. *Wind Power*. James & James. ISBN 9781902916545. URL <https://books.google.com.br/books?id=4UzrnQEACAAJ>.
15. Glegg, S.A.L., 1987. "Significance of unsteady thickness noise sources". *AIAA Journal*, Vol. 25, No. 6, pp. 839–844. doi:10.2514/3.9709. URL <https://doi.org/10.2514/3.9709>.
16. Hansen, M. (2008). *Aerodynamics of Wind Turbines* (Second Edition ed.). London: Earthscan.
17. Jenkins, N., Burton, A., Sharpe, D. and Bossanyi, E., 2001. *Wind Energy Handbook*. John Wiley & Sons Ltd, United Kingdom. ISBN 0-4714-8997-2.
18. Kamruzzaman, M., Lutz, T., Nuebler, K. and Krämer, E., 2011. "Implementation and verification of an aeroacoustic wind turbine blade analysis tool". Fourth International Meeting on Wind Turbine Noise, INCE Europe, Rome.
19. Lawton, B., 2001. "Damage to human hearing by airborne sound of very high frequency or ultrasonic frequency". URL <https://eprints.soton.ac.uk/10750/>.
20. Lawson, M.V. 1996. *Aerodynamic noise of wind turbines - Proceedings of Internoise*, Liverpool, 96, 479-484.
21. Marten, D., Pechlivanoglou, G., Weinzierl, G., Moesus, N. and Wendler, J., 2021. "Qblade wind turbine design and simulation". URL <http://www.q-blade.org>.
22. Martin, C.M., Arnett, E.B., Stevens, R.D. and Wallace, M.C., 2017. "Reducing bat fatalities at wind facilities while improving the economic efficiency of operational mitigation". *Journal of Mammalogy*, Vol. 98, No. 2, pp. 378–385. ISSN 0022-2372. doi:10.1093/jmammal/gyx005. URL <https://doi.org/10.1093/jmammal/gyx005>.



19. May, R., Nygård, T., Falkdalen, U., Åström, J., Hamre, Ø. and Stokke, B.G., 2020. "Paint it black: Efficacy of increased wind turbine rotor blade visibility to reduce avian fatalities". *Ecology and Evolution*, Vol. 10, No. 16, pp. 8927–8935. doi:10.1002/ece3.6592. URL <https://doi.org/10.1002/ece3.6592>.
20. Moriarty, P. and Migliore, P., 2003. "Semi-empirical aeroacoustic noise prediction code for wind turbines". Technical report, National Renewable Energy Lab., Golden, CO. (US). doi:10.2172/15006098. URL <https://doi.org/10.2172/15006098>.
21. NBR10151. (2000). *Acústica - Avaliação do Ruído em Áreas Habitadas, Visando o Conforto da Comunidade - Procedimento*. ABNT.
22. NREL. (2005). *Wind Energy Myths*. Retrieved may 7, 2013, from National Renewable Energy Laboratory, DOE: <http://www.nrel.gov/docs/fy05osti/37657.pdf>
23. Oerlemans, S. and Fuglsang, P., 2012. "Low-noise wind turbine design". URL <http://www.ewea.org/events/workshops/wp-content/uploads/2012/12/EWEA-Noise-Workshop-Oxford-2012-1-1-Stefan-Oerlemans.pdf>.
24. Pedersen, Eja (2003). *Noise annoyance from wind turbines a review (NV--5308)*. Sweden, 1-27
25. Saab Jr., J.Y. and de Mattos Pimenta, M., 2015. "Displacement thickness evaluation for bpm-type airfoil-te noise prediction model". INCE Europe 6th International Conference on Wind Turbine Noise, Glasgow.
26. Saab Jr., J.Y. and de Mattos Pimenta, M., 2016. "Displacement thickness evaluation for semi-empirical airfoil trailing-edge noise prediction model". *Journal of the Brazilian Society of Mechanical Sciences and Engineering*. Saab Jr., J.Y. and de Mattos Pimenta, M., 2017. "Verification and validation of the "pnoise" airfoil trailing-edge noise prediction module inside "qblade"". INCE Europe 7th International Conference on Wind Turbine Noise, Rotterdam. Saab Jr., J.Y., de Mattos Pimenta, M., Faria, A.M. and Rodriguez, S., 2018. "Determination of local flow conditions and preliminary investigation on the validity of the PNoise code for large-size wind turbine". *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, Vol. 40, No. 10. doi:10.1007/s40430-018-1412-1. URL <https://doi.org/10.1007/s40430-018-1412-1>.
27. Saab Jr., J.Y., 2016a. *Trailing-Edge Noise – Development and Application of a Noise Prediction Tool for the Assessment and design of Wind Turbine Airfoils*. Ph.D. thesis, University of Sao Paulo - EPUSP. <http://www.teses.usp.br/teses/disponiveis/3/3150/tde-14032017-140101/pt-br.php>.
28. Saab Jr., J.Y., Rodriguez, S., Faria, A.M. and de Mattos Pimenta, M., 2019. "The quasi-3d TE rotor noise prediction tool of the pnoise code". INCE Europe 8th International Conference on Wind Turbine Noise, Lisbon. Schmidt, J.H. and Klokke, M., 2014. "Health effects related to wind turbine noise exposure: A systematic review". *PloS one*, Vol. 9, p. e114183. doi:10.1371/journal.pone.0114183.
29. The Qt Company, 2021. "Qt designer manual". URL <https://doc.qt.io/qt-5/qtdesigner-manual.html>. Thomsen, F., Lüdemann, K., Kafemann, R. and Piper, W., 2006. "Effects of offshore wind farm noise on marine mammals and fish".
30. Wagner, S., Bareiß, R., & Guidati, G. (1996). *Wind Turbine Noise*. Berlin: Springer - EUR 16823
31. Zhu, W.J., 2004. *Modelling of noise from wind turbines*. Ph.D. thesis, Technical University of Denmark. Lyngby, Denmark.
32. Zidan, E., Elnady, T. and Elsabbagh, A., 2014. "Comparison of sound power prediction models of wind turbines". In *International Conference on Advances in Agricultural, Biological & Environmental Sciences*.

## INFLUENCE OF IMPURITIES ON THE PROPERTIES OF NEW TRANSFORMER OIL

**Ramin Chikhladze**

**Ketevan Chikhladze**

**Zurab Janiashvili**

*Georgian Technical University, Faculty of Energy and Telecommunication, Department of Electrical Engineering and Electromechanics  
Tbilisi, Georgia.*

### Abstract

It is not possible to regenerate the oil of a high voltage power transformer that has been in operation for a long time due to aging and new oil is poured into such devices. But despite cleaning, some of the old oil aging products remain in the active part of the transformer and in the solid insulation; this significantly affects the properties of fresh oil in operation. Some directions of this actual issue are discussed in the piece of work, namely: the influence of these impurities on new transformer oils (Nytro 11 GX) and oils T-1500 and regenerated oils T-1500 is discussed.

Oil breakdown voltage and dielectric loss tangent ( $\text{tg}\delta$ ) are determined by increasing the concentration of impurities in the oil. Also oil acid number. The results obtained were analyzed and the corresponding conclusions of practical importance were drawn.

**Keywords:** Transformer, transformer oil, Oil regeneration, oil acid number.

### INTRODUCTION

Transformer oil is a special type of oil which has excellent electrical insulating properties and is stable at high temperatures. Transformer oil is also used to preserve the transformer's core and windings – as these are fully immersed inside the oil.

Transformer oils surround the core and windings of transformers, preventing wiring and cellulose-based insulation from oxidizing, corroding and becoming less effective. With excellent dielectric strength, chemical stability and thermal conductivity, transformer oils circulate between the core and radiators, reducing the temperature of the infrastructure.

Transformer oils are subject to electrical and mechanical stresses while a transformer is in operation. In addition there is contamination caused by chemical interactions with windings and other solid insulation, catalyzed by high operating temperature. The original chemical properties of transformer oil change gradually, rendering it ineffective for its intended purpose after many years. Oil in large transformers and electrical apparatus is periodically tested for its electrical and chemical properties, to make sure it is suitable for further use.

### DISCUSSION

Electrical paper and transformer oil are used to create an insulation system for high voltage electrical equipment. During operation, the electrical and non-electrical parameters of the transformer oil deteriorate under the influence of high voltage, temperature, humidity, partial discharge and other factors. This process is known as aging of transformer oil [1].

Gaseous, liquid and solid particles formed as a result of aging are released on the surface of the active part of the transformer and also reach the volume of solid insulation, dissolve in the transformer oil and significantly worsen its insulating properties. Aging products significantly alter the physical as well as the electrical and chemical properties of the oil. When the transformer oil is obsolete and its characteristics do not meet the maximum

permissible requirements of the current oil standard, the oil is regenerated, and the active part is washed with process oil [2].

Regeneration of strongly aged oil is in most cases impossible, then it is replaced with new oil. During the cleaning process, part of the aging products remains in some areas of the active part and in the volume of solid insulation during the repair process. During operation, the oil moves, and under the impact of the electric field, impurities move from the insulation to the new oil, dissolve in the oil and cause deterioration in the characteristics of the new oil. The characteristics of such oils are deteriorating faster than the characteristics of the new oils used in new electrical equipment, which is undoubtedly due to the aging of waste is a problem unexplored.

To study the impact of aging products on the properties of new or regenerated oils prepared for use, we decided to mix aging products of transformer oil with such oils in a certain dose and study the change in the properties of these oils in laboratory conditions.

## RESULTS

For this purpose, new T-1500 oils were used, produced by the Baku Oil Refinery and prepared for installation in a 500 V electrical appliance, which were aged and then regenerated during operation, Which were prepared for work in a 110 kV transformer. For comparison, the experiment used new Nytro 11CX oil, prepared for use. Some of the initial characteristics of these oils are shown in the table1, which shows that they have almost the same characteristics and meet the requirements of the new oil standard [3].

Table №1

№	Characteristic	Dimension	New T-1500	Regenerated T-1500	Nytro 11CX	Norm	
						New	For operation
1.	Breakdown voltage	Sq.	66	64	68	>60	35
2.	$tg\delta$ 90°C	%	0,35	0,4	01	<0,5	15
3.	Resistivity				90	-	-
	20°C		75	67	12	10	1
	90°C	$10^{10} \cdot \text{Ohm, mole}$	7	5			
4.	Cleanliness class	Class	XI	XI	XI	XI	XIII
5.	Moisture contents	PPM	10	10,1	10,2	<10	
	Surface tension 20°C	kN / m	42,2	41,3	44,0	32	28

A certain amount of impurities was dissolved in a small portion of the examined oil, then the solution was added in different amounts to the same oil and, after complete stirring, was left to stand at room temperature for 25-30 hours before testing.

Since the impurities did not contain moisture, the initial moisture content of the oil did not change in all experiments, and due to the absence of impurities, the acid content of the oil practically did not change, Ie The change in the characteristics of the test oil was caused only by a change in the amount and properties of impurities dissolved in the oil

The properties of the oil were evaluated by the breakdown voltage (at 2.5 mm), dielectric losses, resistivity and surface tension, which were determined by the corresponding standard for transformer oil [3].

The amount of mechanical impurities (solid particles) in the transformer oil was determined by the photometric analyzer AO3-101, the oil purity class was determined according to the corresponding tables [4].

This device and the standard provide for the amount of mechanical impurities in 100 ml of oil, the geometric dimensions of which vary from 2.5 microns to 500 microns. The spectrum is divided into 7 parts. It is believed that the oil performance of transformer particles is influenced by particles ranging in size from 5 to 15 micrometers. These dimensions correspond to the second channel of the analyzer and their quantity are called as N<sub>2</sub>. For this reason, we estimated the number of particles of this size (N<sub>2</sub>) and the total number of particles (N).

#### Changes in characteristics due to changes in the amount of impurities in the oil

Table №2

##### New brand T-1500oil

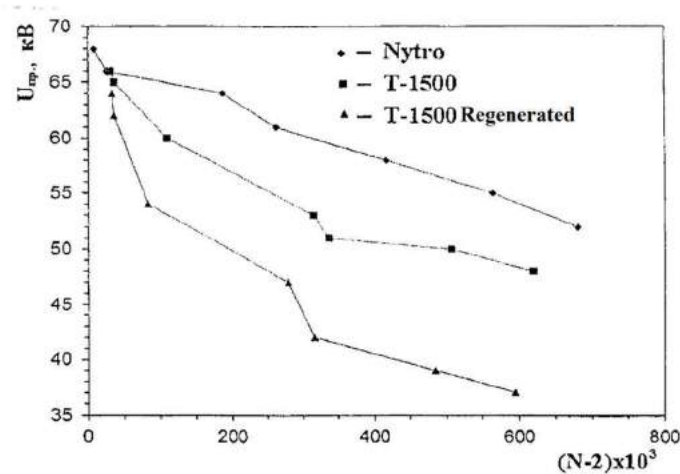
№	The amount of impurities in 100 ml of oil		U <sub>sq</sub>	Dielectric losses, %		Resistivity, 10 <sup>10</sup> Ohm, mole		Surface tension 20 kN/m t=25°C
	N <sub>total</sub>	N <sub>2</sub>		20°C	90°C	20°C	90°C	
1.	395420	31565	66	0,03	0,35	75,0	7,0	42,2
2.	412320	35670	65	0,04	0,55	71,1	6,7	37,9
3.	628410	109910	60	0,21	2,16	39,1	3,0	37,1
4.	1069730	314560	53	0,63	6,78	3,51	0,56	35,
5.	1107650	335730	51	0,77	8,86	2,81	0,41	34,8
6.	1201656	506640	50	1,28	14,3	1,64	0,22	32,3
7.	1279716	619414	48	1,81	21,63	1,15	0,13	30,4

##### T-1500 Regenerated oil

1.	410390	32980	64	0,042	0,4	67	5,8	41,3
2.	435720	36560	62	0,051	0,6	48	4,2	36,5
3.	605220	82870	54	0,33	3,8	29	2,9	35,9
4.	1038890	278645	47	0,72	8,1	2,6	0,4	33,1
5.	1010560	315725	42	0,89	9,8	1,3	0,15	31,1
6.	1095110	485430	39	1,4	16,0	0,9	0,01	28,9
7.	1216450	595440	37	2,3	24,5	0,3	0,02	26,4

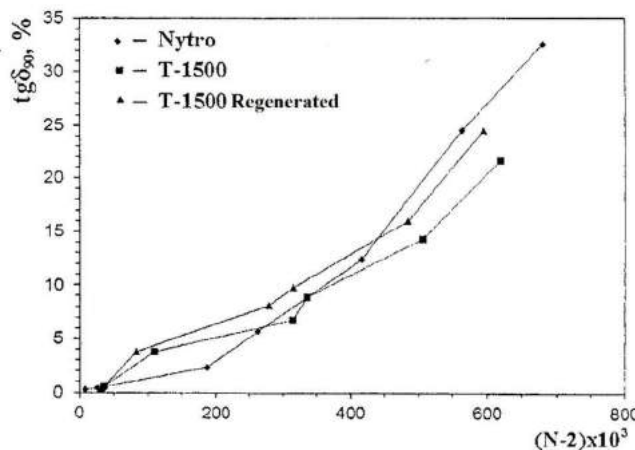
##### Nytro 11 CXnew oil (prepared for use)

1.	188706	8123	68	0,014	0,28	123,2	16,5	49,5
2.	366664	26506	66	0,015	0,30	110	15,0	49,2
3.	665054	186826	64	0,017	0,32	102	16,0	47,1
4.	896110	263065	61	0,079	0,38	89	15	41,9
5.	1155687	416578	58	0,11	0,40	76	14	37,9
6.	1183413	563960	55	0,12	0,42	70	12	33,9
7.	1297937	6809000	52	0,16	0,01	61	6,8	32,8



Picture1. U

Breakdown voltage according to the amount of products of aging in the examined oil



Picture2. Quantity of dielectric losses  $tg\delta_{90}$  on the amount of aging products in the examined oil

As can be seen from table 2, with an increase in the total amount of impurities, respectively, the number of particles with sizes from 5 microns to 15 microns, all the characteristics of the new and regenerated oil significantly deteriorate in comparison with the original and moreover, the value of some of them exceeds the maximum permissible value of the current norm.

To illustrate this concept, Figures 1 and 2 show the breakdown voltage (at 2.5 mm) and dielectric loss (at 90 ° C) as a function of the number of particles in the range from 5 μm to 15 μm (N-2). From these graphs it can be seen that impurities have little effect on the properties of all three oils at the initial stage; And with an increase in the amount of impurities, the properties of the recovered oil deteriorate significantly more than the properties of the new oil and in all cases of the examined oils. Increasing the number of oil aging products increases the sharply expressed exponential law. The breaking voltage decreases less, but is going on exponentially.

## CONCLUSION

Finally, it can be concluded that if the moisture content and acid number of the new and regenerated transformer oil do not change, then the electrical properties of the oil deteriorate with an increase in the amount of impurities and moreover, the dependence of the change in these characteristics on the amount of impurities has an exponential form.

## REFERENCES

1. Osama E. Gouda & Adel Z. Dein Prediction of Aged Transformer oil and Paper insulation: Electric Power components and System Volume 47.2019. Pages 406-4019. 15 Jul, 2019.
2. Alekseev B.A. Condition monitoring (diagnostics) of large power transformers. M: NTs EIAS, 2002-216.
3. IEC 60970, and Edition, July 2007 – Insulating liquids – Methods for counting and sizing particles.
4. GOST 17216-71 Cleanliness of industry. Cleanliness classes of liquids (ISO4406).



## AKKUMULYATOR BATAREYALARI VƏ YANACAQ ELEMENTLƏRİ ACCUMULATOR BATTERIES AND FUEL ELEMENTS

**Abdullayev Anar Arif**

*Cand. of phys.-math. sciences, doctoral student*

*ORCID ID: <https://orcid.org/0000-0001-7672-3940>*

*National Aviation Academy of Azerbaijan, AZ1045, Baku city, Pos Bina 25 km.*

### **Xülasə**

Konfrans materialında akkumulyator batareyalarının və yanacaq elementlərinin istismar xüsusiyyətləri, texniki xarakteristikaları (xüsusi çəki və həcmə görə enerji tutumları) haqqında məlumatlar, pilotsuz uçuş aparatlarının, eləcə də insan fəaliyyətinin müxtəlif sahələrində istismar olunan daşıyan elektron cihazların və qurğuların uzun müddətli işləməsini təmin edən enerji mənbələri-akkumulyator batareyaları və yanacaq elementləri əsaslandırılmış müqayisəli təhlil edilmişdir. Litium əsaslı akkumulyator batareyalarının istehsalının inkişaf mərhələləri, konstruksiyası və hazırlanma texnologiyalarının xüsusiyyətləri, elektrodlarının və elektrolitlərinin hazırlanmasında istifadə edilən kimyəvi elementlər, kimyəvi tərkibindən aslı olaraq elektrodların parametrləri, daxilində gedən kimyəvi reaksiyalar, yüklənmə və boşalma xarakteristikaları, tətbiq sahələri, üstünlükləri və çatışmazlıqları, istismarı və utilizasiyası zamanı təhlükəsizlik qaydaları təhlil edilmiş və ümumiləşdirilmişdir. Xüsusi çəki və həcmə görə enerji tutumu göstəricilərinin yüksək olması səbəbindən pilotsuz uçuş aparatlarında, daşıyan elektron qurğularda və s. litium-polimer akkumulyator batareyalarından istifadə etməyin üstün tərəfləri müəyyənəşdirilmişdir.

Hidrogen əsaslı yanacaq elementlərindən istifadənin xüsusiyyətləri, hidrogen yanacağının alınması və saxlanması üsulları, tətbiq sahələri öyrənilmiş, enerji tutumu imkanları qiymətləndirilmiş, xüsusi enerji tutumlarının əsasında götürülmüş ekvivalent tərkibin parametrləri, eləcə də hidrogenlə işləyən yanacaq elementlərdən pilotsuz uçuş aparatlarında əsas enerji mənbəyi qismində geniş istifadə edilməməsinin səbəbləri müəyyənəşdirilmiş, hidrogenin alınması və onunla işləyən yanacaq elementlərinin iş fəaliyyətinin təşkili üçün tələb olunan enerji sərfiyyatını və s. amilləri nəzərə alaraq sistemin faydalı iş əmsalının təxminən 50% təşkil etdiyi göstərilmişdir.

Uçuş aparatlarının uzun müddətli uçuşun təmin edilməsində enerji mənbəyi qismində istismarda olan litium-ion və litium-polimer tipli akkumulyator batareyalarından istifadənin daha yaxşı göstəricilərə malik olduğu müəyyənəşdirilmiş və onların effektiv əvəzləyicilərinin olmaması qeyd edilmişdir.

**Açar sözlər:** Akkumulyator batareyaları, litium-ion akkumulyatoru, litium-polimer akkumulyatoru, hidrogen akkumulyatoru, yanacaq elementi, pilotsuz uçuş aparatı, konvertoplan.

### **Abstract**

The conference material includes information on the tactical and technical characteristics, technical characteristics (specific gravity and volumetric capacity) of batteries and fuel cells, energy sources that ensure long-term operation of unmanned aerial vehicles, as well as portable electronic devices and devices used in various fields of human activity, batteries and fuel cells were reasonably matched. Stages of development of lithium batteries, design features and manufacturing technology, chemical elements used in the manufacture of electrodes and electrolytes, parameters of electrodes depending on their chemical

composition, internal chemical reactions, loading and unloading characteristics, applications, advantages and disadvantages, operation. Were analyzed and summarized the safety rules. Due to its high energy intensity due to its specific gravity and volume, it can be used in unmanned aerial vehicles, portable electronic devices, etc. The advantages of using lithium polymer batteries have been revealed.

The features of the use of hydrogen fuel cells, methods of obtaining and storing hydrogen fuel, areas of application are studied, the energy intensity is assessed, the parameters of the equivalent composition based on specific energy capacities are studied, as well as the reasons for the non-proliferation of the use of hydrogen fuel cells as the main source of energy in drones., Energy consumption required for the production of hydrogen and the organization of the operation of fuel cells, etc. Taking into account the factors, it is shown that the efficiency of the system is about 50%.

It was found that the use of lithium-ion and lithium-polymer batteries as an energy source during a long flight of an aircraft has better characteristics and the absence of effective substitutes.

**Key words:** rechargeable batteries, lithium-ion battery, lithium-polymer battery, hydrogen battery, fuel cell, unmanned aerial vehicle, convertible.

PUA-ların etibarlı, təhlükəsiz və dayanıqlı uçuşlarının aparılması üçün elmi-tədqiqat institutları və müxtəlif ixtisaslaşmış şirkətlər enerji mənbələrinin axtarışındadır. Ehtiyatların məhdudluğu, sənayenin digər sahələrində onlara olan tələbatın artması, ekoloji problemlər və s. ilə əlaqədar gələcəkdə enerji tələbatının üzvü yanacaqlar hesabına ödənilməsi çətinləşəcək. Bu səbəbdən mümkün alternativ enerji mənbələrinin (hidrogen, metanol və s.) alınmasını və xammal ehtiyatı məsələlərini, o cümlədən aviasiyada, xüsusi ilə pilotsuz uçuş aparatlarında (PUA) istifadə imkanlarını dərinlən öyrənməyə ehtiyac vardır.

PUA-nın uçuş müddəti qida mənbəyinin enerji tutumu ilə düz mütənəsbidir. Təyinatına, tətbiq sahəsinə və hazırlanma texnologiyasına qoyulan şərtlərə uyğun olaraq PUA-da tətbiq edilən enerji mənbələrinin seçilməsi mühüm əhəmiyyət kəsb edir.

Bu məqsədlə yanacaq elementi (YE), eləcə də YE + AB (akkumuliyator batareyası) və ya YE + daxili yanma mühərriki (DYM) ibarət hibrid enerji mənbələrinin tətbiq imkanlarının daha dərinlən öyrənilməsinə və tədqiq edilməsinə ehtiyac vardır. YE-dən təşkil olunmuş qida mənbələrinin iş prinsipi, elektrokimyəvi reaksiya nəticəsində hidrogen əsaslı yanacaqdan sabit cərəyan və istiliyin ayrılması ilə gedən prosesə əsaslanır. Elektrokimyəvi reaksiya nəticəsində sabit cərəyan hasil edən AB-də olduğu kimi, hidrogenlə işləyən YE-nin də konstruksiyasına anod, katod və elektrolit daxildir. Fərqli xüsusiyyətləri odur ki, YE-də elektrik enerjisi toplanmır və o, təkrar yüklənmir. DYM-lərdən, eləcə də qaz, kömür, mazut və s. ilə işləyən turbin və generatorlardan fərqli olaraq, YE-də enerjinin hasil olunması üçün yanacağın yanma prosesindən istifadə edilmir. Nəticədə sistem, yanmış qazların ayrılması zamanı yaranan akustik küydən və titrəmədən azad olur. Yanacaq və hava ehtiyatı olduqda YE-də fasiləsiz olaraq elektrik enerjisi hasil edilir, bu zaman az miqdarda karbon qazı və su buxarı ayrılır.

Məqsəd, istifadə edilən perspektiv AB və YE-lərin xüsusiyyətləri, hazırlanması, eləcə də enerjinin alınması zamanı gedən texniki və kimyavi prosesləri müqayisəli təhlil edərək PUA-ların uzun müddətli uçuşunu təmin edə bilən optimal parametrlərə malik enerji mənbəyini müəyyənləşdirməkdir.

Bu məqsədlə qarşıya qoyulmuşdur:

- AB-lər və yanacaqlar haqqında məlumatların toplanması;
- qida mənbələrinin enerji tutumlarının müqayisəsi;
- seçilmiş qida mənbəyinin üstünlüklərinin əsaslandırılması.

AB-lər şəbəkəyə yüksək cəldliklə qoşulma qabiliyyətinə malik olduğuna görə onlardan əsas, ehtiyat və qəza enerji mənbələri kimi istifadə edirlər. Enerji tutumunun artırılması AB-lərin çəki və həcm parametrlərindən, hazırlanma texnologiyasından, eləcə də 1 kVt/saat enerjinin maya dəyərindən aslıdır. Zaman keçdikcə qida mənbələrinin öz-özünə boşalması, enerji tutumlarını itirməsi, effektiv enerji tutumunun temperaturdan asılılığı və s. problemlər yaranır. Hazırlanma texnologiyalarına, enerji tutumlarına və kimyavi reaksiyalar vasitəsi ilə enerjinin alınması üsullarına görə növbəti AB növləri məlumdur :

- **Pb** (qurğuşun-turşu) birləşməli akkumulyator batareyaları (QTAB);
- **NiCd** - nikel-kadmium birləşməli akkumulyator batareyaları (NCAB);
- **NiMh** - nikel-metal-hidrid birləşməli akkumulyator batareyaları (NMHAB);
- **NaS** - natrium-kükürd birləşməli akkumulyator batareyaları (NSAB);
- **Li-ion** - litium-ion birləşməli akkumulyator batareyaları (LiAB);
- **LiPo** - litium-polimer birləşməli akkumulyator batareyaları (LPAB);
- **Oksidləşmə-reduksiya əsaslı** akkumulyator batareyaları (ORAB);
- **Superkondensator tipli** akkumulyator batareyaları (SKAB);
- **H<sub>2</sub>** - hidrogen birləşməli enerji mənbələri (HAB);
- **CH<sub>3</sub>OH** - metanol əsaslı enerji mənbələri (MAB).

Ardıcıl olaraq - alkalın tipli qida mənbələri, FuelCell tipli günəş elementləri, QTAB, eləcə də radioelektron cihazlarında və müxtəlif aviamodellərdə əsas qida mənbəyi qismində istifadə edilməsi mümkün olan NCAB-lar hazırlanmışdır. Hal-hazırda sonuncuları yeni nəsil NMHAB-lar, təkmilləşdirilmiş, yüksək göstəricilərə malik LiAB-lar və PUA-larda istifadəsi mümkün olan, yığcam formalı LPAB-lar əvəz etməyə başlayıb. Eyni zamanda, istifadəsinə çox az rast gəlinən SKAB, LiMn<sub>2</sub>O<sub>4</sub>, LiCoO<sub>2</sub>, LiFePO<sub>4</sub> və LiFeSO<sub>4</sub> və s. tipli AB-lər və perspektivli HAB və MAB tipli enerji mənbələri də hazırlanmışdır. Xüsusi enerji tutumuna görə LiAB-lar alternativləri ilə müqayisədə daha böyük üstünlüyə malikdir. Eləcə də, bir elementdə yaranan gərginliyin qiyməti bu tip AB-lərdə daha yüksəkdir (təxminən 3.6÷4.2 V). Hazırlanma texnologiyasının inkişafı nəticəsində litium əsaslı AB-lərin istismar müddətləri artmışdır.

Hazırlanma texnologiyasına görə litium əsaslı enerji mənbələri üç əsas növə ayrılırlar:

- metal-litium elektrodlu və maye elektrolit əsaslı AB-lər;
- litium-ion əsaslı AB-lər (LiAB);
- litium-polimer əsaslı AB-lər (LPAB).

#### **Metal litium anodlu AB-lər.**

Bu tip AB-lərin müsbət elektrodlarını litium-oksidi-kobalt, litium-oksidi-nikel və litium-oksidi-manqan birləşmələri əsasında hazırlamaq mümkündür. İsrail istehsalı olan və 0.75 A\*saat nominal cərəyan tutumuna malik, anodu litium, katodu litiumlu marqans şpineli əsaslı silindrik formalı “Taridan” AB-ləri 125÷140 Vt\*saat/kq və ya 280÷314 Vt\* saat/litr xüsusi enerji tutumuna, 3.3÷2.5 V son boşalma gərginliyinə və təxminən 300 dəfəyə qədər dolub-boşalma imkanına malikdir.

#### **LiAB-lar.**

**LiAB** böyük sürətlə inkişaf etmiş və geniş yayılmış qida mənbəyi sayılır. LiAB-dan portativ elektron cihazlarında, elektrik nəqliyyat vasitələrində, elektromobildə, UA-da, kosmik-raket texnikasında, və s. sahələrdə enerji mənbələri qismində istifadə edilir. AB-lərin dəyəri, eləcə də istismar resursu anod və katodun istehsalında istifadə olunan birləşmələrin kimyavi tərkibindən, istismar temperaturundan və işləmə rejmindən aslı olur. Dolub-boşalma dövrlərinin sayı AB-nin enerji tutumu ilə tərs mütənəsibdir.

Normal və təhlükəsiz işçi şəraiti təmin etmək üçün LiAB-lar nəzarət və idarəetmə sistemi ilə təchiz edirlər. Bunlara, yükləmə və boşalma zamanı artıq yüklənmə və tam boşalmanın qarşısını almaq məqsədi ilə gərginliyə nəzarət sxemi, cərəyan və temperatur tənzimləyiciləri

və s. sistemlər aiddir. Gərginlik artımına həssas olmaları səbəbindən yükləmə dövrəsinə LİAB-ları artıq yüklənmə və boşalmadan qorumaq məqsədi ilə qoruyucu qoşulur. Düzgün istismar olunduqda da, böyük enerji tutumlu LİAB-lar dolub-boşalma səbəbindən il ərzində öz tutumlarının 5-10 %-i itirirlər.

İstehsalının və tətbiq sahələrinin artmasına baxmayaraq LİAB-ın idarəetmə sistemləri ilə birlikdə dəyəri digər AB-lərdən, məs., NCAB, NMHAB və NSAB-dan yüksəkdir. Bu AB-lərin həm müsbət, həm də mənfi elektrodlarının hazırlanmasında litium elementindən istifadə edilir. Mənfi elektrodun hazırlanma materiallarına görə, koks və qrafit əsaslı olmaqla LİAB-lar iki əsas növə bölünür.

### **LPAB-lar.**

Bu tip AB-lər vahid çəki və ölçü nisbətlərində böyük elektrik tutumuna və rahat yüklənmə qabiliyyətinə malikdir. Son illərdə əsas və ehtiyat qida mənbəyi qismində UA-da, kosmik-raket texnikasında, mobil rabitə vasitələrində, daşınan elektron cihazlarda və s. sahələrdə geniş istifadə edilən müxtəlif çeşiddə LPAB-lar hazırlanmışdır.

İstehsal qiymətinin yüksək, eləcə də istismar zamanı təhlükəli olması LİAB-ların əvəzinə LPAB-ların yaradılmasına səbəb oldu. LPAB-ları LİAB-dan fərqləndirən əsas cəhət, elektrolitin məsaməli separator və ion keçiriciliyinə malik polimer elektrolitdən hazırlanmasıdır. LPAB-larda lövhə formalı bərk-quru polimer elektrolitdən istifadə edilir. Böyük cərəyan vermək imkanına malik elektrolit müstəvi formada, kip sıxılmış halda hazırlanır. Burada ion mübadiləsi polimer elektrolitdə baş verir. Polimer elektrolitin hopdurulmuş şəkildə hazırlanması istehsal prosesini sadələşdirir və təhlükəsiz edir. Tərkibinə daxil olan hər elementin qalınlığının az olması, AB-ni istənilən formaya salmağa və tələb olunan yerdə istifadəsinə imkan yaradır.

Polimer elektrolitlər hazırlanma texnologiyasına görə 3 qrupa bölünür.

- 1) Quru polimer elektrolitli LPAB-lar;
- 2) Gel-polimer elektrolitli LPAB-lar;
- 3) Mikroməsaməli elektrolitli LPAB-lar.

İstismar və yüklənmə şərtlərinə həssas olduqları üçün LPAB-ların sıradan çıxma ehtimalları çox olur. Gərginliyin icazə verilən həddən yuxarı qalxması, onların alışma həddinə qədər qızmasına, nəticədə partlamasına, aşağı düşməsi isə sıradan çıxmasına səbəb olur. Bu səbəbdən istismarı zamanı LPAB-lara qoyulan texniki şərtlərə düzgün əməl edilməlidir. Qeyd edilən xüsusiyyətlərinə baxmayaraq LPAB-ın PUA-larda qida mənbəyi qismində istifadə imkanları artmaqdadır.

NMHAB-dan fərqli olaraq istismar zamanı sistemdə gərginlik aşağı düşəndə LPAB dövrədən ayrılır və o, sona qədər boşalır. Nəticədə sistemin və akkumulyatorun sıradan çıxma ehtimalı artmış olur. Ömrünü uzatmaq məqsədi ilə istismar zamanı LPAB-ı enerjinin son qiymətinə qədər boşaltmaq olmaz, bu zaman elementlərin hər birində gərginliyin qiymətini nominal minimal həddə saxlamaq lazımdır (20-30% yük saxlanılmalıdır). Eyni zamanda, yükləmə və boşalma zamanı LPAB-ın 60°S-yə qədər qızmasına yol vermək olmaz.

### **Litium əsaslı AB-lərin çatışmazlıqları:**

- istifadə edilmədikdə köhnəlməyə meyilli olması;
- köhnəlmə prosesinin istismara başlama müddətindən deyil, istehsal tarixindən başlaması;
- digər tip AB-lər ilə müqayisədə qiymətinin baha olması;
- LPAB-nin mexaniki zədələnməyə, həddindən artıq yüklənməyə və temperatur dəyişməsinə qarşı həssas olması, həmçinin qısaqapanma səbəbindən alışma ehtimalının yaranması. Eləcə də, dərin boşalma AB-nin tutumunun azalmasına (elektrolitin oksidləşməsi), daxili müqavimətinin artmasına səbəb olur və təkrar yükləmə zamanı enerjinin tam toplanmasına mane olur. Bu hal bir neçə dəfə təkrarlandığında 2-3 ildən sonra AB tamamilə istismara yararsız hala düşür.

**Litium əsaslı AB-lərin üstünlükləri:**

- PUA-da və digər daşınan qurğularda güc və enerji mənbələri qismində istifadə edilməsi;
- uzun müddətli xidməti;
- dolub-boşalma sayının çoxluğu (zəmanətli 1000-dən artıq);
- ehtiyat enerji saxlamaq və geniş temperatur diapazonunda işləmə qabiliyyəti;
- öz-özünə boşalma cərəyanının minimal olması (otaq temperaturunda ilə 3%-ə qədər);
- bir elementdə gərginliyin yüksək ( $3.6 \div 4.2$  V) olması;
- konstruktiv olaraq müxtəlif formada hazırlanmasının mümkün olması (LPAB);
- elementlərin qalınlıqlarının çox nazik olması (LPAB-da təxminən 1 mm);
- elastik formada hazırlanma imkanının (LPAB) olmasıdır.

**Litium əsaslı AB-lərdən istifadə və saxlama zamanı təhlükəsizlik qaydaları:** Litium əsaslı AB-lər istismar və yüklənmə rejimlərinə olduqca həssasdır. Bu səbəbdən növbəti təhlükəsizlik qaydalarına riayət etmək tələb edilir:

- AB-nin 4.2 V-dan çox yüklənməsinə və 3 V-dan az boşalmasına;
- AB-də qısaqapanmanın baş verməsinə;
- AB-nin temperaturunun  $60^{\circ}\text{C}$ -dən çox qızmasına;
- AB-nin hermetikliyinin pozulmasına (LPAB);
- AB-nin boşaldılmış halda saxlanılmasına;
- AB-nin zədələnməsinə və daxilinə hava dolmasına (LPAB) yol verilmir və onu  $50 \div 70$  % yüklü vəziyyətdə  $30^{\circ}\text{C}$  temperaturda saxlamaq tələb edilir.

**Litium əsaslı AB-lərin əsas xüsusiyyətləri və tətbiq sahələri:** bu tip AB-lərdə enerji tutumu  $100 \div 180$  Vt\*saat/kq və ya  $250 \div 400$  Vt\*saat/litr, gərginlik  $3.6 \div 4.2$  V, buraxıla bilən gərginliyin aşağı həddi  $2.5 \div 2$  V və işçi temperatur diapazonu ( $-20 \dots +60$ )  $^{\circ}\text{C}$  arasında dəyişir. Kiçik ölçülü AB-də boşalma cərəyanının qiyməti 2C, güclü AB-lərdə isə bu qiymət təxminən  $10 \div 20$  C tərtibdə olur. Bir çox istehsalçılar mənfi  $40^{\circ}\text{C}$ -də işləyən AB-lər hazırlamışlar [10]. Litium əsaslı AB-lərin öz-özünə boşalması birinci ayda 4-6 %, sonrakı aylarda isə bu hədd əhəmiyyətli dərəcədə azalaraq ildə 10-20 %-ə çatır. Dolub-boşalma sayı təxminən 500-1000 dövr təşkil edir. Eyni ölçülü digər AB-lər ilə müqayisədə litium əsaslı AB-lər 20-30 % daha çox enerji tutumuna, az "yaddaş effekti"-nə, tam boşalmanı gözləmədən istənilən vaxt yükləmənin mümkün olması xüsusiyyətlərinə malikdir. Çoxdəfəli istismar xüsusiyyətləri ilə əlaqədar olaraq litium əsaslı AB-lər "adi" və "tez boşalan" olur. Birincilərdən az (mobil telefonlarda, noutbuklarda və s.), ikincilərdən isə böyük cərəyan tələb edilən yerlərdə (PUA-da, hibrid avtomobildə və s.) istifadə edilir.

**YE-lər.**

YE-lər konstruktiv olaraq vahid struktura malikdir və daxilində ayrı-ayrı funksional modullar yerləşdirilir. Yanacaq qismində YE-də istifadə edilən hidrogenin qaz halında saxlanması və daşınması üçün kompozit çənlərdən istifadə edilir. Böyük çənlərin hazırlanması və hidrogenin onlara doldurulması, istifadə üçün kiçik çənlərə boşaldılması böyük zəhmət və xərc tələb edir. Daxilində təzyiq 300-700 atm. olan çənə doldurulmuş hidrogen çənin ümumi çəkisinin 5-7 %-ni təşkil edir. Yüksək təzyiqli hidrogenin daşınması və qablaşdırılması üçün tələb olunan xüsusi boru və çənlərin partlama təhlükəsi olur. Avtonəqliyyat vasitələrində, YE-nin xüsusi enerji tutumu  $0,9 \dots 1$  kVt\*saat/kq (çənin təxminən 5%-ə qədər hidrogen olarsa) təşkil edən kiçik çənlərdən istifadə edilir. Böyük nəqliyyat vasitələri, məsələn gəmi ilə daşımaq üçün hidrogeni maye halına çevirmək tələb edilir. Bu halda, YE-nin xüsusi enerji tutumu orta hesabla  $0,8 \dots 1,3$  kVt\*saat/kq təşkil edir. Alınan enerjinin 35%-ə qədər



hidrogenin maye haldan qaz halına çevirilməsinə sərf edildiyi üçün, az həcmli işlərdə bu tip YE-dən istifadə etmək səmərəli olur.

Yanacaqın saxlanması, oksidləşməsi, reaksiya nəticəsində yaranan qalıq məhsullarının və istiliyin sistemdən kənarlaşdırılması, eləcə də elementlərin ardıcıl və paralel qoşmaqla gərginliyin və cərəyanın lazımı qiymətinin seçilməsi, gərginliyin çevrilməsi (məs., invertor) və xarici dövrəyə ötürülməsini təmin edən sistemə YE deyilir.

YE-də anod və katod, protonları keçirən elektrolit ilə bir-birindən ayrılır. Hidrogen atomları anoda, oksigen atomları katoda daxil olduqda kimyəvi reaksiya getməyə başlayır. Nəticədə elektrik enerjisi, su və istilik ayrılır. Anodun katalizatorunda molekulyar hidrogen dissosiasiya olunmağa və özündən elektronlar xaric etməyə başlayır. Hidrogen ionları (protonları) isə elektrolitdən keçir və katoda istiqamətlənilir. Bu zaman elektrolit özündən xarici elektrik dövrəsinə elektronlar generasiya edir və dövrədə sabit cərəyan formalaşır. Katodun katalizatorunda olan oksigen molekulları, xarici dövrədən gələn elektronlar və elektrodan keçib gələn protonlar ilə birləşir. Əsasən YE-də elektrolit qismində bir neçə millimetr qalınlığında olan polimer membrandan (PEM) istifadə edilir. YE-də hər bir element (modul) maksimal olaraq 0.5-0.6 V gərginlik hasil edir. YE-nin dəyərinin yüksək olmasına səbəb, istehsal texnologiyasının, oksigen və hidrogen elementlərinin sənaye və ya laboratoriya üsulu ilə istehsalının mürəkkəb və baha olması, həmçinin bahalı katalizatordan, eləcə də polimer elektrolitdən istifadədir.

### ***YE-nin tipləri.***

YE-lər, tətbiq sahələrindən və istehsal texnologiyalarından asılı olaraq, aşağı və yüksək temperaturlu olmaqla iki əsas növə bölünürlər. Birincilərdə, yanacaq qismində təbii qazdan emal edilən nisbətən təmiz hidrogendən istifadə edilir. Bu da əlavə enerji sərfiyyatını və köməkçi qurğuların olmasını tələb edir. İkincilər isə əlavə proseslərin aparılmasını tələb etmir və enerji daxili çevrilmələr hesabına hasil edilir. Bu da hidrogen enerjisindən istifadə infrastrukturuna əlavə vəsaitin yatırılması problemini aradan qaldırmış olur. İstifadə edilən elektrolitin və yanacağın tipindən, həmçinin temperatur

çevrilməsindən asılı olaraq YE, aşağıda göstərilən istiqamətlərdə sürətlə inkişaf etmişdir.

- **PEMFC** (Polimer Electrolyte Membrane Fuel Cell) - polimer elektrolit membranlı YE (PEMYE);
- **DMFC** (Direct Methanol Fuel Cell) - metanolun birbaşa oksidləşmə effektivə əsaslanan YE (MOƏYE);
- **AFC** (Alkaline Fuel Cell) - qələvi YE (QYE);
- **PAFC** (Phosphoric Acid Fuel Cell) - elektrolit qismində maye fosfat turşusundan istifadə edilən YE (MFTYE);
- **SOFC** (Solid Oxide Fuel Cell) - bərk keramik elektrolitli YE (BKEYE);
- **MCFC** (Molten Carbonate Fuel Cell) - əridilmiş karbonat əsaslı (litium, kalium və ya natrium duzları) YE-nin (ƏKƏYE);
- **BTBYE** bərk turşu birləşməli YE;
- **MAFC** (Metal Air Fuel Cells) bərk yanacaq əsaslı YE (BYƏYE).

### **Hidrogen əsaslı enerji mənbələrinin müsbət xüsusiyyətləri:**

- küyün və işlənmiş qazların az olması;
- çıxış gücünün tənzimlənməsinin real zamanda istifadəçidən asılı olması;
- etibarlılığının (az sayda birləşdirici detallardan hazırlanması) yüksək olması;
- cəld işə düşmə, istənilən temperaturda (0...+50 °C) soyuq işə salınm və konstruksiyasında dəyişiklik etmədən gücünün, eləcə də enerji hasilinin tənzimlənmə imkanının olması;
- faydalı iş əmsalının (FİƏ) yüksək olması;
- ekoloji cəhətdən təmiz olması;



- hasil edilən enerjinin gücünün və istiliyin geniş diapazonda olması;
- yanacaq qisminə elektroliz nəticəsində təmiz sudan alınan hidrogendən istifadə etmək imkanı;
- alınan son məhsuldan kompleks istifadənin mümkün (isti su, buxar) olması;
- çəkiyə nəzərən xüsusi enerji tutumunun yüksək olması;
- blok-modul formalı hazırlanma imkanının olması;
- enerjinin paralel hasil edilmə imkanı.

#### **Hidrogen əsaslı enerji mənbələrindən istifadəni məhdudlaşdıran amillər:**

- yanacağın oksidləşmə reaksiyasının otaq temperaturunda çox yavaş getməsi;
- vahid zamanda əldə edilən enerjinin gücünün az olması;
- qurğunun ölçülərinin böyük olması;
- enerji hasil olunan reaksiyanın yüksək temperaturda getməsi;
- aşağı temperaturlarda bahalı katalizatordan istifadəni tələb etməsi;
- həcmə nəzərən xüsusi enerji tutumu göstəricisinin aşağı olması;
- bəzi yanacaqların (metanol spirtinin) zəhərli olması;
- qiymətinin, emal və istehsal texnologiyasından bir başa asılı olması;
- YE-nin qiymətinin yüksək olması;
- alınan enerjinin maya dəyərinin yüksək olması;
- alınan enerjinin bir hissəsinin yanacağın maye halından qaz halına çevirilməsinə sərf edilməsi;
- polimer elektrolitdən istifadənin mürəkkəb olması;
- istismarının təhlükəli olması.

#### **PUA-larda YE-dən istifadə zamanı aşağıdakı problemlərin həll olunması tələb olunur:**

- hidrogenin kimyəvi birləşmə və yaxud sıxılmış qaz halında effektiv saxlanması üsulları;
- sadə konstruksiyalı və yüksək FİƏ-li YE-nin hazırlanması;
- yüksək hühdürlüklərdə, aşağı oksigen və temperatur şəraitində işləmək imkanına malik YE-nin

hazırlanması;

- enerji mənbəyi qisminə böyük xüsusi enerji tutumuna malik olan əsas və yaxud ehtiyat YE-lərin hazırlanması;
- hibrid enerji mənbələrinin optimal istismar edilməsi üçün mükəmməl idarəetmə sisteminin (alqoritm) hazırlanması.

Cədv. 1-də müxtəlif növ (AB, DYM, hibrid və YE) enerji mənbələrinin texniki göstəriciləri müqayisə edilmişdir. Müəyənləşdirilmişdir ki, YE-nin FİƏ və çəkiyə nəzərən xüsusi enerji tutumu digər tip enerji mənbələrindən yüksəkdir. Lakin, həcmə nəzərən xüsusi enerji tutumu müqayisə olunan digər tip enerji mənbələrindən 3-4 dəfə azdır. Bu səbəbdən PUA-larda YE-lərdən az istifadə edilir.

*Cədvəl 1.*

*Müxtəlif növ enerji mənbələrinin texniki göstəriciləri*

S/s	Göstəricilər	Akkumulyator batareyası (Li-Po)	DYM (dizel)	Hibrid DYM (qaz)	Yanacaq elementi (hidrogen-PEMYE)
1	FİƏ, (%)	70	40	50	60
2	Xidmət müddəti, (il)	4	7	5-6	15
3	Enerji sıxlığı, (Vt*saat/kq)	150÷260	10.17	15.45	39.45
4	Enerji sıxlığı, (Vt*saat/m <sup>3</sup> )	25÷40	8.3	11.11	3.53
5	Qulluq	periodik olaraq 3-7 ildən bir AB-lar dəyişdirilir	mövsümə uyğun periodik olaraq mühərrikin yağının, filtrin və yanacağın dəyişdirilməsi	periodik olaraq mühərrikin yağının və filtrin dəyişdirilməsi	hava filtrin 1-2 ildən bir dəyişilməsi
6	Küy	yoxdur	var,- yüksək	var,- orta	yoxdur
7	İşlənmiş qaz	yoxdur	yanacağın yanma	yanma məhsulları	yoxdur

			məhsulları		
8	İşləmə dövrü	kimyəvi enerjinin birbaşa elektrik ener-jisinə çevirilməsi nəticəsində	yanma-fırlanma-EHQ yaranması-elektrik enerjisi	yanma-fırlanma-EHQ yaranması-elektrik enerjisi	kimyəvi enerjinin birbaşa elektrik enerjisinə çevirilməsi nəticəsində
9	Uzun müddət işləmək imkanı	yoxdur	var	var	var
10	İşə düşmə müddəti	dərhal	2-3 dəqiqəyə	2-3 dəqiqəyə	dərhal

Hidrogen yananda ayrılan istilik üzvü yanacaqlara nisbətdə 2,8 dəfə çox olur. Hidrogenin tam yanma xüsusiyyəti DYM-də yanacaq sərfiyyatının azalmasına, mühərrikin ölçü və çəkisinin kiçilməsinə və FİƏ-nin yüksəlməsinə səbəb olur. UA-da ikili yanacaqdan istifadə etdikdə, hidrogen üçün əlavə yanacaq çəninin quraşdırılması tələb olunur. Çəkisinin kerosindən 2.8 dəfə az olmasına baxmayaraq, hidrogen üçün tələb olunan yanacaq çəninin həcmi 4.3 dəfə böyük olur. Ümumiyyətlə aviasiya yanacağı qismində istifadə edilən hidrogen, hibrid DYM-də yanma kamerasının həcmi boyu sürətlə yayılır və asan buxarlanır. Mühərrik az enerji və geniş alışma sahəsi hesabına müxtəlif temperatur və hündürlüklərdə tez işə düşür. Yanma zamanı hidrogen aşağı şüalanma qabiliyyətli alov verir və qalıqsız yanır. Bu da mühərrikin etibarlılığını artırır. Hidrogen mühərrikləri praktiki olaraq ətraf mühiti çirkləndirmir. Hidrogenin istilikudma qabiliyyəti kerosindən 30 dəfə çoxdur, bu da onun mühərrik elementlərinin soyudulmasında istifadə edilməsinə imkan verir. Soyudulma effektivliyinin yüksək olması, turbinin önündə temperaturun və kompressorun təzyiqinin artmasına, yanacaq sərfiyyatının azalmasına (15-20 %) və mühərrikin dartı qüvvəsinin yüksəlməsinə səbəb olur. Hidrogen yanacağı tez axma qabiliyyətli olub, titrəyişlərə qarşı dayanıqlı olur.

## Nəticə

Uçuş aparatlarında və daşıyan elektron cihazlarında enerji parametrlərinin yüksək olması səbəbindən qida mənbəyi qismində litium-polimer və litium-ion akkumulyator batareyalarının əvəzolunmazlığı müəyyənləşdirilmişdir. Pilotsuz uçuş aparatlarda enerji mənbəyi qismində enerji sıxlığı yüksək litium-polimer tipli akkumulyator batareyalarından, daxili yanma mühərriklərindən və hibrid enerji mənbələrindən geniş istifadə edilir. Lakin, seçim etmək üçün akkumulyator batareyası tətbiq olunduğu işin xüsusiyyəti, yerləşdiriləcəyi yerin konstruksiyası, ətraf mühit temperaturu, tələb olunan enerji və güc, istismar müddəti və s. parametrlər istifadəçi tərəfindən düzgün müəyyən edildikdən sonra qərar qəbul etməlidir. Daxili müqavimətin nisbətən aşağı olması, yüksək enerji sıxlığına malik olma, dolub-boşalma sayının çox olması, qiymətin nisbətən aşağı olması və s. müsbət xüsusiyyətlər litium-ion akkumulyator batareyalardan elektron cihazlarda tətbiqinə imkan yaradır.

Hazırlanması zamanı polimer bərk elektrolitdən istifadə nəticəsində yüngül, elastik, nazik və istənilən formada hazırlanma, ekoloji cəhətdən təhlükəsiz, böyük cərəyan vermək, elementdə gərginliyin yüksək və öz-özünə boşalma cərəyanının az olması, səhra şəraitində istifadə imkanının olması və s. litium-polimer akkumulyator batareyaların əsas üstünlükləri sayılır və pilotsuz uçuş aparatlarda, yüksək cərəyan və güc tələb olunan cihazlarda enerji mənbəyi qismində istifadəni məqsədəuyğun edir.

Qiymətinin emal və istehsal texnologiyasından bir başa aslı olması, alınan enerjinin bir hissəsinin yanacağın maye halından qaz halına çevirilməsinə sərf edilməsi, polimer elektrolitdən istifadənin mürəkkəb olması, bəzi yanacaqların (metanol spirtinin) zəhərli olması, istismarının təhlükəli olması, enerji hasil olunan reaksiyanın yüksək temperaturda getməsi, aşağı temperaturlarda isə bahalı katalizatorun tələb edilməsi hidrogenlə işləyən yanacaq edən istifadəni məhdudlaşdırır.

Hidrogen yanan zaman ayrılan istiliyin yüksək olması və tam yanma xüsusiyyəti ondan yanacaq qismində istifadə zamanı yanacaq sərfiyyatının azalmasına, mühərrikin ölçüsünün kiçilməsinə, faydalı iş əmsalının yüksəlməsinə səbəb olur. Pilotsuz uçuş aparatlarda yerləşdirilən hidrogen əsaslı yanacaq elementi və daxili yanma mühərriklərindən ehtiyatsız

istifadə zamanı qaz çəninin partlama ehtimalı, alınan enerjinin maya dəyəri və ayrılan temperatur yüksək olur. Hidrogenin oksidləşməsi zamanı ayrılan enerjinin faydalı iş əmsalının yüksək olmasına baxmayaraq çəkisi 15 kq-a qədər olan pilotsuz uçuş aparatlarda çəkinin artması səbəbindən enerji mənbəyi qismində hidrogen əsaslı yanacaq elementlərindən istifadə etmək səmərəli olmur. Həmçinin pilotsuz uçuş aparatlarda qida mənbəyi qismində daxili yanma mühərriklərindən istifadə etdikdə çəki artır. Çəkisi 15 kq-dan böyük olan pilotsuz uçuş aparatlarında daxili yanma mühərriki və yanacaq elementləindən hibrid enerji mənbəyi qismində istifadə etməklə uzaq məsafələrə uçuşları təmin edə bilən effektiv qida mənbələrini yaratmaq mümkündür. Bu səbəbdən enerji mənbəyi qismində hidrogendən istifadə edilməsi istiqamətində elmi-tədqiqat işlərinin davam etdirilməsinə böyük zərurət vardır.

Gələcəkdə uçuş aparatlarının güc qurğularında enerji mənbəyi qismində hidrogen əsaslı yanacaq elementləri və metanol əsaslı akkumulyator batareyalarından, eləcə də akkumulyator batareyaları ilə paralel, böyük faydalı iş əmsalına malik daxili yanma mühərriklərindən istifadə etməklə hibrid qida mənbələrinin tətbiq imkanlarının daha geniş şəkildə tədqiqinə ehtiyac vardır.

## ƏDƏBİYYAT

1. Р.Н.Набиев, А.А.Абдуллаев. Малоразмерные беспилотные летательные аппараты и средства борьбы с ними. Вестник Азербайджанской Инженерной Академии. Том 9. №2, 2017. с 15-20.
2. R.N. Nəbiyev, A.A. Abdullayev. Kiçik ölçülü pilotsuz uçuş aparatları və onlara qarşı mübarizə vasitələri. Milli Aviasiya Akademiyasının Elmi Əsərləri. 2016. №1. s. 20-31.
3. Р.Н.Набиев, А.А.Абдуллаев. Этапы развития, конструкция и проблемы проектирование БПЛА типа мультикоптер. Milli Aviasiya Akademiyasının Elmi Məcmuələri. Cild 18, №4, oktyabr-dekabr 2016. с. 10
4. Р.Н.Набиев, А.А.Абдуллаев. Обзор этапов развития, конструкций и проблем проектирования БПЛА типа мультикоптер. Современная наука: актуальные проблемы теории и практики. Серия Естественные и технические науки. Москва, 2017. №3-4 (март-апрел). с 16-21.
5. R.N. Nəbiyev, A.A. Abdullayev. Multikopter tipli pilotsuz uçuş aparatlarının inkişaf mərhələləri, konstruksiyası və lahiyələndirilməsi problemləri. Milli Aviasiya Akademiyasının Elmi Əsərləri. 2016. №2. s. 15-29.
6. R.N. Nəbiyev, A.A. Abdullayev. Müasir innovasiyaların tətbiqi ilə hazırlanması planlaşdırılan multikopter tipli PUA-lara qoyulan tələblər. Bakı Mühəndislik Universiteti, «Azərbaycan Beynəlxalq nəqliyyat sistemində: hədəflər və perspektivlər». 02-05 oktyabr 2018-ci il, Bakı, Azərbaycan. Beinəlxalq elmi-praktiki konfrans. s. 176-180.
7. R.N. Nəbiyev, Q.İ.Qarayev, A.A. Abdullayev, V.A. Abbasov. Multirotasiya əsaslı pilotsuz uçuş aparatlarına qoyulan tələblər. Milli Aviasiya Akademiyasının Elmi Əsərləri. 2017. №2. s. 3-16.
8. Р.Н. Набиев, Г.И. Гараев, А.А.Абдуллаев, В.А. Аббасов. Требования к беспилотным летательным аппаратам на мультиротационной основе. Авиакосмическое приборостроение. Мос., 2018 г. № 9. с 3-11.
10. R.N. Nəbiyev, Q.İ.Qarayev, A.A. Abdullayev. Pilotsuz uçuş aparatları üçün qida mənbələrinin seçilməsi. Milli Aviasiya Akademiyasının Elmi Məcmuələri. Cild 20, №3, 2018. s.1-11.
11. R.N. Nəbiyev, A.A. Abdullayev. Akkumulyator batareyaları və yanacaq elementləri. “Ölçmə və keyfiyyət: problemlər, perspektivlər” mövzusunda Beynəlxalq Elmi-texniki

- konfransı. Azərbaycan Texniki Universiteti. 21-23 noyabr 2018-ci il, Bakı, Azərbaycan. s. 235-237.
12. R.N. Nəbiyev, A.A. Abdullayev. Litium-polimer əsaslı akkumulyator batareyaları. "Azərbaycanın nəqliyyatı: nailiyyətlər, problemlər və perspektivlər" mövzusunda Respublika Elmi konfransı. Azərbaycan Texniki Universiteti. 16-17 aprel 2019-cu il, Bakı, Azərbaycan. s. 103-106.
  13. Р.Н.Набиев, Г.И.Гараев, А.А.Абдуллаев. Сравнительный анализ особенностей аккумуляторных батарей на основе лития. Авиакосмическое приборостроение. Москва, 2019 г. № 9. с 29-41.
  14. Hidrogen Power/ Borderlands.Vol. 52.No. 04/ [https://borderlandsciences.org/journal/vol/52/n04/Armstrong\\_on\\_Hydrogen\\_Power.html](https://borderlandsciences.org/journal/vol/52/n04/Armstrong_on_Hydrogen_Power.html)
  15. R.N. Nəbiyev, A.A. Abdullayev, Q.İ.Qarayev. Litium əsaslı akkumulyator batareyalarının inkişaf mərhələləri. Azərbaycan Mühəndislik Akademiyasının Xəbərləri. Cild 11. №4, 2019. s. 70-81.
  16. R.N. Nəbiyev, A.A. Abdullayev, Q.İ.Qarayev. Pilotsuz uçuş aparatlarında hidrogen əsaslı yanacaq elementlərindən istifadənin xüsusiyyətləri. 1st International Conference: Modern Information, Measurement and Control Systems: Problems and Perspectives (MIMCS'2019), 01-02 July, Baku, Azerbaijan. p. 212.
  17. R.N. Nəbiyev, A.A. Abdullayev, Q.İ.Qarayev. Enerji mənbəyi qismində hidrogenin xüsusiyyətlərinin təhlili. Milli Aviasiya Akademiyasının Elmi Məcmuələri. Cild 21, №4, oktyabr-dekabr 2019. s. 16-30.
  18. С.С.Попова, А.В.Денисов, Г.П.Денисова. Химические источники тока. Литий-ионные аккумуляторы. Пленочной конструкции. Учебное пособие. Саратов 2009. 44 ст.
  19. Р.Н. Набиев, А.А.Абдуллаев, Г.И. Гараев. Анализ особенностей водорода в качестве источника энергии. Авиакосмическое приборостроение. Москва, 2021 г. № 3. с 41-58.
  20. R N Nabiyev, G I Garayev, A A Abdullayev. Conceptual functional design of hybrid energy source of unmanned convertiplane. IOP Conference Series: Conference Scopus. Materials Science and Engineering. 862 (2020) 022043, doi:10.1088/1757-899X/862/2/022043.
  21. Nabiyev Rasim Nasib oğlu, Abdullayev Anar Arif oğlu, Garayev Kadir Isaxan oğlu. Dönəbilir kanatlı uçak tipli pilotsuz uçuş makinesi için amaçlanmış hibrit enerji kaynağının konseptüel şeması. 8-ci Ulusal havacılık ve uzay konferansı UHUK-2020-093, 9-11 Eylül 2020, Türk Hava Kurumu Üniversitesi, Ankara.
  22. Сравнение аккумуляторных систем и установок на основе топливных элементов. [www.inenergy.ru](http://www.inenergy.ru).
  23. Р.Н. Набиев, А.А. Абдуллаев, Г.И. Гараев. Разработка концептуальной функциональной схемы беспилотного конвертоплана с гибридным источником энергии. Авиакосмическое приборостроение. Мос., 2021 г. № 5. с 1-16.
  24. А.А. Абдуллаев. Тенденция развития беспилотных летательных аппаратов конвертопланового типа. Тенденции развития науки и образования, Научный журнал, №63/07/2020, Часть 1, Самара, с. 84-90.
  25. Сравнительный анализ различных видов топливных элементов. [www.inenergy.ru](http://www.inenergy.ru).
  26. Р.Н. Набиев, А.А. Абдуллаев. Беспилотные летательные аппараты конвертопланового типа: Текущее состояние и перспективы. Естественные и технические науки. Москва, 2021. №3 (154). с 146-162.
  27. R.N. Nebiyev, A.Aabdullayev. Creation of convertible-type unmanned aerial vehicles. 4th International New York conference on evolving trends in interdisciplinary research & practices. May 2-4, 2021, Manhattan, New York City. p. 504-513.

28. R.N. Nebiyev, A.Aabdullayev. Development trends of unmanned aerial vehicles: Main tasks, prospects and expectations. II International baku scientific research conference 28-30 april 2021 / Baku, Azerbaijan, Odlar Yurdu University, conference. p.556-579
29. [http://powerelectronics.com/portable\\_power\\_management/battery\\_charger\\_ics/804PE-T22li-ion-battery-life.pdf](http://powerelectronics.com/portable_power_management/battery_charger_ics/804PE-T22li-ion-battery-life.pdf). Фрэн Хоффард. Правильная эксплуатация может продлить жизнь литий-ионного аккумулятора.

## THE RELATIONSHIP OF INTERNATIONAL COLLECTIVE MEMORY AND CINEMA: ERTUĞRUL 1890 (125 YEARS MEMORY/ KAINAN 1890)

Sena KURT<sup>1\*</sup>

<sup>1</sup> *Giresun University, Department of Communication Science, Giresun, Turkey  
0000-0003-0809-3312*

### Abstract

Historical events that connect international societies can sometimes take place between war-allied states, sometimes in sports competitions, and sometimes on the ground of being human. The historical events that took place between Japan and Turkey also paved the way for the formation of a collective memory by bringing these two states and societies closer. The Ertuğrul Frigate disaster in 1890 and the rescue operation carried out in 1985 brought a new dimension to the relations between Japan and Turkey in a political sense, also leading to a social connection. The frigate named Ertuğrul set off because of a visit to Japan with 656 sailors during the reign of Ottoman Sultan II. Abdulhamid. In the case of the Ertuğrul Frigate, where the officers and crew were present, the ship crashed into the rocks and sank on the way back. Residents of the nearby town in Kushimoto threw 69 survivors a lifeline. Ertuğrul is an event that is remembered with the death of 587 sailors and the help and sacrifices of the Japanese. In 1985, more than 200 Japanese citizens who were stranded in Iran during the Iran-Iraq war were transported to their countries by Turkish Airlines. Despite the airspace deadlines and threats of the Iraqi President Saddam Hussein, Turkey organized two flights for Japanese citizens and made a significant sacrifice. Although it is sad that the ship sank and people were stranded in Iran, thanks to these events, it is possible to talk about an international collective memory. While the collective memory provides the identity for the members of that society, the international collective memory provides a common identity as well as the mutually close positioning of the nations. Cinema, which is an important tool for the transfer of historical narratives from generation to generation, also plays a role in the construction of international collective memory. In 2015, the motion picture 125 Years Memory, produced by the Ministry of Culture and Tourism of the Republic of Turkey, was turned into a screenplay with the cooperation of Turkish and Japanese. The relationship between international collective memory and cinema, which is the subject of this study, will be examined in a theoretical framework through the film 125 Years Memory.

**Keywords:** Cinema, Collective memory, Ertuğrul Frigate, Japan

### INTRODUCTION

When international history is the witness of various events, there are also events that bring nations close together, sometimes with common pain and joy, as in the long-standing relations between Turkey and Japan. The first of them is the event which took place in 1890 and had a very bad effect on people of two country. The period of Ottoman Sultan II. Abdulhamid wanted to make a return visit due to the order sent by the Emperor of Japan Meiji and the visitation of his nephew (Şahin Uluşan, 2004). Thereupon, a trip was organized for the delegation to go to Japan. The voyage was to be made by sea. However, Ottoman maritime was not in its golden age at that time. Ertuğrul Frigate was decided for this intercontinental voyage. A frigate is a type of warship with three masts and sails (TDK, 2021). The 25-year-old Ertuğrul Frigate was a controversial ship to handle that journey. Although the ship's woods were repaired before the voyage, the lower part of the ship's machinery and boilers had not been repaired (T.C. Tokyo Büyükelçiliği, 2017). However, at that time, there was no other ship that was produced in Ottoman shipyards and suitable for that journey. The origin of the ship was important to other countries to be visited during the voyage. Because the ports visited on this route, and especially the visit to Japan, were of strategic



importance for the balance that the Ottomans would establish in the international arena. The Ertuğrul Frigate set off from Istanbul on 14 July 1890 with a crew of 609 people. During its journey, it stopped at 9 ports in total, namely Suez, Port-Said, Jeddah, Aden, Mumbai, Colombo, Singapore, Nagasaki and Kobe, and reached Yokohoma Port in Japan on June 7, 1890. The delegation, which met the Japanese Emperor after 11 months of travel, completed its task. A total of 609 people, including ship's crew, officers and newly graduated students who came to gain maritime experience after naval school, stayed in Japan for 3 months. The Ertuğrul crew then completed their preparations for the return and decided to set off. Although the Japanese Navy warned Ertuğrul's crew about typhoons at sea at that time of the year, the Ertuğrul Frigate left Yokohoma on September 15, 1890, which raised anchor. Ertuğrul was caught in a typhoon off Kushimoto Town on September 16, 1890, one day after his journey, crashed into the rocks and sank. The Ertuğrul Frigate was buried in Japanese waters with Ottoman soldiers and crew. With the help of the residents in Kushimoto Town, 69 people survived. Town residents reported the situation to the authorities. By the order of Emperor Meiji, the sailors who were survived were brought to Istanbul. The event and the subsequent developments in the news in the Japanese newspapers of the period were published under the title of '*Memoir*' (Şahin Uluşan, 2004). The help and sacrifice of the Japanese in this painful event can be seen in the narratives in the historical document. After the accident, the Martyrdom Monument was erected in Kushimoto in 1891 in memory of the Ertuğrul Frigate martyrs. The monument was restored in the following years by Japan and later by Turkey. Every year, commemoration ceremonies are held at the Martyrs Memorial. In the museum, which was opened in Kushimoto in 1974, there are models of Ertuğrul, paintings and sculptures of Turkish sailors (T.C. Tokyo Büyükelçiliği, 2017). Afterwards, Mersin and Yakakent were declared town twinning with Kushimoto. The deep ties between Kushimoto Street in Mersin and the two states have made a place in our daily lives and contributed to the social memory.

Another incident in which Turkey and Japan were parties dates back to 1985. In the hot war between Iran and Iraq, Iraq's target was Tehran. On March 17, 1985, Iraqi President Saddam Hussein warned that any civilian and military aircraft that would pass through Iranian airspace would be shot down, as well as threats that he would bomb Tehran after 72 hours. Thereupon, the countries that wanted to evacuate their citizens in Iran started to beat the gun. The Japanese Ambassador warned his citizens to leave the country and as a matter of fact, 450 Japanese citizens were evacuated (Sarıboğa & Sarıkaya, 2004). However, air tickets could not be purchased for 215 Japanese citizens. Because each airline company gave priority to its own citizens. The Japanese State, on the other hand, could not send a plane to Tehran with the shrinking time of the attack threat. Afterwards, upon the dialogue of the Japanese and Turkish consuls in Iran, the Turkish Airlines flight request to save the Japanese citizens was approved by the Turkish Prime Minister of the time, Turgut Özal, and Tehran Airport was reached by radar orientation. 215 Japanese were liberated 3 hours before the planned attack. Although that special flight was a dangerous mission, especially for the aircrew, it brought the two nations closer together, enabling the Japanese to return home.

Even years after those events, as a result of disasters such as earthquakes, the support and assistance of the Turkish and Japanese peoples to each other continued. These two countries, which are miles apart, have had deep ties by creating a common collective memory over time. These ties are transferred from generation to generation as cultural and historical heritage.

In this study, how collective memory is shaped in the international dimension will be framed through the example of cinema. The research subject was determined as Turkey and Japan as international actors, and the movie Ertuğrul 1890. With this study, which will be evaluated theoretically, it is aimed to shed light on the concept of international collective memory and to explain the cultural dimension of Turkish-Japanese relations.

## IDENTITY

Identity enables individuals to position themselves in society in a sociological sense. This positioning can be “in-community” or “out-of-society”. In social positioning, individuals feel themselves to belong to a group. Belonging also creates positions like us and them. In particular, national and political identities point to the “other”. Although the other is not always referred to as the enemy, it is not from “us”.

While the concept of identity is related to the science of psychology from the center of the self, social identity refers to the science of sociology. The concept of international identity is explained by political science. While the concept of identity, which is an interdisciplinary subject, is also discussed in the field of philosophy, it includes the positioning of the individual, group, society, nation or nations themselves and their interlocutors accordingly in communication sciences. This positioning is concentrated on the basis of sameness or difference. As a matter of fact, the Latin root “idem”, which is the original source of the European equivalent of the word “identity” linguistically, means “same” (Aydemir, 2021).

The political and international reflections of our social identities largely stem from historical events (Dalbay, 2018), that is, from collective memory. Feelings against a race or nationality are frequently faced in encounters that can be taken sides. However, in some cases, identities in which the consciousness of “we” come to the fore are born without polarization such as good-bad radicalization.

Weber states that the nation is a “community of emotions” associated with an element of struggle and a collective sense of belonging. In other words, he defined the nation as a group that requires a certain solidarity (Weber, Gerth, & Mills, 1946). Alexis de Tocqueville's works based on American society are pioneers in the concept of national identity (Amos, 1995). National identity can be defined as a person's identity or feeling of belonging to a state or nation (Ashmore, Jussim, & Wilder, 2001).

International identity, on the other hand, is a self-concept that transcends national borders (Kluckhohn, Murray, & Schneider, 1953).

The concept, which is also referred to as global identity, world mindedness and global human identity in the literature (Der-Karnbelian & Rosen, 1990; Sampson & Smith, 1957), emerges in 3 different forms (Arrow & Sundberg, 2004); The first is identification with all peoples of the world that transcends national borders that can qualify as world citizens, the second is social identification with groups across borders in areas such as occupational, religious or sexual orientation, and the third is the individual's international personal connections. In another study (Moje & Luke, 2009) pointing out five different components of the concept of identity, the metaphor of consciousness and narrative, which are two of the five components, comes to the fore in the relationship between memory and identity. Identity as consciousness, in the words of Karl Marx; It can be defined as the reality of the verb and the reality shaping the consciousness. Identity as a narrative, on the other hand, represents that one's identity is constructed in the narrative of experiences in life. The effect of narrative identity on national identity can be given as an example to the behavioral observation of Turkish hospitality narratives in Turkish individuals.

## COLLECTIVE MEMORY

### Memory

The concept of memory, which is defined in the dictionary (TDK, 2021) as the power to consciously keep in mind what happened, learned subjects and their relation to the past is closely related to identity. This relationship is bidirectional and both concepts affect each other. Memory is a computing system; It is used to encode and store information in different time periods and to access the information we need from our memory when we need it.

In psychology, memory is examined in two ways: short-term and long-term. Long-term memory is divided into procedural, semantic and episodic. Procedural memory refers to the performance

of psychomotor skills. Semantic memory includes making sense of concepts. Episodic memory is the memory of experiences. In episodic memory, the experience of remembering is likened to time travel (Tulving, 2002).

### **Collective Memory**

The concept called collective memory or social memory in the literature is a representation of the past shared by members of a group, such as a generation or nation-state (Wertsch, 2008). Maurice Halbwachs, who has an important place in the literature with his studies on the concept of collective memory, developed the concept of collective memory by arguing that individual memories are understood only in the context of a group, uniting the nation or community through time and space (García-Gavilanes, Mollgaard, Tsvetkova, & Yasser, 2017).

Collective memory also includes historical and cultural memory. By definition, memory, which includes experiences of the past, can be defined as heritage with its history, culture and even spiritual values when it refers to a community. But at the same time, it is an organism that develops, changes and is transferred by accumulation. The point where collective memory differs from the pure understanding of history is not limited to the past, but is related to the present (Orta, 2019). As it affects the social identity, it provides the definition and positioning of the groups currently. In short, as Halbwachs states, history is just a set of facts (semantic memory); whereas memory (episodic memory) has a subjective dimension: it creates an existing or enduring sense of self and an identity over time (Halbwachs, 1966). On the other hand, Marie-Claire Lavabre does not limit collective memory to lived experiences. However, she still associates it with a sense of identity and continuity that are products of episodic memory (Russell, 2006). In order for the reminder objects and symbols to function as reminders in the collective memory, the members of the group must associate those objects and symbols with their own life (Olick, 1999). People acquire knowledge of the event, not its memory because they do not experience it. It is known that sociologists see those who do not have first-hand experience with a past event as mediators of memory in their understanding of collective memory. For Halbwachs, memory of events is a tool of collective memory (Saito, 2010).

Social memory also brings up the concept of culture. Culture is the learned and shared patterns of behavior and belief of a particular group. It can also be defined as a complex set of collective human beliefs with a structured stage of civilization that may be specific to a nation or period. People use culture to adapt and transform the world they live in. In the literature, there is no agreed definition of the concept of culture. This is due to the dynamic and organic structure of culture. Assmann (2008) states that “the belief that culture is intrinsically related to memory has increased in recent years”. In short, culture, like history, is a component of social memory and interacts with each other.

The existence of collective memory, rather than being an expression of the society around it, illuminates institutional environments and decision-making processes, whether and how politics shapes daily life as well as society, culture, beliefs and values (Finney, 2013). In order to express the collective memory formed by different groups, there is an international concept of social memory that is dimensioned both interculturally and culturally.

### **International Collective Memory**

Much of the literature in this field deals with war and post-war issues, which are generally considered to be in the field of international history, efforts to rebuild peaceful interstate relations afterwards, international and transnational flows of power, and intellectual dimensions of foreign relations (Finney, 2013). The concept of collective memory in the bilateral relations of international states, especially the Holocaust, I. and II. It is examined within the framework of international events, including World War II. In addition, there are studies on how the common collective memory, carried out by political scientists, affects the political policies of states. However, it should be underlined that; political policies are not determined by collective memory.

Historian Jan-Werner Müller argues that the purpose of appealing to memory is not 'to deny that interests shape politics' but rather 'to examine the historically and ideologically conditioned construction of these interests' (Müller, 2002).

Emphasis on collective memory can also be seen in our daily lives in the form of public commemoration events, museum and monument construction, heritage tourism and an increase in history-themed publications. These are also referred to as concrete memory spaces. The memory space represents abstract spaces as well as spaces and objects that are important to the group. Memory spaces are among the intermediaries that contribute to collective memory (Nora, 2006). International collective memory is the primary tool by which nations position themselves emotionally, intellectually, politically and ethically in time and space, thereby both constraining and enabling the nation's external actions. Memory plays an important role in determining the dynamics of individual and collective identity formation that shape both perceptions and political action; in other words, interpretations of the past 'help frame the horizon of the future' (Bell, 2006). Past experiences and their memories are the constituent elements of the national political culture that influence the diplomatic roadmap of states and the values they promote in foreign relations (Finney, 2013). The concept of memory, which includes narratives or social tendency (perceived or real), maintains its effects despite rising globalization trends.

### **The Relationship Between Memory and Cinema**

Cinema is a means of expression that has commercial concerns and is related to art in many ways, and that enables it to produce, consume and reproduce meaning with its social accessibility. This meaning is on collective memory when it comes to history movies. The past of society and system of meanings are presented to the audience as fictional texts articulated with reality on the big screen. Thus, history based on collective memory realizes its existence and reproduction with the fictional events it shows (Duruel Erkiş S. A., 2005).

Cinema has had a wider success in reaching the mass than educational, academic or textual content (Karaca, 2019) and impact researchers have found that cinema has significant contributions to general cultural learning (Göker, 2018). Knowledge acquisition has an undeniable share in memory formation. One can provide information through cinema and moreover, realize social learning through indirect experiences on the big screen. The share of sense organs in learning also proves the construction of memory through cinema (Akpınar & Ersözlü, 2008). The teaching mission of history films within the scope of lifelong learning has been found in the light of researches (Şahin Kübra, 2019; Kalçık & Ünal, 2017; Okumuş, 2020). However, there are also studies suggesting that the fictional content of cinema is far from instructiveness. For example, Erdemir Göze stated that (2018) in history-theme films, the cinema audience perceives each content as "real" and that the fictional structure is overlooked and the mission of history teaching is attributed to the cinema. However, in the middle of these controversies, Rosenstone (1995) categorizes the representations of history in the cinema and named them as drama, document and experiment, and stated that they have different contents and missions.

While cinema often makes use of history in terms of the readiness and importance of the scenario framework, history also applies to cinema to benefit from its visual and auditory effects. Thus, by providing mutual benefit, social memory is built and the official historical narrative is strengthened (2014). In the light of Nora's concept of 'Memory Space', media and media-mediated tools can be evaluated as memory spaces through the messages they contain. Memory spaces are those that are composed of places, objects or content and that remind a certain life. Cinema is also considered as one of these areas. Ertuğrul 1890 film, which is the subject of this study, will be analyzed within the framework of its contributions to international collective memory as a memory space.

### **Ertuğrul 1890 (125 Years Memory/ Kainan 1890)**

The movie named Ertuğrul 1890 was released in Turkey and Japan in 2015 under the production of the Turkish Republic Ministry of Tourism and Culture. The cast of the film includes Japanese

and Turkish artists. Mitsutoshi Tanaka is in the director's chair and the cinematographer is Tetsuo Nagata. Japanese and Turkish names in order to stay true to the folklore of both countries; Hidefumi Hanatani and Hakan Yarkın shared the art direction staff. The script was written by Eriko Komatsu, while the researcher writer Iskender Pala, who is also the Head of Culture and Art Policies of the Republic of Turkey, was the script consultant of the film. The cast includes names such as Seiyou Uchino, Kenan Ece, Shioli Kutsuna, Alican Yücesoy.

The film presents a fictional structure in the historical background. In the film, the Ertuğrul Frigate incident in 1890 and the rescue operation in 1985 are handled one after the other on the basis of Japan and Turkey, which are the common sides of the events. The first co-production of Japan and Turkey, the film focuses on the friendship and cooperation between the two countries. The film received full marks from critics due to its mission. 451,794 audiences watched the movie, which was screened for 22 weeks in total in Turkey (box office , 2021).

Cinema offers a dynamic structure due to its unique language(Güçhan, 1993). This structure consists of a multidimensional system apart from the image. Therefore, in order to analyze the system, the channels that compose it should be considered. French film theorist Christian Metz (2012) categorizes the materials used in the narrative of cinema in 5 channels. They are image, dialogue, music, sound and text. The main social memory elements of Ertuğrul 1890's cinematic text are analyzed based on Mertz's classification.

In the first scene of the movie, Japan and Turkey were pointed out by the voice-over narrator and said, “Two nations; The stories of the land of the rising sun in the East and the land of the rising moon in the West began here, on this small island”. The sun on the Japanese flag and the crescent figure on the Ottoman/Turkish flag are both celestial bodies in the sky, as well as representing countries. The metaphorical expression that connects to this common ground also indicates the ties between countries.

While Japanese Doctor Motosada Tamura, one of the heroes in the movie, trains with sword, Captain Mustafa also practices swordsmanship in the cross-editing. Meanwhile, the stories of the heroes have not yet intersected. The fictionally intertwined sword scenes emphasize the similar cultures of both countries and add a new element to the social connections.







The fictionally intertwined sword scenes emphasize the similar cultures of both countries and add a new element to the social connections.

In the dialogues in another sequence of the movie, an illiterate old man in the town asks the town doctor to read the news he showed in the newspaper which he brought to the town doctor. There is an Ottoman/Turkish and Japanese flag in the image of the newspaper article. Reading this newspaper clipping that points to historical friendship, the doctor shows the location of Turkey and Japan on the world globe. This tells us about the close friendship of two countries that are miles apart.





The sinking of the Ertuğrul Frigate, which is the scene with the highest tempo of the movie, is handled in a cross-cut with the town's entertainment accompanied by a Shamisen (a Japanese instrument). Shamisen that is a musical instrument activating the soul of the Japanese people and its melodies are to reveal the benevolent side of the Japanese.



In addition, the crescent symbols on the shamisens seen in the scene also refer to Turkey. The Turkish symbols seen on an instrument unique to Japan sign the bonds of brotherhood that will begin between the two countries.

Before leaving town, Captain Mustafa respectfully carries the sun and crescent-shaped object, which he bought as a souvenir during his official visit to Japan, and throws it into the sea from the Kushimoto cliffs. The crescent and sun-figured object shown in the movie represents the international social memory and common feelings between the two states. The shores of Kushimoto are not only martyrdom for Turkey, but also where the bonds of brotherhood between Japan and Turkey begin. The region where the Martyrs Memorial is located today symbolizes the memory of our martyrs and Japanese-Turkish friendship.

Another event within the fictional structure of the film is the rescue operation organized by Turkey for the Japanese citizens were stuck in Iran. Kenan Ece and Shioli Kutsuna, who portray the characters of Captain Mustafa and Haru in the narration of the Ertuğrul incident in the film, also play the characters of Murat and Harumi -about 100 years later in reality- in the narration of the rescue operation. The dialogue between them at the end of the movie is as follows:

*-Murat: You know, I feel like I met you a long time ago.*

*-Harumi: Yes, me too.. You know, my grandmother always used to say, "There are moments in life that you will never forget."*

*-Murat: It's true, there are very important things in life that cannot be forgotten.*

*-Harumi: Like today..*

*-Murat: Like today..*

The characters portrayed by the actors who play the lead role in the episodes where two different events are narrated in the movie represent the bonds of friendship that come to life again years later. *"I feel like I met you a long time ago."* (Murat, The Ertuğrul 1890 film) while pointing to the deep bonds of the past, *"My grandmother always used to say; There are moments in life that you will never forget."* (Harumi, The Ertuğrul 1890 film) through the sentence, narratives and memories based on generations are expressed.

## CONCLUSION

Historical films, which contribute to the memory construction process and are one of the places of memory, increase the dramatic effect thanks to their fictional structures by moving past memories beyond the literal narration of historical texts. Collective memory stands out as a phenomenon that has the effect of uniting societies in sociological terms.

The deep ties of the two states, approximately 8000 kilometers away, dating back many years, still maintain their vitality today. Events that have taken a place in the collective memory find a response in the international societies between the two countries with feelings such as friendship, brotherhood, self-sacrifice and cooperation, as well as national feelings.

International societies usually carry the codes of the state or race to which they belong. Friendship and fraternity relations of international societies are not customary except for diplomatic interests and lineage ties. However, a bond has been built between Turkey and Japan, which can almost be called a "a friend in need". Moreover, this relationship continues only on humanitarian grounds, without relying on any self-interest. An example of this is earthquake aid and support. These aids are carried out between the two countries according to need.

The Ertuğrul 1890 film, which is the subject of this study, is not only the first joint film of Japan and Turkey, but also gains importance with its contributions to memory building. The Ertuğrul 1890 film, which is the subject of this study, is gaining importance with its contribution to memory construction as well as being the first joint film of Japan and Turkey. Thanks to the narratives, visuals and music in the film's content, historical reality is reconstructed in our minds and plays a role in the international collective memory construction process. In short, Japan and Turkey have important values within the framework of international social memory, and these values are preserved and passed on to future generations through the film Ertuğrul 1890.

## REFERENCES

- Akpınar, B., & Ersözlü, Z. (2008). Görme ve Koklama Duyularının Bilişsel Öğrenme Sürecindeki Rollerinin Karşılaştırılması. *Sosyal Bilimler Araştırmaları Dergisi*, 42-53.
- Amos, K. (1995). *Alexis de Tocqueville and the American National Identity: The Reception of de La Democratie En Amerique in the United States in the Nineteenth Century*. Peter Lang.
- Arrow, H., & Sundberg, N. (2004). International Identity: Definitions, Development, and Some Implications for Global Conflict and Peace. *Ongoing themes in psychology and culture: Proceedings from the 16th International Congress of the International Association for Cross-Cultural Psychology*. International Association for Cross-Cultural Psychology.
- Ashmore, R. D., Jussim, L. J., & Wilder, D. (2001). *Social Identity, Intergroup Conflict and Conflict Reduction*. Oxford: Oxford University Press.
- Assmann, A. (2008). Canon and Archive. A. Erll, & A. Nünning içinde, *Cultural Memory Studies* (s. 97-108). Berlin, New York: De Gruyter.
- Aydemir, D. (2021). *Siberfeminizm*. İstanbul: Urzeni.
- Bell, D. (2006). *Memory, Trauma and World Politics Reflections on the Relationship Between Past and Present*. Palgrave Macmillan UK.
- box office . (2021). *Ertuğrul 1890*. boxofficeturkiye.com: <https://boxofficeturkiye.com/film/ertugrul-1890--2012653> received from
- Dalbay, R. S. (2018). "Kimlik" ve "Toplumsal Kimlik" Kavramı. *Süleyman Demirel Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 161-176.
- Der-Karnbelian, A., & Rosen, M. (1990). Global belonging, national belonging, and study abroad. *70th Annual Western Psychological Conference*. Los Angeles.
- Duruel Erkişi, S. (2014). *Türk Sinemasında Tarih ve Bellek*. Ankara: Deki Yayınevi.
- Duruel Erkişi, S. A. (2005). Galatasaray Üniversitesi İletişim Dergisi. 2005, 55-69.
- Erdemir Göze, F. (2018). Sinema - Gerçeklik İlişkisini Tarihi Filmler Ekseninde Tartışmak. *Turkish Studies*, 299-314.

- Finney, P. (2013). The Ubiquitous Presence of the Past? Collective Memory and International History. *The International History Review* , 443-472.
- García-Gavilanes, R., Mollgaard, A., Tsvetkova , M., & Yasser, T. (2017). The memory remains: Understanding collective memory in the digital age. *Science Advances*, 1-7.
- Göker, N. (2018). Sinema Seyirci İlişisini Etki Çerçevesinde Düşünmek: Bir İzleyici Araştırmasının Sonuçları. *Akdeniz İletişim Dergisi*, 270-292.
- Güçhan, G. (1993). Sinema-Toplum İlişkileri. *Kurgu Dergisi*, 51-71.
- Halbwachs, M. (1966). *The Collective Memory*. New York: Harper & Row.
- Kalçık, C., & Ünal, F. (2017). Öğretmen Adaylarının Tarihi Dizi/Filmlerle Yaşam Boyu Öğrenme Algısı Ve Tarih Şuuru Oluşumu Hakkındaki Görüşlerinin Belirlenmesi. *Anadolu Kültürel Araştırmalar Dergisi*, 1-19.
- Karaca, Ö. (2019). *Sinema ve Toplumsal Etkisi*. [www.kameraarkasi.org: http://www.kameraarkasi.org/makaleler/makaleler/sinemaveetkisi\\_ozkankaraca.pdf](http://www.kameraarkasi.org/makaleler/makaleler/sinemaveetkisi_ozkankaraca.pdf) received from
- Kluckhohn, C., Murray, H., & Schneider, D. (1953). *Personality in nature, society, and culture*, 2nd ed. Knopf.
- Metz, C. (2012). *Sinemada Anlam Üstüne Denemeler*. İstanbul: Hayalperest Yayınevi.
- Moje, E. B., & Luke, A. (2009). Literacy and Identity: Examining the Metaphors in History and Contemporary Research. *Reading Research Quarterly*, 415-437.
- Müller, J.-W. (2002). *Memory and Power in Post-War Europe: Studies in the Presence of the Past*. Cambridge University Press.
- Nora, P. (2006). *Hafıza Mekanları*. Ankara: Dost Kitabevi.
- Okumuş, O. (2020). Tarih Derslerinde Tarihsel Film Uygulaması Hakkında Öğrenci Düşünceleri. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*, 202 - 224.
- Olick, J. K. (1999). Collective Memory: The Two Cultures. *Sociological Theory*, 333-348.
- Orta, N. (2019). Toplumsal Bellek ve Sinema: Popüler Sinema Örneği Olarak Fetih 1453. *Selçuk İletişim*, 1094-1126.
- Rosenstone, R. A. (1995). The Historical Film as Real History. *Film-Historia*, 5-23.
- Russell, N. (2006). Collective Memory before and after Halbwachs. *The French Review* , 792-804.
- Saito, H. (2010). From Collective Memory to Commemoration. J. R. Hall, L. Grindstaff, & M.-C. Lo içinde, *Handbook of Cultural Sociology* (s. 629-638). London: Routledge.
- Sampson, D., & Smith, K. (1957). A scale to measure world-mindedness. *Journal of Social Psychology*, 207-214.
- Sarıboğa, V., & Sarıkaya, E. (2004, 02 05). *Yüzyılın kurtarma operasyonu*. [arsiv.sabah.com.tr: http://arsiv.sabah.com.tr/2004/02/05/gnd110.html](http://arsiv.sabah.com.tr/2004/02/05/gnd110.html) received from
- Şahin Kübra. (2019). Öğretmen Adaylarının Tarihi Dizi/Filmlerle Yaşam Boyu Öğrenme Algısı Ve Tarih Şuuru Oluşumu Hakkındaki Görüşlerinin Belirlenmesi. *Yüksek Lisans Tezi*. Erzincan, Türkiye: Erzincan Binali Yıldırım Üniversitesi Sosyal Bilimler Enstitüsü.
- Şahin Ulsan, Ş. (2004). Ertuğrul Fırkateyni'nin Japonya Yolculuğuna Dair Bir Belge. *Tarih İncelemeleri Dergisi*, 93-99.
- T.C. Tokyo Büyükelçiliği. (2017, 07 04). *Ertuğrul Fırkateyni Faciası*, 4.7.2017. [tokyo.be.mfa.gov.tr: http://tokyo.be.mfa.gov.tr/Mission/ShowInfoNote/133573](http://tokyo.be.mfa.gov.tr/Mission/ShowInfoNote/133573) received from
- TDK. (2021). *Güncel Türkçe Sözlük*. [sozluk.gov.tr: https://sozluk.gov.tr/](https://sozluk.gov.tr/) received from
- Tulving, E. (2002). Episodic Memory: From Mind to Brain. *Annual Review of Psychology*, 1-25.
- Weber, M., Gerth, H., & Mills, C. W. (1946). *From Max Weber : Essays in sociology*. New York: Oxford University Press. [us.sagepub.com: https://us.sagepub.com/sites/default/files/upm-assets/72275\\_book\\_item\\_72275.pdf](https://us.sagepub.com/sites/default/files/upm-assets/72275_book_item_72275.pdf) received from
- Wertsch, J. V. (2008). The Narrative Organization of Collective Memory. *American Anthropological Association*.

## PANDEMIC, INFODEMIC AND INFORMATION DISORDER: A QUALITATIVE CONTENT ANALYSIS ON FALSE INFORMATION DURING CORONAVIRUS

Mustafa BÖLÜKBAŞI\*

\* Dr. Lecturer, Uşak University, The Office of Communication, Uşak, Turkey.

ORCID: <https://orcid.org/0000-0002-6895-6151>

### Abstract

Although Covid-19 has been attracting a lot of interest in a wide range of fields, most social researchers have only focused on its economical or psychological effects. Recently, considerable literature has grown up around the theme of “information disorder”. However, few studies have investigated the role of the internet in the spread of false information in a systematic way. In addition, there has been little agreement on the conceptional framework. This paper analyzes misinformation/disinformation on websites, social media platforms, and closed messaging applications during the coronavirus pandemic between November 2020 and April 2021 by using the qualitative content analysis method. This study aims to contribute to this growing area of research by exploring the main characteristics of false information. The research data is drawn from the fact-checking website “teyit.org” and covers a total of 73 false contents. The major findings are as follows: 1-) 90% of the contents have “completely false information”. 2-) The most common type of false content is misleading content with 39%. 3-) The number of false contents has relatively decreased with vaccination. 4-) However, about a third of the false contents are related to vaccines.

**Keywords:** Covid-19, infodemic, information disorder, fake news, content analysis

### INTRODUCTION

The role of the internet and social media in the dissemination of information is gradually growing. The rapid increase in the number of internet users provides the opportunity to reach a much wider audience than in the past. For example, today, there are more than 4.5 billion internet users and over 3.8 billion active social media users in the world (We Are Social, 2020). Also, generation Y and Z use the internet more and more for news consumption (Newman, Fletcher, Kalogeropoulos, and Nielsen, 2019). Thus, the internet has become an effective tool for spreading ideas and gathering like-minded people. This also provides the basis for false information to reach the masses quickly.

The increasing number of fake content during the US Presidential elections in 2016 has raised concerns about false information (Silverman, 2016). Upon these reactions, Facebook developed the fact-checking service in 2017 to prevent the negative consequences of fake news. The anxiety and uncertainty created by the coronavirus epidemic have led to an increase in misinformation/disinformation since the end of 2019. The World Health Organization has used the term “infodemic” in order to draw attention to the dangers of false information. The term refers to information pollution including false or misleading information in digital and physical environments during a disease outbreak (information + pandemic). It is obvious that the need for information increases in times of crisis. People are trying to quickly access information that gives meaning to the current situation to decrease their level of anxiety. Messages shared on websites, social media platforms, and closed messaging applications are generally accepted as accurate without any verification.

Unlike the traditional media, new communication technologies (Web 2.0) have led to the decentralization of information and transformed “ordinary” users into content producers. Web

2.0 are platforms where users not only consume content but also produce (sometimes reproduce) it. Producers and consumers are intertwined via those platforms such as Facebook, Twitter, and Youtube, where the hegemony of the “prosumer” becomes evident (Ritzer, Dean, and Jurgenson, 2012, p. 385). Thus, new communication technologies turn the dissemination of false information into a complex process. In other words, rather than the source, the message itself becomes important.

The infodemic that affects the world is turning into a complex process thanks to Web 2.0 tools. In general, the essence of these tools is the bilateral information sharing process that takes the users out of the passive position. In social media, “ordinary” users go beyond being consumers and become content producers. Users who produce and share their content can also provide feedback to other users (Taşkıran and Kırık, 2016, p. 217). The term “user-generated content” points to this dimension of digital information and glorifies the status of the user. It is the contribution of users that makes social media platforms meaningful because these platforms work more like a marketplace where content producers come together - content is created by ordinary users (Van Dijck, 2009, p. 41). This development, which shakes the hegemony of large organizations in broadcasting, “democratizes” the production and sharing of (false) information.

Recently, researchers have shown an increased interest in the effect of misinformation/disinformation. However, few studies have investigated the role of the internet in the spread of false information in a systematic way. Researchers have used different terms to define false information such as disinformation (Erkan and Ayhan, 2018; Yoloğlu, 2017; Soğukdere and Öztunç, 2020), digital disinformation (Ünver, 2018), post-truth (Göncü and Sim, 2019), infodemic (Akyüz, 2020), fake news (Kavaklı, 2019; Ünal and Taylan, 2017) and fabricated news (Uyanık, 2017). That is, there has been little agreement on the conceptual framework. Although the term “fake news” is relatively common, it does not include content that goes beyond the news format in closed messaging applications. On the other hand, disinformation cannot explain the information that is false but not created with the intention of causing harm. Therefore, the conceptual framework of this study is based on Wardle and Derakhshan’s (2017) “information disorder”, which includes different forms of false information. The information disorder works as an umbrella term for the different types of false information we encounter today. The term covers many types of misleading information. It also includes the information that is false and deliberately created to harm (disinformation) and the information that is false but not created with the intention of causing harm (misinformation). In other words, it gathers different types of false content such as misinformation, disinformation, and malinformation.

This paper analyzes misinformation/disinformation on websites, social media platforms, and closed messaging applications during the coronavirus pandemic by using the qualitative content analysis method (Drisko and Maschi, 2016). This study aims to contribute to this growing area of research by exploring the main characteristics of false information.

## RESEARCH DESIGN

The aim of this study is to explore false information spread during the coronavirus pandemic between November 2020 and April 2021 based on Wardle and Derakhshan’s (2017) concept of “information disorder”. The research data were collected from the fact-checking website “teyit.org” and consisted of 73 false contents.

The study applied the following coding process:

First, manifest variables such as the date or the title of false news were coded. For verification, teyit.org’s analysis was used to identify contents as false, mixed, or undetermined. Then, false contents were categorized according to Wardle (2017)’s seven types of mis- and dis-information as follows:



1-) Satire or Parody: No intention to cause harm but has the intention to fool.  
 2-) False Connection: When headlines, visuals or captions don't support the content.  
 3-) Misleading Content: Misleading use of information to frame an issue or individual.  
 4-) False Context: When genuine content is shared with false contextual information.  
 5-) Imposter Content: When genuine sources are impersonated.  
 6-) Manipulated Content: When genuine information or imagery is manipulated to deceive.  
 7-) Fabricated Content: New content is 100% false, designed to deceive and do harm.  
 Finally, contents were coded in terms of the topic they focused on. Six different major themes were identified such as conspiracy theories, authorities' actions/statements, vaccination, health tips, social effects, and the transmission of Covid-19.

## RESULTS AND DISCUSSION

Table 1 shows the breakdown of contents according to the timeline. The number of contents rose to a high point and peaked in December 2020 ( $N=22$ ). The clear trend of decreasing from the end of 2020 could be attributed to relative control of the virus through the beginning of vaccination.

**Table 1. The Number of Analysed Contents According to Months**

Date	<i>N</i>	%
November 2020	17	23%
December 2020	22	30%
January 2021	13	18%
February 2021	12	16%
March 2021	9	12%
Total	73	100%

Table 2 provides the results obtained from verification analyses of contents. 90% of news includes entirely false information. This finding is consistent with that of Akyüz (2020). It can be said that with the second wave of the Covid-19 pandemic, mis- and dis-information about Covid-19 has increased again.

**Table 2. The Results of Verification Analysis**

Verification Analysis	<i>N</i>	%
False	66	90%
Mixed	5	7%
Undetermined	2	3%
Total	73	100%



Table 3 presents the breakdown of contents coded as “false” according to types of mis- and dis-information. Mixed and undetermined contents were excluded from this analysis. As can be seen from the table below, the most common type of false information is misleading content with 39%. This category refers to the misleading use of information to frame an issue or individual. The second most common type of false information is fabricated content with 27%. Almost 90% of the contents consists of only three categories: misleading content, fabricated content, and false context. In other words, false connection, parody, imposter content, and manipulated content were rarely observed.

**Table 3. False Information According to Types of Mis- and Dis-information**

Categories	<i>N</i>	%
Misleading content	26	39%
Fabricated content	18	27%
False context	13	20%
False connection	4	6%
Parody	3	5%
Imposter content	1	2%
Manipulated content	1	2%
Total	66	100%

The themes identified in the study are presented in Table 4. As many as a third of contents are about vaccines. With the beginning of vaccination, false information about vaccines has increased. What is striking about the figures in this table is the high percentage of conspiracy theories (21%). Conspiracy theories are very common since the beginning of the Covid-19 pandemic but they are increasingly targeting vaccines. For example, conspiracy theories about vaccination being used as population control have become popular quickly.

**Table 4. Content According to Themes**

Thema	<i>N</i>	%
Vaccination	21	29%
Conspiracy theories	15	21%
Transmission of Covid-19	11	15%
Authorities' actions/statements	11	15%
Health tips	10	14%
Social effects	5	7%
Total	73	100%

## CONCLUSION

This study examines online misinformation/disinformation during the coronavirus pandemic between November 2020 and April 2021 by using the qualitative content analysis method. The major findings are as follows: 1-) 90% of the contents have “completely false information”. 2-) The most common type of false content is misleading content with 39%. 3-) The number of false contents has relatively decreased with vaccination. 4-) However, about a third of the false contents are related to vaccines.

In spite of its limitations, the study certainly adds to our understanding of the production and sharing of false information. Further research might explore the following questions: Why do some false information reach a large number of people but others don't? What kind of people does believe fake news more easily? Do party preferences affect believing conspiracy theories?

## REFERENCES

- Akyüz, S. S. (2020). Yanlış Bilgi Salgını: COVID-19 Salgını Döneminde Türkiye’de Dolaşıma Giren Sahte Haberler. *Akdeniz Üniversitesi İletişim Fakültesi Dergisi*(34), 422-444.
- Drisko, J. W., Maschi, T. (2016). *Content analysis*. New York: Oxford University Press.
- Erkan, G., Ayhan, A. (2018). Siyasal İletişimde Dezenformasyon ve Sosyal Medya: Bir Doğrulama Platformu Olarak Teyit.Org. *Akdeniz Üniversitesi İletişim Fakültesi Dergisi*(30), 201-223.
- Göncü, S., Sim, Ş. (2019). Post-Truth Zeminde Suriyeli Mülteciler Hakkında Çıkan Haberlere Dair Bir İnceleme. *Düşünce ve Toplum Sosyal Bilimler Dergisi*, 1(1), 1-28.
- Kavaklı, N. (2019). Yalan Haberle Mücadele ve İnternet Teyit/Doğrulama Platformları. *Erciyes İletişim Dergisi*, 6(1), 663-682.
- Newman, N., Fletcher, R., Kalogeropoulos, A., Nielsen, R. K. (2019, September 20). *Reuters Institute Digital News Report 2019*. Retrieved from <http://www.digitalnewsreport.org/>
- Ritzer, G., Dean, P., Jurgenson, N. (2012). The Coming of Age of the Prosumer. *American Behavioral Scientist*, 56(4), 379–398.
- Silverman, C. (2016). *This Analysis Shows How Viral Fake Election News Stories Outperformed Real News*. Retrieved Eylül 14, 2020, from Buzzfeed News: <https://www.buzzfeednews.com/article/craigsilverman/viral-fake-election-news-outperformed-real-news-on-facebook>
- Soğukdere, Ş., Öztunç, M. (2020). Sosyal Medyada Koronavirüs Dezenformasyonu. *Kastamonu İletişim Araştırmaları Dergisi*(5), 59-85.
- Taşkıran, İ., Kırık, A. M. (2016). Gazetecilerin Sosyal Medyayı Haber Kaynağı Olarak Kullanımı: Medya Profesyonellerinin Bakış Açılarını Tespit Etmeye Yönelik Bir Araştırma. *Intermedia International e-Journal*, 3(1), 213-241.
- Uyanık, Ş. (2017). Mobil Teknolojiler Sayesinde Hızla Yayılan Sahte Haberlerle Başa Çıkmanın Yöntemleri: Bilgi Doğrulama Üzerine Bir Araştırma. B. Kalsın içinde, *Tüm Boyutlarıyla İnternet Haberciliği* (s. 333-348). Ankara: Gece Kitaplığı.
- Ünal, R., Taylan, A. (2017). Sağlık İletişiminde Yalan Haber – Yanlış Enformasyon Sorunu ve Doğrulama Platformları. *Atatürk Üniversitesi İletişim Fakültesi Dergisi*(14), 81-100.
- Ünver, A. H. (2018). Dijital Siyasal Dezenformasyon ve Algoritmik Propaganda. *Birikim Dergisi*(355), 6-15.
- Van Dijck, J. (2009). Users Like You? Theorizing Agency in User-Generated Content. *Media, Culture & Society*, 31(1), 41-58.
- Wardle, C. (2017). *Fake News. It's Complicated*. Retrieved Eylül 5, 2020, from First Draft News: <https://firstdraftnews.org/latest/fake-news-complicated/>
- Wardle, C., Derakhshan, H. (2017). *Information Disorder: Toward an Interdisciplinary Framework for Research and Policymaking*. Council of Europe.

- We Are Social. (2020, January 30). *Digital 2020: Global Digital Yearbook*. Retrieved from <https://wearesocial.com/digital-2020>
- Yoloğlu, N. (2017). Küresel Medya ve İletişim Anlayışında Aktüel Enformasyondan Dezenformasyona Yöneliş. *Middle Black Sea Journal of Communication Studies*, 2(1), 8-15.

# **MORPHO-TAXONOMIC STUDY of *Tabanus unifasciatus* LOEW, 1858 (DIPTERA: TABANIDAE). NEW RECORD FOR IRAQ**

**Ahmed Jameel Sabr**

*Dept. of Biology, College of Education for Pure Sciens Ibn Al-Haitham, University of Baghdad.*

## **Abstract**

This search was included external morphological study of horse fly *Tabanus unifasciatus* Loew, 1858 new record in Iraq, which belongs to family: Tabanidae Latreille 1802, order: Diptera. The study was involved the most important taxonomic external characters: the head which includes compound eyes and front in terms of its shape, color and parts; and maxillary palpi in terms of color and palpal calli; and antenna in terms of color, parts and shape of each part; and the dorsal view of thorax in terms of color, and its core parts such as thorax segments and their appendages wings and legs, the study includes the shape of the wing and its color and the characteristics of its venation; and colors and shapes of fore, mid and hind legs; in addition, this work included the spotting in coloring pattern of dorsal view of abdomen, and female genitalia includes the parts of this genitalia and the shapes of each part.

Key words: Horse fly, Diptera, Tabanidae, *Tabanus*, Description.

## **Introduction**

*Tabanus unifasciatus* Loew, 1858 is species belongs to family Tabanidae Latreille 1802 and subfamily Tabaninae Loew, 1860. The subfamily are include about 275 species belong to 72 genera which were of wide global spread, from temperate to subtropical and tropical zones (Pape et al., 2011; Henriques, 2013), it is known from many parts of the world from Asia including Saudi Arabia, Oman, Kuwait, Jordan, Syria, Turkey and Malaysia (Al-Talafha et al., 2004; Chin et al., 2010) to African including Egypt (Abu El-Hassan, 2010) to Europe including Hungary, Italy, Croatia and United Kingdom (Quercia et al., 2008; Egri et al., 2013) to North America including U. S. A. and Mexico (Manrique-Saide et al., 2001) and to South America including Brazil, Chile and Colombia (Para et al., 2008; Christian, 2009), the subfamily Tabaninae are poorly known in the Middle East (Al-Dhafer et al., 2009), yet a comprehensive generic description is not available (Mackerras et al., 2008).

In Iraq, subfamily Tabaninae was studied by Leclercq (1963) describing 24 horse flies species within four genera, studied by Ahmed (2015) describing 15 species within four genera and studied by Hatem (2016) describing seven species within five genera.

The most of female's species takes blood meals by pierce skin and suck blood mainly utilized for Oogenesis and feed on nectar regularly, which they are need for energy; while the males feed on nectar and pollen only because of the loss of the mandible (Rubio, 2002). The veterinary and medical importance of horse flies comes through the blood-feeding behavior of their females, and includes many species important to human and animal health, either by acting as a disease vector such as Surra, Anthrax and Loaloa, or by debilitating the host (Mullen, 2009).

The family Tabanidae members are medium – sized to larger specimens, usually densely haired on thorax and abdomen. Predominant specimens are with brownish side spotting patterns on anterior abdominal segments, or mostly grayish-black to black. Compound eyes in living specimens are mostly greenish with three purple bands, only very rarely unbanded or with one or two bands; always pubescent or naked depend on different species (Leclercq, 1963; Leclercq, 1966; Zainab et al. 2018).

Vertex sometimes was with three small ocelli. Frons usually narrower, frontal calli well developed; median callus usually liner and connected with a larger circular, square to

rectangular shaped lower callus; only exceptionally calli reduced or missing. Wings are clear or slightly clouded especially interiorly, rarely with darker patches on cross veins; exceptionally a very short appendix to vein R<sub>4</sub> (Chvála et al., 1972; Leclercq, 2000).

### Materials and Methods

Specimens of *Tabanus unifasciatus* Loew, 1858 were collected at the first time from Al-Radwan 2014, west of the capital Baghdad, located at longitude 44.2680355 and latitude 33.1863567; and Al-Yousfia 2014, south of the capital Baghdad and away 25 km from Baghdad, located at longitude 44.251662 and latitude 33.07908 (Jawad and Ahmed, 1958). A total of two localities in the East of Iraq were visited during May, June, July and August 2014. Horse flies were trapped with chemical trap and a regular insect net. Samples collected by the above traps were fixed on thick paper and kept in insect box. Date and place of collection and hosts were recorded. A total of three female specimens were identified based on Leclercq (1966) and Chvála et al. (1972).

The study was made using a dissecting and compound microscopes (Olympus, Japan), using normal light. Image of insect by photomicroscope type **Ya Xun Microscope User Manual**, having enlargement power 20X max. (Bourgoin and Szwedo, 2008). The following table shows the solutions that used in the preparation of the attractive substance of chemical trip and concentrations (Ahmed, 2018):

Seq.	Solution used	Concentration
1	Sec-butyl alcohol	11.4 ml
2	Iso-butyl alcohol	11.4 ml
3	n-butyric acid	11.4 ml
4	n-valeric acid	11.4 ml
5	Acetic acid	11.4 ml
6	Dimethyl disulphide	9.0 gm
7	Phenol	9.0 gm
8	P-cresol	9.0 gm
9	Indol	2.3 gm
10	Benzoic acid	2.3 gm
11	Acetone	11.4 ml

### Results and Discussion

Describe of *Tabanus unifasciatus* Loew, 1858.

#### Body of ♀:

Rather large species, its Length 16.5 mm and width 9 mm.

#### Head capsule: Photo. -1-

Compound eyes of species are naked and without bands.

#### Frons: Photo. -1-

Rather broad, almost parallel sides, but it is indistinctly widened above; yellowish-grey dusted, likewise subcallus. Lower frontal callus is long rectangular, black color, slightly shining and narrowly separated from the eye-margins. Median frontal callus is black, spindle-shape and connected with lower frontal callus. Vertex on postocular margin is slightly deeper with somewhat longer mostly black hairs. Subcallus is flat; face and gena are white.

#### Antennae: Photo. -2-

It's brown on basal two segments and the tip of segment three is black; pedicel is short, represents a third of the length of scape, flagellum three times the scape, brown with blunt ended of dorsal tooth, terminal flagellam segments black towards extreme.

#### Maxillary palp: Photo. -2-

It is stout, white color, clothed with pale and black hairs (palpal calli).

**Thorax:** (Dorsal view) Photo. -3-

Its grayish dusted on mesonotum, with indefinite pale longitudinal stripes (a median and two sub laterals) covered with pubescence. Pleura is more grayish dusted and with long white pubescence. Scutellum is black in color. Halter is blackish-brown.

**Wing:** Photo. -4-

The wing is broader and more blunt-tipped. Clear with dark veins, correspondingly long and wide. C vein base thickened. Sc single small vein ended nearly in the middle of anterior margin. R1 arched terminally. R<sub>2</sub>+R<sub>3</sub> are shorter than R<sub>1</sub>, slightly sinuous and joining R<sub>1</sub> at costa. R<sub>4</sub> + R<sub>5</sub> clearly longer than R<sub>s</sub> and shorter than stem of R<sub>4</sub> + R<sub>5</sub> combined; dR five times longer than bR; R<sub>4</sub> without appendix, attached to R<sub>5</sub> almost at right angle, R<sub>4</sub> terminated just before wing apex, and R<sub>5</sub> terminated far behind wing apex. M<sub>1</sub> shorter than M<sub>2</sub> and both shorter than M<sub>1</sub>+M<sub>2</sub> combined. M<sub>3</sub> sub-equal in long with M<sub>4</sub> and both longer than M<sub>3</sub>+M<sub>4</sub> combined. Cross r-m vein short, divided R<sub>4</sub>+R<sub>5</sub> combined two the bR and dR, meeting anterior margin of discal cell near of its midlength. Cross m-m vein meeting basal of M<sub>2</sub> and midlength of M<sub>3</sub>. The basal cells (cells br and bm) tend to be elongate, br cell slightly longer, but narrower than bm cell. CuA+CuP contact with them before the wing margin. Cross m-cu vein longer than cross m-m and r-m veins, meeting basal of M<sub>4</sub> and midlength of CuA. The cu cell closed, with short petiole distally. The d cell wide except apical part is not widened, with anterior margin is arched.

**Leg:** Photo. -5-

Grayish on coxa, trochanter and femur, tibia are brownish, tarsus black. Femur and tibia cylindrical shape, tarsus consist of five segments with pair of two long and hard claws at the end, arolium is median size between the claws.

**Fore leg:** Coxa is elongate with medium size and dense of pale haired, trochanter small size and bare, femur with median size of separate hairs, tibia with short separate hairs, basitarsus bare (Fig. 5 – 1).

**Mid leg:** Coxa square shape and bare, trochanter median size with few short separate hairs, femur with tuft of long hairs on anterior part from ventral side, tibia with median size hairs on far half and has pair of black and long special spurs on far end near basitarsus, the last is bare (Fig. 5 – 2).

**Hind leg:** Coxa nearly square with short pale hairs, trochanter with dense pale hairs, femur large size and inflate with long dense hairs along it, tibia with a long and median size hairs, basitarsus with short and median size hairs (Fig. 5 – 3).

**Abdomen:** (Dorsal view) Photo. -6-

It's reddish-brown, the side markings on anterior three to four tergites, otherwise black-gray with three rows of pale patches, a row of median tergites and sublateral oval patches.

**Female genitalia** ♀: Photo -7-

These are dorso-ventrally compressed and are never rotated.

**Sub genital plate (sternite 8) (Ventral view):**

• **Genital fork or Furca (Dorsal view):** Photo 7 – 1

Lies dorsally of tergite 9 and is usually large and irregular in shape, with narrow and convex base in anterior margin; two tufts of strong bristles at apex; central cavity inverted subtriangular with one bulge in each side. Three spermatheca are present, elongate with rounded apex; the spermathecal ducts are long, slender and lightly sclerotized and pigmented.

- Wider than long with slightly straight base, posterior margin with a weak indentation and seta not represented; consist of hypogynium and with distinct hypogonal valve fused (gonapophysis), the last projected distally, slightly concave, with long and abundant bristles; both form a ventral shell. Photo 7 – 2.

• **Tergite 8 (Dorsal view):** Photo 7 – 3



Large size, wider than long, subrectangular, anterior margin clear, with V-shape in the middle with dark of dense and long calli. Posterior margin is dark in color, strait and without calli.

## Reference

1. Pape, T.B. and Mostovski, M.B. (2011). Order Diptera Linnaeus, 1758. In Z-Q Zhang, Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness. Zootaxa, 3148: 222 – 229.
2. Henriques A.L. and Krolow T.K. (2013). Description of *Muscotabanus* gen. nov. and *Muscotabanus rafaelli* sp. nov. (Diptera: Tabanidae: Diachlorini) from Amazon Basin, Brazil. Mem Inst Oswaldo Cruz, Rio de Janeiro, Vol. 108(3): 383 – 385.
3. Al-Talafha, H.; Amr, Z.; Baker, M. and Bader, A. (2004). Horseflies of Jordan. J. Med. Vet. Entomol. 18: 208 – 221.
4. Chin, H.; Nazni-Wasi-Ahmad, N.; Kian, W.; Kurahashi, H.; Jeffery, J.; Kiang, S. and Omar, B. (2010). A Study of Cow Dung Diptera in Sentul Timur, Kuala Lumpur, Malaysia. J. Trop. Med. Parasitol.: 33:53–61.
5. Abu El-Hassan, G. M.; Badrawy, H. B.; Mohammad, S. K. and Fadl, H. H. (2010). Cladistic analysis of Egyptian horse flies (Diptera: Tabanidae) based on morphological data. Egypt. Acad. J. biolog. Sci. 3 (2): 51 – 62.
6. Quercia, O.; Emiliani, F.; Foschi, F. and Stefanini, G. (2008). The wasp-horsefly syndrome. Eur Ann Allergy Clin Immunol vol. 40 (3): 61 – 63.
7. Egri, A.; Blahó, M.; Száz, D.; Barta, A.; Kriska., G.; Antoni, G. and Horváth, G. (2013). A new tabanid trap applying a modified concept of the old flypaper: Linearly polarising sticky black surfaces as an effective tool to catch polarotactic horseflies. International Journal for Parasitology, 43: 555–563.
8. Manrique-Saide, P.; Delfin-González, H.; Ibáñez-Bernal, S. (2001) Horseflies (Diptera: Tabanidae) from protected areas of the Yucatan Peninsula, Mexico. Florida Entomologist, 84(3): 352 – 362.
9. Parra, H.G.; Alarcón, P.E. and López, V.G. (2008). Ecology and Parasitological Analysis of Horse Flies (Diptera: Tabanidae) in Antioquia, Colombia. Caldasia, 30(1): 179 – 188.
10. Christian, R. G. (2009). *Agelanius chiloensis*, a new species of horse fly from southern Chile (Diptera: Tabnidae). Guyana, 73(1): 12 – 16.
11. Al Dhafer, H.M.; Dawah, H.A. and Abdullah, M.A. (2009). Tabanidae (Diptera) of Saudi Arabia Saudi. Journal of Biological Sciences, 16: 77–83.
12. Mackerras, I. M.; Spratt, D. M. and Yeates, D.K. (2008). Revision of the horse fly genera *Lissimas* and *Cydistomyia* (Diptera: Tabanidae: Diachlorini) of Australia. Zootaxa, 1886: 1 – 80.
13. Leclercq M. (1963). Tabanidae (Diptera) of Iraq. Bulletin of the Iraq Natural History Institute (University of Baghdad). vol. 11 (7): 1 – 12.
14. Ahmed J. S. (2018). Seasonality and Relative Abundance of Deer and Horse flies (Diptera: Tabanidae). From Three Farms in Al- Anbar, Iraq. Biochem. Cell. Arch. Vol. 18, No. 2, pp. 1915-1920.
15. Hatem, A. N. (2016). Taxonomic and ecological studies on horse flies (Diptera: Tabanidae), and their roles in *Trypanosoma evansi* transmitted in Basrah province, Iraq. PHD thesis, Basrah University, College of Education for pure Science, 217pp. (In Arabic).
16. Rubio, M.P. (2002). Diptera Tabanidae. Fauna Iberica vol. 18. Museo Nacional de Ciencias Naturales. Madrid. 309 pp.

17. Mullen, B. A. (2009). Horse flies and deer flies (Tabanidae). In: G. R. Mullen and L. A. Durden (Eds.) Medical and veterinary entomology (Second Edition). Academic Press, Burlington USA: 261 – 274.
18. Leclercq, M. (1966). Révision Systématique et Biogéographique, des Tabanidae (Diptera) Paléarctiques, Tabaninae. Inst. R. Sci. Nat. Belg., Bruxelles. 237 pp.
19. Zainab H., Mouhannad M. and Ahmed J. S. (2018). External Morphological Study of *Aporia crataegi* (Linnaeus, 1758), (Lepidoptera: Pieridae). Northern Iraq Journal of Global Pharma Technology; 10 (07):71 – 76.
20. Chvála, M.; Lynborg, L. and Moucha, J. (1972). The Horse Flies of Europe: Entomological Society of Copenhagen, Copenhagen, 498 pp.
21. Leclercq, M. (2000). A Faunistic account of Tabanidae (Diptera) of Saudi Arabia and Oman. Faun. Arabia. 18: 285 – 292.
22. Jawad, M. and Ahmed, S. (1958). The Detailed Map of Baghdad Guide. Iraqi Academy of Sciences Press-Baghdad. Iraq. (In Arabic).

Photo 1: The head of *Tabanus unifasciatus*  
(Facial view)

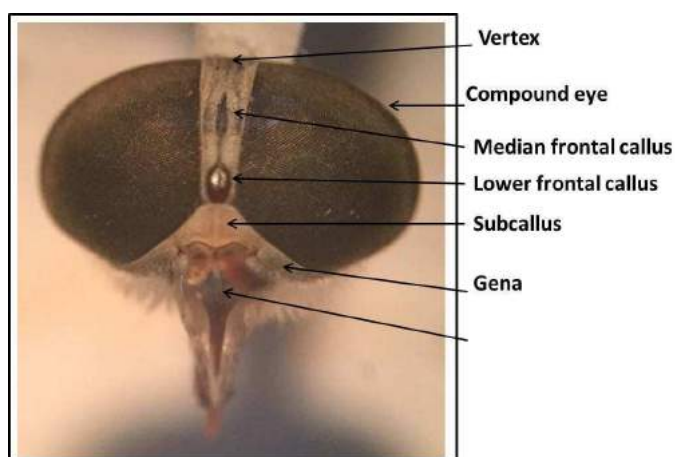


Photo 2: The head of *Tabanus unifasciatus*  
(Lateral view)

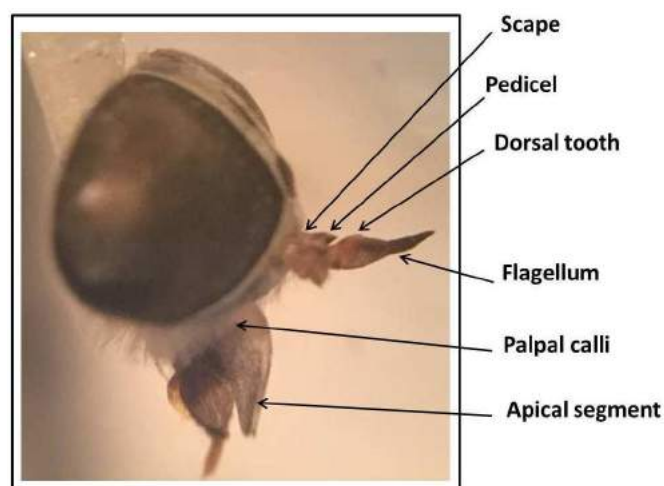
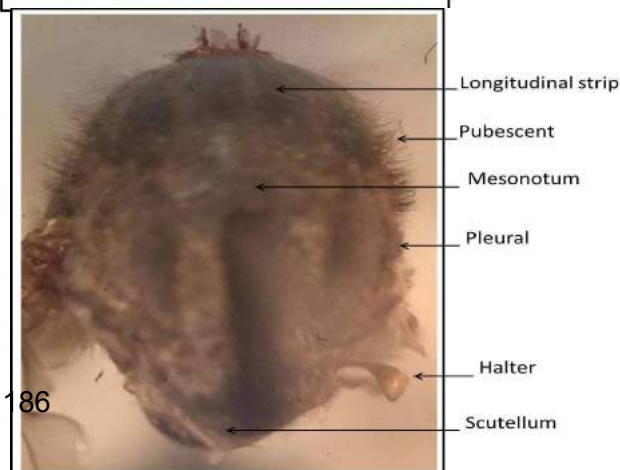


Photo 3: the thorax of *Tabanus unifasciatus*



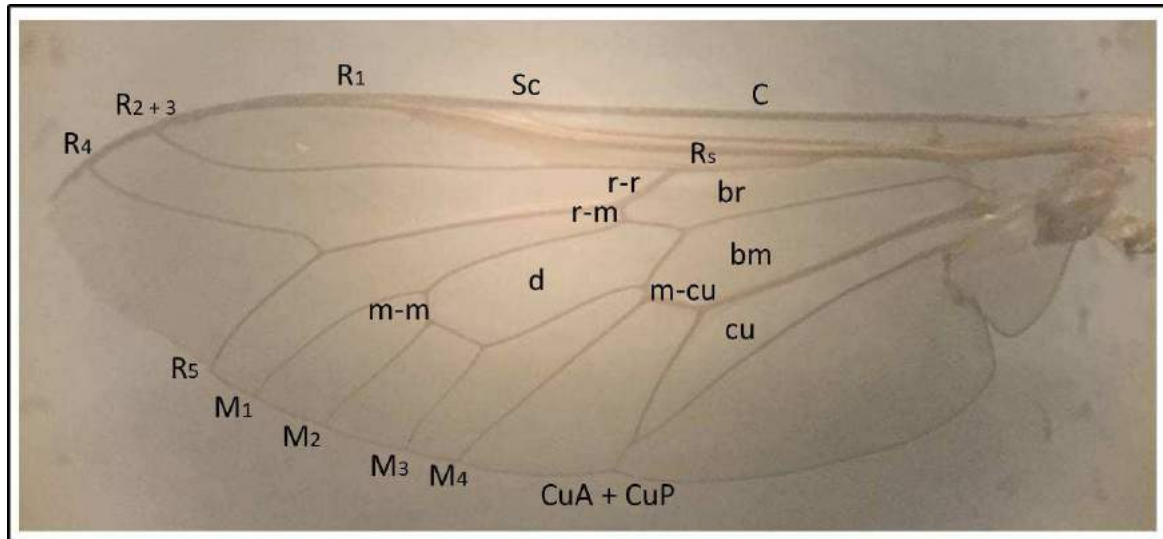


Photo 4: The wing of *Tabanus unifasciatus*



Photo 5: The Legs of *Tabanus unifasciatus*  
1. Fore leg; 2. Mid leg; 3. Hind leg.

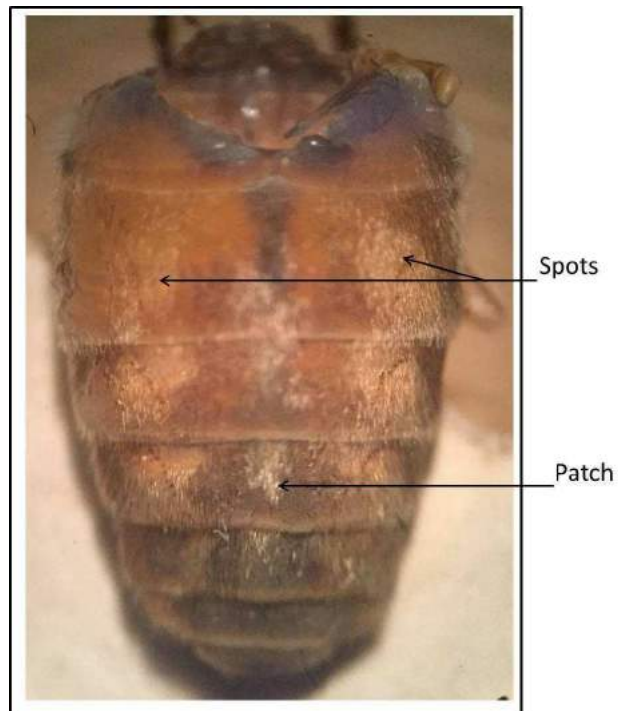


Photo 6: The Abdomen of *Tabanus unifasciatus*

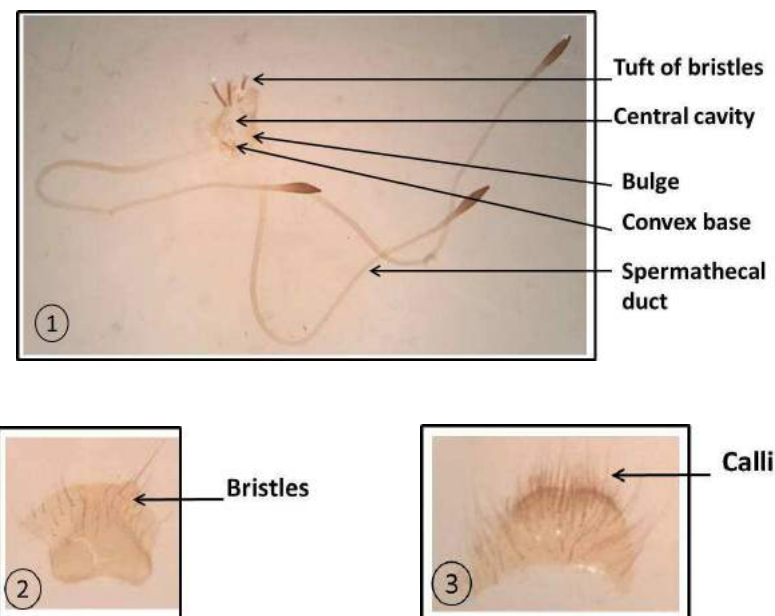


Photo 7: The Genitalia of *Tabanus unifasciatus*

1. Forca & Spermathecal ducts (dorsal view).
2. Sternite 8<sup>th</sup> and gonapophysis.
3. Tergite 8<sup>th</sup>.

## CAN ETHICAL BANKING DO JUSTICE TO CUSTOMER INVESTMENTS?

**M.A.K.De.S., Jayasekera and M.D Pushpakumari**

*Faculty of Graduate Studies*

*University of Sri Jayawardenapura, Sri Lanka*

*Faculty of Management Studies and Commerce*

*University of Sri Jayawardenapura, Sri Lanka*

### Abstract

The modern customer is ethically conscious and wish to align him/herself with organizations that make a positive impact on society and environment. The Customer investments may not easily come for banks that engage in irresponsible behaviours. Unlike the present-day customer who is concerned about the Socio- Environmental impact of his/her investments, the previous generation of customers have been only making calculations of costs and benefits of their investments. People can change the world with their investments, if it is wisely re invested by the financial intermediaries such as banks. Banks have a responsibility to invest Customer Deposits to obtain gains in all three areas of Economy, Environment and Society. The Conventional system of banking failed in this respect. The Financial crisis 2007, exposed banks for their lack of morality. The way banking was carried out was no longer be accepted and needed an ethical orientation of banking practices. An alternative banking type was required and Ethical Banking was accepted as the type of banking that aim for Socio-Economic and Environmental gains. The objective of Ethical Banking is Triple Bottom line – People, Planet and Profit. Ethical Banks maintain an Ethical Investment policy and maintain high transparency standards. The customers of these banks have access to information about where their money is invested. They actively take part in projects that lowers the Carbon Footprint. Future Investments in Banks will be subject to the scanning for possible negative externalities their investment can cause on Environment and Society. Under these circumstances this study is carried out to determine whether Ethical Banking can do justice to customer investments through a literature review. The methodology is a desk research. The significance of the study is to find out whether Ethical Banks are the right banks for customer investments.

**Key Words** – Deposits; Environment; Ethical Banking; Investments: Society;

### INTRODUCTION

The Banking industry had gone through unprecedented changes during the past few years and in the process, Banks were able to enter into many meaningful customer relationships. The technology plays an increasingly important role in the business of banking. The technological advances of the banking sector allowed banks to identify the customer preferences. Money is woven into our habit's beliefs and also to our daily activities. Can owners of money make a positive change to the world by investing responsibly? Customers are conscious about how and where their money is reinvested by the banks. They demand for accountability and responsibility for their investments from banks. The preferences of a banking customer have changed over the years. From a traditional conservative customer type of the past, the present-day customer has developed into an active and demanding type. The modern customer is knowledgeable and is concerned about the developments and changes that are happening around the world. This knowledgeable customer is concerned about the impact of their investments can make on the Society and the Environment. The customer base of banks is now dominated by the customers belong to generational categories of Millennials and Generation Z. They are different in their thinking and preferences to the previous generations. These two generations are concerned about negative developments happening around, and would prefer to deal with organizations that can make a positive change to the world.



The experience gained during and after the financial crisis required banks to change its behavior. The customer perception of banks has changed since then and customers were not ready to accept banks as trustworthy financial institutions. The operating landscape also is changing and banks are adopting themselves to the changes. Banks have been building Capital buffers to accommodate regulatory requirements after the crisis. Customers see banks as more than institutions where you can keep your money safely. Banks in their objective to achieve high financial gains, neglected its duties to Environment and Society. Ethical practices were not common in the banking business. Public and Civil society were concerned about banks lackadaisical approach to achieve Environmental and Social progress. This led people to search for an alternative banking model as a countermovement to the Financialization of the economy, which can achieve success in all three areas of Economy, Environment and Society. Banks were blamed by Academia for their irresponsible lending to organizations and projects that were directly and /or indirectly involved in environmental destruction (Sarokin & Schulkin, 1991; Smith, 1994) There should be a banking alternative for ethically conscious people to choose. Ethical Banking was progressing and was accepted as an alternative to Conventional Banking. The Ethical Banks differentiate itself with their approach and fulfills the needs of their ethically conscious customers. Ethical Banking does good by directing its lending towards Environmentally and Socially gainful projects and businesses. Ethical Banking is all encompassing and is values based. It is driven by the responsibilities towards Environment, Society and Economy. Ethical Banks deals with organizations /projects that can make a positive impact on Environment and Society. These banks are committed not to reinvest customer money in any project or business that could have detrimental effect to the Environment and Society. Ethical Banks maintain high transparency standards. Ethical Banking is a future-focused banking concept. Customers are willing to pay a higher price or forego interest for an ethical banking product. They make sure that their chosen bank invests the customer deposits in a prudent and responsible manner. The customers are now keeping an eye on ethical policies of banks. Customers are making ethical choices now. Customer expectations go beyond earning economic returns, they are more conscious about the threat to environment and marginalization of certain segments of Society. The Economic, Digital and Knowledge disparities the societies experience are concerns of present generation. They are keen to find solutions to climate emergencies. They expect their Bankers to be responsible and demonstrate it by helping to make positive changes to the Environment and Society. Ethically conscious customers were looking for ethically oriented banking alternatives. Customers wants their investments wisely re-invested in Environmentally, Socially and Economically gainful projects and businesses. They do not want their investment to be used for environmentally or socially harmful projects. Under these circumstances this research is carried out to determine whether Ethical Banking can do Justice to customer investments through a literature review.

## **METHODOLOGY**

The study is a Desk research, researchers have reviewed literature from 1990 to 2020. Relevant articles were searched and over 60 articles have been reviewed in Journal articles, working papers and text books. The articles were searched through on-line web sites such as Emerald Insight, Science Direct, Willey online library, JSTOR etc., using key words- Deposits; Environment; Ethical Banking; Investments: Society

## **LITERATURE REVIEW**

Civil society require banks to engage in responsible lending practices by extending banking services to all societies (Schoenmaker & Werkhoven, 2012). Banking at present has advanced to become a Socio-Environmental based operation from being a profit-oriented operation, in which they consider all three Environmental, Social and Economical based costs (Chew et al, 2016). Banks objective of profit making should not affect the social systems, hence; it should be done in an ethical manner (Francis, 2000). Banks were blamed for their irresponsible behaviours. Banks on their way to earn high economic gains have



been abandoning its responsibilities towards Environment and Society. People were looking for an ethically oriented alternative banking model, which promotes Social and Environmental sustainability whilst earning Economic returns. Ethical Banking emerged as the alternative banking model. Ethical Banking is also involved in delivering whole range of banking services (Babu and Boitan 2009) Harvey (1995) claims that Ethical Banks take full responsibility of its investments and customer deposits Ethical Banks strive to achieve triple bottom line -the People, Planet and Profit (Tse, 2011). The core of Ethical Banks mission, ambitions and practices is Sustainable Development (De Clerck, 2009). San-Jose et al (2011) confirms that Ethical Banks work to achieve, societal environmental and economic benefits. The aims of Ethical Banks include, providing marginal communities and investing communities with environmentally and socially sustainable economic opportunities (Benedikter, 2011).

Due to the irresponsible behaviours of conventional banks Ethical banks were able to increase its customer base. The financial crisis of 2007, contributed to the growth of clientele of ethical banks (Webber and Remer, 2011) (Ijeoma, 2014), (Rodriguez Gutierrez, 2013), (Borgia, 2013). Ethical Banking is popular among small savers and it doubled its asset base within a period of 3 years (2007-2010) (Benedikter, 2011). It is not only the trust customers have in their bank officers, the ability to achieve social gains along with economic benefits makes Ethical Banking more acceptable (Davies, 2001). Ethical Banks were eager to make a positive change in the lives of people by promoting projects that are Environmentally, Socially and Economically viable (Weber & Remer 2011) Ethical Banking was accepted as a benevolent banking model since they consider the interest of Environment, Society and Economy. Ethical Banking promotes not only Economic gains but it strives to achieve Social and Ecological returns as well (Jayasekera & Puspakumari 2020)

Ethical consumption is a new phenomenon. (Devinney et al, 2010) felt that ethical consumption phenomenon has potential to be accepted at mass market level. There is an increasing demand for Ethical products and services. The decisions for ethical purchasing are based on specific social or ethical issues and Ethical Purchasing is a conscious exercise (Gulyás, 2008). It is noted that Ethical Products and Services are on the increase and is consistently gaining an increased market share in separate markets (Ethical Consumer Market Report, 2012). Many consumers punish organizations for unethical behavior by temporary boycotting or engage in anti-consumption behavior of their products or services over a long period, few honours ethical their behavior by purchasing ethical brands instead of any other alternative brand (Carrigan & Attalla 2001) Forsyth et. al. (2008) noted that what is considered ethical differs from society to society. In banking too, people look for ethical alternatives. Modern ethically conscious bank customers will prefer Ethical Banks over other Traditional Banks.

Why customers prefer Ethical Banking? Their ethics enable them to make sound decisions than conventional Banks (Karl, 2016). The Banks which has good ethical practices has an advantage over its competitors and are considered trustworthy by its constituents who are confident about those banks, and this supports their long-term existence (Safakli, 2011). Ethical Banking discourages investment in speculative products (Tischer & Remer, 2016), it operates only in real economic activity (Wagemans et. al, 2013) Ethical Banks has low default rate in its loan portfolios (Cowton & Thomson, 2001). Cornée & Szafarz (2013) were of the opinion that this kind of banks are safer to bank with. Some customers voluntarily sacrifice part of their earning for a good cause. In order to achieve socially beneficial results there are socially minded people who are willingly forego part of earnings (Cornée & Szafars, 2014). Ethical Banking considers Transparency as a key value. Maintaining transparency is a key value in their policies, they publish their lending details for anyone interested to view (Novaković & Liović, 2016). The investors and depositors of Ethical Banks have access to information about where and how their money is re-invested (San-Jose et al. 2011) These banks are capable of assessing risks correctly because they were specialized in specific sectors (Karl, 2016). This enables them to build customer confidence. Giving customers loans on advantaged terms, makes a strong bond between customer and bank. Ethical Banks offer attractive terms to borrowers and they in turn reciprocate it by their low defaults (Cornée & Szafarz 2013). Ethical Banks have been more stable in crisis situations and are resilient (Wagemans et.

al ,2013). Ethical Banks fulfills customer expectations. From the above it can be finalized that Ethical Banks do justice to the customer investments.

## DISCUSSION

Modern customers are Ethically conscious and would prefer to deal with ethical products and services. The new generation of customers prefer to associate themselves with organizations that make a positive impact to the world. Many consumers punish organizations for unethical behavior by temporary boycotting or engage in anti-consumption behavior of their products or services over a long period, few honours their ethical behavior by purchasing ethical brands instead of buying any other alternative brand (Carrigan & Attalla 2001). Ethical consumption is becoming popular. Devinney et al (2010) felt that ethical consumption phenomenon has potential to be accepted at mass market level. Customers of banks too prefer to deal with ethically oriented Banking Institutions. People were looking for an ethically oriented alternative banking type. Ethical Banking was accepted as an alternative banking model. Ethical Banks were eager to make a positive change in the lives of people by promoting projects that are Environmentally, Socially and Economically viable (Weber & Remer 2011). The aims of Ethical Banks include, providing Marginal Communities and Investing Communities with environmentally and socially sustainable economic opportunities (Benedikter,2011). Ethical Banking considers Transparency as a key value. Maintaining transparency is a key value in their policies, they publish their lending details for anyone interested to view (Novaković & Liović, 2016). Ethical Banks takes responsibility of Customer deposits and investments (Harvey,1995). Ethical Banks manage risks well. These banks are specialized in specific sectors, it allows them to correctly assess risks in financing Projects (Karl, 2016) Ethical Banks has low default rate in its loan portfolios (Cowton & Thomson,2001). The investors and depositors of Ethical Banks have access to information about where and how their money is re-invested (San-Jose et al. 2011). Ethical Banking discourages investment in speculative products (Tischer & Remer ,2016), it operates only in real economic activities. (Wagemans et. al,2013) As per Cornée & Szafarz (2013) investing in this type of banking –Ethical Banking is safe.

The above review identifies the following. Customer expectations are fulfilled by Ethical Banks as they do not engage in Speculative Trading, are only involved in real time economic activity. They maintain transparency.They do not involve in high risk lending. Promote Environmentally, Socially and Economically beneficial Projects. Today's, ethically conscious customer prefer to associate with organizations that can make a positive impact to the planet. Therefore, it can be justified that Ethical Banking lives up to the expectations of customers and do justice to their investments.

## CONCLUSION

As per the reviewed literature it is can be identified that present day customers are moving towards ethical products and services. This is becoming a mass market phenomenon. Ethical Banks are preferred by these modern-day ethically conscious customers. Ethical Banking is a future- focused banking concept. Ethical Banks fulfill customer expectations Hence, it can be concluded from the reviewed literature that Ethical Banking does justice to customer deposits. Few researches on the subject of ethical banking is available in the eastern part of the world as compared to the Western world. This research tries to fill this gap. For further research It is recommended to test these findings empirically. These findings can be useful to Bankers and Policy makers for future policy making.

## REFERENCES

- Barbu, T. C., & Boitan, I. A. (2009). The financial crisis; impact on ethical financial institutions. *Annals of Faculty of Economics*
- Benedikter R. (2011). *Social Banking and Social Finance. Answers to the Economic Crisis*. Springer Briefs in Business. New York
- Borgia M.S. (2013). The Social Report as a tool of ethical governance in cooperative banking. *Megatrend Review*, 10(3):139-154
- Carrigan M & Attalla A, (2001) The myth of the ethical consumer—Do ethics matter in purchase behavior? *Journal of Consumer Marketing*, 18 (7): 560-577
- Chew BC, Tan LH, Hamid SR. (2016) Ethical banking in practice: A closer look at the Co. operative Bank UK PLC. *Qualitative Research in Financial Markets*. 8(1):70–91.
- Cornée, S.; Szafarz, A. *Vive la Différence* (2014) Social Banks and Reciprocity in the Credit Market. *Journal Business. Ethics* 125, 361–380
- Cowton CJ, & Thompson P (2001) Financing the social economy: a case study of Triodos Bank. *International Journal of Nonprofit and Voluntary Sector Marketing*;6(2):145–155.
- Davies, H. (2001), 'Ethics in regulation', *Business Ethics: a European Review*, 10(4): 280-287.
- DE CLERCK, F. (2009) Ethical Banking. In *Ethical Prospects — Economy, Society and Environment*, edited by L. Zsolnai, Z. Boda, and L. Fekete, 209–227. Dordrecht: Springer.
- Devinney T.M, Auger P & Eckhardt G.M (2010) *The myth of the ethical consumer* Cambridge University Press, Cambridge.
- Ethical Consumer Markets Report (2012) *The Co-Operative*. Available at:<http://www.ethicalconsumer.org/portals/0/downloads/ethical-consumer-markets-report-2012.pdf>
- Forsyth D. R, O'Boyle E.H, McDaniel M.A (2008), East meets west: A meta-analytic investigation of cultural variations in idealism and relativism *Business Journal of Ethics*, 83 (4): 813-833
- Francis, R. D. (2000). 'Ethics and corporate governance. University of New South Wales: University of New South Wales Press Ltd.
- Gulyás, E (2008) Interpretations of ethical consumption, *Reviewing Sociology*, 14 (1): 15-44
- Harvey, B. (1995), Ethical bank: the case of the Co-operative Bank, *Journal of Business Ethics*, 14(12): 1005-13
- Ijeoma N.B. (2014). The Effect of Creative Accounting on the Nigerian Banking Industry. *International Journal of Management Studies and Research*, 2(10): 13-21
- Jayasekera M.A.K.De.S & Pushpakumari M.D (2020) Ethical Banking as an alternative to Conventional Banking ? A Literature Review, *Sri Lankan Journal of Business Economics*, 9 (II)
- Karl M (2016) Are ethical and social banks less risky? Evidence from a new dataset. *Europe Working Paper*, n° 96,
- Novaković D, & Liović D, (2016) Ethical Banks – European Experiences and Croatian Perspectives, Management International conference, Paula, Croatia
- Rodríguez Gutiérrez P. (2013). Transparency in social disclosure in financial institutions. through Spanish CSR reports in the context of crisis. *Universia Business Review*, 38(2):84-107.
- Safakli O.V., 2011 "Ethical perceptions: Do they differentiate in respect to demographics, impact satisfaction and subsequent word of mouth?" *African Journal of Business Management Vol. 5*(2), 85-293.
- San-Jose L., Retolaza J. L., Gutierrez-Goiria J. (2011). Are ethical banks different? a comparative analysis using the radical affinity index. *Journal of Business. Ethics* 100 151–173. 10.1007/s10551-011-0774-4

- Sarokin, D. and Schulkin, J. (1991) “Environmental concerns and the business of banking”, *Journal of Commercial Bank Lending*, Vol. 74 No. 5, pp. 6-19.
- Schoenmaker, D., & Werkhoven, D. (2012). What is the appropriate size of the banking system? *Duisenberg School of Finance Policy Paper Series*, No. 28. October.
- Smith, D.R. (1994, Environmental Risk: Credit Approaches and Opportunities, An Interim Report, United Nations Environment Programme, Geneva.
- Tischer D, Remer S (2016) *Growing Social Banking Through (Business) Associations*. In Routledge Handbook of Social and Sustainable Finance: Othmar M Lehner, Abingdon, UK: 480–498
- Tse, T. (2011). Shareholder and stakeholder theory: After the financial crisis. *Qualitative Research in Financial Markets*, 3(1): 51-63.
- Wagemans FAJ, Van Koppen CSA, Mol APJ (2013), The Effectiveness of Socially Responsible Investment: A Review. *Journal of Integrative Environmental Sciences* 10:235–252.13
- Weber, O.; Remer S (2011). *Social Banks and the Future of Sustainable Finance*. Routledge: London, UK.

# **TÜRKİYE’DE ENERJİ KAYNAKLARI TÜKETİMİ İLE İKTİSADİ BÜYÜME İLİŞKİSİ**

## **THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND CONSUMPTION OF ENERGY RESOURCES IN TURKEY**

**Doç. Dr. Levent AKSU**

Doç. Dr., Balıkesir Üniversitesi, Burhaniye MYO, Pazarlama Bölüm Başkanı.,  
ORCID ID 0000-0002-2298-0762

### **Özet**

Dünyada herşey enerji ile sağlanmakta olup, insanoğlunun yeryüzünde varolduğu ilk günden bu yana hayatını korumak, idame ettirmek ve hayat standardını yükseltmek için olmazsa olmaz olan temel ihtiyaçlarının karşılanması ve bunların giderilmesi için en önemli kaynakların başında enerji ve bunun kullanımı gelmektedir. Bu bağlamda enerjisiz bir hayat düşünülemez. Dünya planetinde çok değerli ve jeostratejik bir yerde bulunan Anadolu coğrafyası üzerinde yaşayan Türk milleti bulunduğu konum itibarıyla çok önemli ve çok değerli mineral ve madenlere sahip durumundadır. 21. yüzyılda stratekon (stratejik-ekonomik) bir mal olan bor minerallerinin Türkiye’nin geleceğinde oynayacağı rol tartışılmaz boyuttadır. Dünyada borun stratejik, teknolojik ve ekonomik önemi gün geçtikçe artmaktadır. Dünya bor rezervinin %72,3’üne sahip olan en önemli bor rezervleri Türkiye’nin batı bölgesindedir. Ülkelerin iktisaden kalkınmasında ve büyümenin artmasında sanayileşmenin çok önemli stratejik rolü bulunmaktadır. Sanayileşmenin gerçekleşebilmesinde de ülkelerin enerjiye, madenlere ve hammaddelere çok büyük ihtiyacı vardır. Günümüzde sanayileşme ve teknolojik gelişmelerle birlikte yeni tarz üretim modellerinin yanı sıra, yeni tip ürünler ve ileri teknolojik araçların üretim sürecinde kullanımı görülmektedir.

Dünya enerji tüketim talebi, 2016 yılı sonu itibarıyla 13.760 milyon ton petrol eşdeğeri (MTEP) olarak gerçekleşmiştir. Enerji tüketim talebinin yaklaşık %19’u Kuzey Amerika ülkelerince, %14’ü Avrupa ülkelerince tüketilirken, %41’i Asya-Pasifik ülkelerince tüketim talebi yapılmıştır. 2016 yılı sonu itibarıyla, dünyada tüketilen enerjinin %87’si fosil kaynaklardan oluşmaktadır. 2015 yılında, dünya toplam birincil enerji talebinin %42’si elektrik üretimi için kullanılmıştır. Diğer bir değerli madenimiz, “Toryum”dur. Toryum, ilk kez 1828 yılında Norveçli mineralog Morten Thrane Esmark tarafından keşfedilmesine rağmen İsveçli kimyager Jons Jacob Berzelius tarafından tanımlanarak periyodik cetveldeki yerini almıştır. Element adını mitolojide savaş tanrısı olarak kabul edilen Thor’dan almıştır. Toryum, Dünya uranyum rezervlerine nazaran toryum rezervleri bir kaç yüz kat daha fazladır. Bu, toryumun enerji üretimi açısından stratejik önemini göstermektedir. İnsanlığın enerji gereksinimini binlerce yıl karşılamaya yetecek toryum rezervi dünyada mevcuttur.

Enerji kaynakları tekrar kullanılabilir durumuna göre ikiye ayrılabilir. Söz konusu ayrıma göre kaynaklar yenilenebilir ve yenilenemeyen kaynaklar olarak sınıflandırılmaktadır. Cobb-Douglas üretim fonksiyonunun içinde yer alan (K) fiziki sermayenin kapsamında hammadde ve doğal kaynaklar da yer almaktadır. Üretimin artışında ve büyümenin hızlanmasında (K) faktörü önem arz etmektedir. Dikkat edilirse, (K) düştükçe üretimde düşmeler görülmektedir. Enerji kaynaklarının tüketimi ile iktisadi büyüme ilişkisi ampirik olarak akademik araştırmalar incelendiğinde farklı ülkelerde, farklı dönemlerde, farklı yöntemler kullanılarak yapılan ampirik çalışmaların birbirinden oldukça farklı sonuçlar ortaya çıkardığı görülmektedir. Enerji kaynaklarının tüketimi ile iktisadi büyüme arasındaki nedensellik ilişkisinin yönü üzerine yapılan ampirik çalışmaların sonuçlarında bir görüş birliği sağlanamadığından değişik perspektif açıklamaları literatürde rastlanmaktadır. Bu farklılıkları



açıklayabilmek için aşağıda açıklanan dört önemli kuram geliştirilmiştir. Bu kuramlar; “büyüme”, “muhafaza”, “yansızlık” ve “geri besleme” kuramlarıdır.

Enerji kaynak türleri ile GSMH arasında Granger nedensellik ilişkisi mevcuttur. GSMH’den bor madeni, elektrik enerjisi, petrole, taş kömüre doğru tek yönlü pozitif bir ilişki tespit edilmiştir. Eğim terim yorumunu ve etkilerini şu şekilde belirtmek mümkündür; \*Bor Madenindeki (logaritması alınmış) bir birimlik artış, GSMH’yı (logaritması alınmış) 1.45 arttırmaktadır (diğer değişkenler sabitken). \*Elektrik Enerjisindeki (logaritması alınmış) bir birimlik artış, GSMH’yı (logaritması alınmış) 2.63 arttırmaktadır (diğer değişkenler sabitken). \*Taşkömürü Madenindeki (logaritması alınmış) bir birimlik artış, GSMH’yı (logaritması alınmış) 6.237 oranında arttırmaktadır (diğer değişkenler sabitken). \*Linyit Kömürü Miktarındaki (logaritması alınmış) bir birimlik artış, GSMH’yı (logaritması alınmış) 1.60 yükseltmektedir (diğer değişkenler sabitken). \*İktisadi Büyüme Oranındaki (logaritması alınmış) bir birimlik artış, GSMH’yı (logaritması alınmış) 6.99 oranında yükseltmektedir (diğer değişkenler sabitken). \*Petrol Miktarındaki (logaritması alınmış) bir birimlik artış, GSMH’yı (logaritması alınmış) 1.54 arttırmaktadır (diğer değişkenler sabitken).

**Anahtar Kelimeler:** Enerji Kaynakları, İktisadi Büyüme, Bor, Toryum, Granger Nedensellik Testi, Birim Kök Testleri, EKK testleri.

## Abstract

Everything in the world is provided with an energy, and energy and its use are the most important resources for meeting the basic needs of humankind, which are indispensable for protecting, maintaining and raising the standard of living, since the first day of human existence on earth. In this context, a life without energy is unthinkable. The Turkish nation living on the Anatolian geography, which is in a very valuable and geostrategic place on the planet Earth, has very important and very valuable minerals and minerals. Strateko the 21st century (strategic and economic) role to play in the future of Turkey, which is a producer of boron minerals are indisputable size. The strategic, technological and economic importance of boron in the world is increasing day by day. The most important boron reserves having 72.3% of the world's boron reserves are in the western part of Turkey. Industrialization has a very important strategic role in the economic development and growth of countries. Countries are in great need of energy, mines and raw materials for industrialization. Nowadays, along with industrialization and technological developments, new types of production models as well as new types of products and advanced technological tools are used in the production process.

World energy consumption demand was realized as 13,760 million tons of oil equivalent (MTEP) as of the end of 2016. Approximately 19% of the energy consumption demand was consumed by North American countries, 14% by European countries, and 41% was consumed by Asia-Pacific countries. As of the end of 2016, 87% of the energy consumed in the world consists of fossil resources. In 2015, 42% of the world's total primary energy demand was used for electricity generation. Another precious metal of ours is "Thorium". Thorium was first discovered in 1828 by the Norwegian mineralogist Morten Thrane Esmark, but it was identified by the Swedish chemist Jons Jacob Berzelius and took its place in the periodic table. The element is named after Thor, who is accepted as the god of war in mythology. Thorium reserves are several hundred times higher than the world's uranium reserves. This shows the strategic importance of thorium in terms of energy production. There are sufficient thorium reserves in the world to meet the energy needs of humanity for thousands of years.

Energy sources can be divided into two according to their reusability. According to the said separation, resources are classified as renewable and non-renewable resources. Raw materials and natural resources are also included in the scope of (K) physical capital, which is included in the Cobb-Douglas production function. The (K) factor is important in the increase in



production and acceleration of growth. Note that as (K) decreases, production decreases. When the relationship between the consumption of energy resources and economic growth is examined empirically, it is seen that empirical studies conducted in different countries, at different periods, using different methods have produced quite different results. Since there is no consensus in the results of empirical studies on the direction of the causality relationship between consumption of energy resources and economic growth, different perspective explanations are encountered in the literature. In order to explain these differences, four important theories have been developed which are explained below. These theories; "Growth", "protection", "neutrality" and "feedback" theories.

There is a Granger causality relationship between energy resource types and GNP. A one-way positive relationship has been determined from GNP to boron mine, electrical energy, oil, stone coal. It is possible to state the interpretation of the term slope and its effects as follows; \* One unit increase in Boron Mine (with its logarithm) increases the GNP (with its logarithm) by 1.45 (when other variables are fixed). \* One unit increase in Electrical Energy (whose logarithm is taken) increases the GNP (with its logarithm) by 2.63 (when the other variables are fixed). \* One unit increase in the Hard Coal Mine (whose logarithm is taken) increases the GNP (with the logarithm) by 6,237 (when the other variables are fixed). \* One unit increase in Lignite Coal Quantity (logarithm taken) raises GNP (logarithm taken) by 1.60 (other variables fixed). \* One unit increase in Economic Growth Rate (logarithm taken) increases GNP (logarithm taken) by 6.99 ( while other variables are constant). \* One unit increase in the amount of oil (with its logarithm) increases the GNP (with its logarithm) by 1.54 (while the other variables are constant).

**Keywords:** Energy Resources, Economic Growth, Boron, Thorium, Granger Causality Test, Unit Root Tests, EKK tests.

## 1. GİRİŞ

Eski Yunan’ da enerji kelimesi, de anlamına gelen “en” ve iş ve eylem anlamına gelen “ergon” kelimelerinin birleşiminden meydana gelmiştir. “Energeia” kelimesi, ilahi eylem ve esrarengiz iş anlamına gelen energeia sözcüğü, Aristo tarafından “bir amaç için yapılan hareket veya iş” ve Siculus tarafından “bir motorun gücü” olarak tarif edilmiştir (Özaydın,2019:28). “En ergoneia” un ingilizce karşılığı “in work”, türkçe karşılığı “çalışan” dır. Yani “enerji” terimi eski Yunan literatürüne “çalışan” olarak geçmiştir (Broyles, 2001: 4; aktaran bknz: Güngör, 2016:5).

Dünyada herşey bir enerji ile sağlanmakta olup, insanoğlunun yeryüzünde varolduğu ilk günden bu yana hayatını korumak, idame ettirmek ve hayat standardını yükseltmek için olmazsa olmaz olan temel ihtiyaçlarının karşılanması ve bunların giderilmesi için en önemli kaynakların başında enerji ve bunun kullanımı gelmektedir. Bu bağlamda enerjisiz bir hayat düşünülemez.

Dünya planetinde çok değerli ve jeostratejik bir yerde bulunan Anadolu coğrafyası üzerinde yaşayan Türk milleti bulunduğu konum itibariyle çok önemli ve çok değerli mineral ve madenlere sahip durumundadır. 21. yüzyılda yedi önemli stratejik maden, ekonomik yapı ve faaliyetlerde etkisini hissettirecektir. Bunlara sahip olan ülkeler büyük ekonomik güç olarak karşımıza çıkacaktır. Bu yedi önemli ve değerli maden; “altın”, “gümüş”, “bor”, “toryum”, “osmiyum”, “yeda”, “platinyum” ve “petrol ve bileşenleri”dir. Burada “yeda” bilinmeyen bir güçtür. Bu yedi madenden altın ve gümüş ekonomik hayatta vazgeçilmez olarak önemini artıracaktır. Merkantilist dönemin iki stratejik ürünü (altın ve gümüş) bu yüzyılın vazgeçilmezi olacaktır (Aksu, 2020:120).

21. yüzyılda en önemli ve stratejik madenlerinden ilki, “Bor madenleri”dir. Türkiye sahip olduğu bor rezervleri ve cevherlerinin kalitesi ile dünyanın en önde gelen ülkesidir. Bor mineralleri bazı alanlarda ham bor olarak kullanılmakta ise de genel olarak rafine bor

bileşiklerine ve özel bor ürünlerine dönüştürüldükten sonra geniş alanda kullanılmaktadır. Bor mineralleri günümüzde cam sanayinden, deterjan sanayine, metalurji sektöründen tarım sektörüne, bilişim sektöründen yapay zeka formlarının alt yapısını oluşturan sinir ağlarına, uzay sektöründen ve nükleer uygulamalara kadar yaygın ve gün geçtikçe artan uygulamalara sahiptir. Bu stratejik özelliklerinden dolayı bor madeni Türkiye için büyük bir öneme sahiptir.

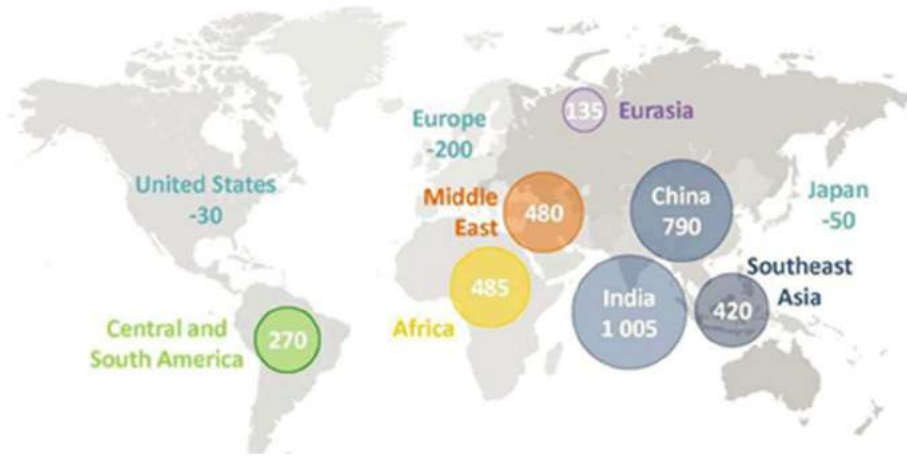
21. yüzyılda stratekon (stratejik-ekonomik) bir mal olan bor minerallerinin Türkiye'nin geleceğinde oynayacağı rol tartışılmaz boyuttadır. Dünyada borun stratejik, teknolojik ve ekonomik önemi gün geçtikçe artmaktadır. Dünya bor rezervinin %72,3'üne sahip olan en önemli bor rezervleri Türkiye'nin batı bölgesindeki 6 ilinde (Balıkesir, Eskişehir, Bilecik, Manisa, Kütahya, Bursa'da) bulunmaktadır. Diğer önemli rezervler ise ABD, Rusya, Çin, Şili, Peru, Kazakistan, Güney Afrika Cumhuriyeti başta olmak üzere dünyanın çeşitli ülkelerinde bor rezervleri bulunmaktadır. Dünya bor rezervleri B<sub>2</sub>O<sub>3</sub> bazında 369 milyon ton görünür, 807 milyon ton muhtemel ve mümkün olmak üzere toplam 1.176 milyar tondur. Bu rezervlerde Türkiye'nin payı % 72,3, ABD'de % 6,8 ve Rusya'da ise % 8,5'tir. Türkiye'deki bor rezervlerinin ömrü 567 yıl iken, dünyanın ikinci büyük rezerv ülkesi Rusya'da bor rezervleri 67 yıllık bir ömre sahiptir (Yenmez, 2009:59-60).

Ülkelerin iktisaden kalkınmasında ve büyümenin artmasında sanayileşmenin çok önemli stratejik rolü bulunmaktadır. Sanayileşmenin gerçekleşebilmesinde de ülkelerin enerjiye, madenlere ve hammaddelere çok büyük ihtiyacı vardır. Günümüzde sanayileşme ve teknolojik gelişmelerle birlikte yeni tarz üretim modellerinin yanı sıra, yeni tip ürünler ve ileri teknolojik araçların üretim sürecinde kullanımı görülmektedir. Sanayi faaliyetlerinde ve üretiminde çok yaygın olarak kullanılan önemli hammaddelere "stratejik maden veya maddeler" adı verilir (Yenmez, 2009:61).

21 yüzyılda dünyada büyük bir dönüşümün bir diğer önemli vechesi ise, enerji jeopolitiği ile ilgilidir. Enerji sektörü bütün dünyada hızlı bir dönüşüm içerisinde. Atlantik merkezli bir enerji dünyasından, Asya-Pasifik merkezli bir enerji dünyasına doğru gidilmektedir. Jeostratejik konsept bu bölgeye doğru kaymaktadır. Sıklet merkezi artık 20. yüzyıldaki gibi Atlantik eksenli olmayacaktır. Türkiye bu noktada iyi bir rol sahibi ve üst ligde söz sahibi olacak ülkeler arasına girebilecektir. Diğer taraftan, konvansiyonel olmayan petrol ve gaz keşif ve üretimleri, enerji ithalatçısı önemli ülkelerin enerji ihracatçısı haline gelmesine yol açmıştır (Kalkınma Bakanlığı, 11. Kalkınma Planı, 2018:1-2).

21. yüzyıldan itibaren enerji politikalarında yaşanan değişim ve dönüşümler enerji yoğunluğunda geçmiş yıllara göre daha önemli gelişmeler izlenmektedir. 2010'dan beri dünya ekonomisindeki enerji yoğunluğu yılda ortalama %2,1 oranında düşmüştür. Bu değer, 1970 ve 2010 arasındaki ortalama %1,3 olan enerji yoğunluğu iyileşmelerinden daha iyi bir seviyeyi temsil etmektedir. Küresel enerji sistemi; kaya gazı ve petrol üretiminin ulaştığı şaşırtıcı aşama, OECD harici ülkelerdeki ekonomik büyüme ve enerji talebi artışı, kadim enerji güzergâhları üzerindeki fay hatlarının kırılabilirliği gibi faktörlere bağlı olarak bir taraftan coğrafik bir kaymaya maruz kalmakta, diğer yandan jeopolitik dengeleri etkilemektedir. Bugün Doğu-Akdeniz'de, Ege'de, Karadeniz'de yapılan petrol, doğal gaz ve likit gaz sistemlerine ait sismik araştırmalar ve çıkartmalar bu bağlamda çok önemli stratejik adımlardır. Türkiye'nin de bu bağlamda küresel oyuncu olma yolunda ilerlediğini göstermektedir. Önemli küresel oyuncular açısından enerji üretimi ve sahip olunması, dış politika yaklaşımlarında sadece bir "alt başlık" olarak değil, doğrudan doğruya bir "dış politika eksen ve büyük ekonomi aktörü" olma yolunda ciddi adımlar atıldığını göstermekte ve stratejik öncelik olarak ele alınmaktadır (Kalkınma Bakanlığı, 11. Kalkınma Planı, 2018:7-8).

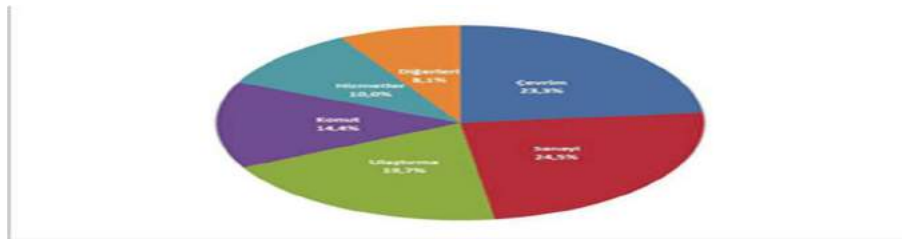
**Şekil 1 : Dünyadaki Bölgelerin 2016-2040 Arası Enerji Talep Değişimleri(MTEP)**



Kaynak: Dünya Enerji Görünümü (WEO) 2017, aktaran bknz: Kalkınma Bakanlığı (2018), 11. Kalkınma Planı (2019-2023), Enerji Arz Güvenliği ve Verimliliği, ÖİK Raporu, Ankara, s.8'deki şekilden alınmıştır.

Dünya enerji tüketim talebi, 2016 yılı sonu itibarıyla 13.760 milyon ton petrol eşdeğeri (MTEP) olarak gerçekleşmiştir. Enerji tüketim talebinin yaklaşık %19'u Kuzey Amerika ülkelerince, %14'ü Avrupa ülkelerince tüketilirken, %41'i Asya-Pasifik ülkelerince tüketim talebi yapılmıştır. 2016 yılı sonu itibarıyla, dünyada tüketilen enerjinin %87'si fosil kaynaklardan oluşmaktadır. 2015 yılında, dünya toplam birincil enerji talebinin %42'si elektrik üretimi için kullanılmıştır. Uluslararası Enerji Ajansı (IEA) öngörülerine göre, 2035 yılında bu rakamın %46,6'ya çıkması beklenmektedir. Elektrik üretiminde en fazla kullanılan kaynak hala kömürdür. Petrol, daha çok ulaştırma sektörü tarafından talep edilmektedir. 2015 yılında petrolün ulaştırma sektöründeki payı %95,1'dir. 2035 yılına kadar bu oranın %91,1'e düşmesi, doğal gazın ise taşımacılık sektöründe kullanımının artması beklenmektedir. Bununla birlikte elektrikli hibrid arabaların öngörülenden daha hızlı artması bu oranın daha da düşmesine neden olacaktır (Kalkınma Bakanlığı, 11. Kalkınma Planı, 2018:1-12).

Şekil 2 : 2016 yılı Türkiye Enerji Tüketiminin Sektörel Dağılımı

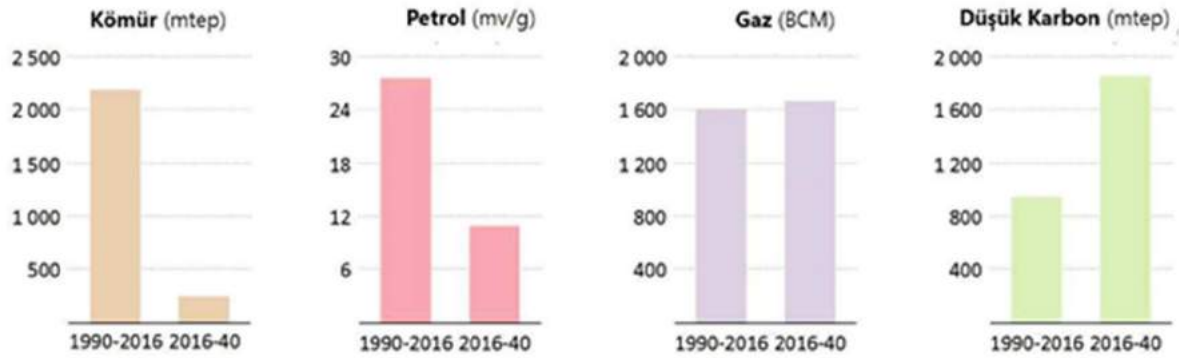


Kaynak: ETKB 2016 Genel Enerji Denge Tablosu, aktaran bknz: Kalkınma Bakanlığı (2018), 11. Kalkınma Planı (2019-2023), Enerji Arz Güvenliği ve Verimliliği, ÖİK Raporu, Ankara, s.12'deki şekilden alınmıştır.

Türkiye gelişen ekonomisi ile dünyanın önemli enerji tüketicileri arasında yer almaktadır. 2016 yılında, Türkiye'nin 136,2 MTEP olan birincil enerji arzında petrol %31 (2007 yılında %30,9 ve 2011 yılında %26,6), kömür %28,2 (2007 yılında %28,7 ve 2011 yılında %31,3) ve doğal gaz %28,1 (2007 yılında %31,5 ve 2011 yılında %32,2) paya sahiptir. Yenilenebilir enerji kaynaklarının payı ise %12,7 (2007 yılında %8,9 ve 2011 yılında %9,7) olarak gerçekleşmiştir. Türkiye birincil enerji talebinin sektörlere göre dağılımı incelendiğinde; birincil enerji arzının %23,3'ünün dönüşüm ve çevrim sektöründe (elektrik ve kok üretimi ile rafinaj) kullanıldığı görülmektedir. Enerji tüketimindeki en yüksek pay %24,5 ile sanayiye aittir. Diğer önemli bileşenler ise %19,7 ile ulaştırma, %14,4 ile konutlar ve %10

ile hizmetler sektörüdür. Birincil enerji arzının yaklaşık %8,1'i ise diğer alanlarda kullanılmıştır. Türkiye'nin kişi başına enerji tüketimi OECD ortalamasının %40'ı düzeyindedir. Türkiye'nin enerjide dışa bağımlılığı, %74 seviyesindedir. Dışa bağımlılık oranı, özellikle 1990'ların başından itibaren doğal gaz tüketimindeki büyük yükselişe bağlı olarak önemli bir artış göstermiş ve 2000'li yılların başından itibaren %70'ler civarında seyretmeye başlamıştır (Kalkınma Bakanlığı, 11. Kalkınma Planı, 2018:11-12).

Şekil 3: Küresel Enerji Talebinin Kaynaklara Göre Değişimi



Kaynak: Dünya Enerji Görünümü (WEO) 2017, aktaran bkznz: Kalkınma Bakanlığı (2018), 11. Kalkınma Planı (2019-2023), Enerji Arz Güvenliği ve Verimliliği, ÖİK Raporu, Ankara, s.6'daki şekilden alınmıştır.

Diğer bir değerli madenimiz, "Toryum"dur. Toryum, ilk kez 1828 yılında Norveçli mineralog Morten Thrane Esmark tarafından keşfedilmesine rağmen İsveçli kimyager Jons Jacob Berzelius tarafından tanımlanarak periyodik cetveldeki yerini almıştır. Element adını mitolojide savaş tanrısı olarak kabul edilen Thor'dan almıştır (Eroğlu ve Şahiner, 2017:20-21). Toryum, Dünya uranyum rezervlerine nazaran toryum rezervleri bir kaç yüz kat daha fazladır. Bu, toryumun enerji üretimi açısından stratejik önemini göstermektedir. İnsanlığın enerji gereksinimini binlerce yıl karşılamaya yetecek toryum rezervi dünyada mevcuttur.

2016 verilerine göre dünyada bilinen toplam toryum rezervinin yaklaşık 6,35 milyon ton olduğu ve ortalama % 6-7 civarında toryum içerdiği tahmin edilmektedir. Rezervler ağırlıklı olarak Hindistan, Brezilya, Avustralya, ABD ve Türkiye'de bulunmaktadır (Eroğlu ve Şahiner, 2017:20-21).

Toryum gelişmiş ülkelerde uranyuma dayalı olarak geliştirilen nükleer teknolojiler sonrasında ortaya çıkan nükleer atıkların yeniden değerlendirilmesinde ve atık miktarı ile yarı ömürlerinin azaltılmasında bir çözüm aracıdır. Aynı zamanda nükleer yakıt ekonomisi sağlar. Toryum, Dünyadaki yayılım itibarıyla uranyuma göre daha dengeli bir coğrafi dağılıma sahiptir. Toryum madenciliği uranyuma kıyasla daha az radyoaktif kirliliği olan bir süreçtir. Uranyumdan yaklaşık 1000 kat daha fazla temiz bir enerji vermektedir. Kadim toplumlar da bir enerji aracı olarak kullanılmıştır. Uranyum gibi toryum da doğada serbest halde bulunmaz, fakat 60 civarında mineralin içinde rastlanır. Bunlardan sadece monazit ve thorite, toryum üretiminde kullanılır. Bu mineraller de genellikle nadir toprak elementleri ile birlikte bulunmaktadır. Toryuma dayalı nükleer santrallerin henüz ticari yapılabilirliği olmayıp, deneme safhasında bulunması ve bu sektörün dışındaki kullanımının sınırlılığı nedeniyle, dünyada bugüne kadar, doğrudan toryum aramalarına fazla önem verilmemiştir ([http://www.maden.org.tr/genel/bizden\\_detay.php?kod=117&tipi=5&sube=0](http://www.maden.org.tr/genel/bizden_detay.php?kod=117&tipi=5&sube=0); erişim tarihi: 05.04. 2019). Ama bu önemsiz bir maden olduğu anlamına gelmesin.

Ülkemizde toryumun çıkarılan yerlerini belirtmek gerekirse; Eskişehir-Sivrihisar-Kızılcaören, Malatya-Hekimhan-Kuluncak, Kayseri-Felâhiye, Sivas, Diyarbakır ve Burdur-Çanaklı sahalarında ve en önemlisi Isparta ile Burdur arasında ciddi bir miktar toryum, monazit ve torobastnazit minerallerinin kafes yapısında bulunmaktadır. Toryum kompleks cevher yataklarında, yaklaşık 380.000 ton görünür ThO<sub>2</sub> (thorite) rezervi saptanmış olup, bu rezervin tenörü %0,21 ThO<sub>2</sub> (thorite) dir. Söz konusu bölgede bor üretim havzaları da bulunmaktadır. Türkiye’de bulunan miktar dünyadaki Toryum miktarının %6-8’i arasındadır. Bu oran bazı kaynaklarda %15-16 oranında olduğudur. Kesin bir rezerv kaynağı bilinmemektedir. Toryum ticaretine bakıldığında; toplam dünya ithalatında en büyük alıcı %99,7’lik pay ile Çin’dir. Diğer alıcılar ise; Japonya, İspanya ve Rusya’dır. Türkiye, nükleer enerji hammadde olan toryum açısından önemli bir potansiyele sahiptir ve zenginlik sınıflandırmasında toryum madenimiz çok zengin madenler sınıfında bulunmaktadır (Eroğlu ve Şahiner, 2017:20-25).

Yatağın tamamında yapılacak sondajlı çalışmalarla bu rakamın, iki katına çıkması olasıdır. Toryum cevherinin zenginleştirilmesiyle ilgili teknolojik altyapı sorunları bulunmaktadır. Toryum uzay çalışmalarında enerji olarak, pil olarak, ülkelerin enerji gereksinimlerinde, örneğin, Toryum Santralinden elde edilecek enerji ile Türkiye’nin 100-150 senelik ihtiyacı karşılanabilecektir. Hatta bu elde edilen enerjiyi Balkanlara, Kafkasya’ya ve Ortadoğu’ya satmamız mümkün olabilecektir. Bu çalışmada toryumun yıllara göre verilerini bulamadığımız için ampirik analizde değişken olarak kullanamamaktadır.

## 2. TEORİK ANALİZ

Enerji kaynakları tekrar kullanılabilirlik durumuna göre ikiye ayrılabilir. Söz konusu ayrıma göre kaynaklar yenilenebilir ve yenilenemeyen kaynaklar olarak sınıflandırılmaktadır (Pamir, 2016:45). Yenilenemeyen enerji kaynakları insanlık tarafından bir kez kullanılabilir ve tekrar enerji kaynağı olarak işlev gösteremezler ve çevreye zararlı atık olarak toprağa karışmaktadırlar. Buna mukabil yenilenebilir enerji kaynakları ise, yenilenemeyen enerji kaynaklarına göre daha temiz ve çevreye daha az zararlı enerji kaynakları olup, insanlığın ihtiyaç duyduğu müddetçe kullandığı enerji kaynaklarıdır. Bu kaynaklar kullanıldıktan sonra tekrar işlevselliklerini yitirmezler ve tekrar insanlık hizmetinde kullanılabilirler.

Yenilenemeyen Enerji Kaynaklarını şöyle belirtilebilir (Pamir, 2016:46);

- Petrol ve Doğalgaz Sıvıları
- Doğalgaz
- Kömür
- Uranyum
- Toryum
- Osmiyum

Yenilenebilir Enerji Kaynaklarını ise şöyle belirtebiliriz (Pamir, 2016:47).

- Güneş (Solar Pilleri ve aynaları)
- Hidroelektrik
- Rüzgar
- Biyoyakıtlar
- Jeotermal
- Dalgalar, gel-gitler
- Diğer kaynaklar; hidrojen, yakıt hücreleri, gazdan ve kömürden sıvı elde edilmesi sayılabilmektedir.

Mankiw, Romer ve Weil (1992), Solow (1956:65-94) ve Arrow (1962:155-173) öne sürdüğü Cobb ve Douglas (1928:139-165) üretim fonksiyonunun içinde yer alan (K) fiziki sermayenin kapsamında hammadde ve doğal kaynaklar da yer almaktadır. Üretim



fonksiyonunda (A) terimi teknolojik gelişmeyi gösterirken, (K) terimi fiziki sermaye miktarındaki büyüklüğü, (H) emeğin sağlık sermayesi ve (L) terimi de emek miktarındaki değişmeyi vermektedir. Bu modele göre, hammaddeler ve doğal kaynaklar üretimin ve iktisadi büyümenin motorunu oluşturmaktadır (Mankiw, Romer ve Weil, 1992:407-437; Romer, 1986:1002-1037; Barro ve Sala-i Martin, 2004:220-227):

$$Y = A \cdot K^\alpha \cdot S^\beta \cdot H^\gamma \cdot (L e^{xt})^{1-\alpha-\beta-\gamma} \quad (1) \quad 0 < \alpha + \beta + \gamma < 1$$

$\alpha > 0$ ,  $\beta > 0$ ,  $\gamma > 0$  iken, üretim fonksiyonu yoğun olarak denklemini yazmak gerekirse;

$$y = A \cdot k^\alpha \cdot s^\beta \cdot h^\gamma \quad (2), \quad \text{şeklinde yazmak mümkün olacaktır.}$$

Ekzogen temelinde teknolojik seviye  $A > 0$ 'dan büyük olmak zorundadır. Cobb-Douglas tipi üretim fonksiyonundan hareketle emek, fiziki sermaye (hammaddeler, madenler, doğal kaynaklar vb.) ve beşeri sermaye üretim faktörlerinin, üretimin üzerinde yaptığı etkiyi tespitte kullanılır (Özsoy, 2008:34; aktaran bkz: Aksu, 2018:3618). Üretimin artışında ve büyümenin hızlanmasında (K) faktörü önem arz etmektedir. Dikkat edilirse, (K) düştükçe üretimde düşmeler görülmektedir. Hatta ekonomik krizler görülmektedir.

Enerjinin üretimdeki yerini inceleyen literatürde, Georgescu-Roegen'in 1971'de yayınlanan "*The Entropy Law and The Economic Process*" ve 1975 yılında yayınlanan "*Energy and Economic Myths*" adlı çalışmaları enerji ile iktisadi büyüme ilişkisi konusunda temel taşları oluşturmaktadır. Georgescu-Roegen'in söz konusu çalışmalarından sonra çevre iktisatçıları, neoklasik akım yerine, merkezinde enerjinin yer aldığı bir üretim sürecinin önemi ortaya çıkarken, kapsamlı bir alternatif politikalar oluşturmaya çalışmışlardır (Sorrell ve Dimitropoulos, 2007: 100; aktaran bkz: Şentürk, 2012:6).

### 3. LİTERATÜR ANALİZİ

Enerji kaynaklarının tüketimi ile iktisadi büyüme ilişkisi ampirik olarak akademik araştırmalar incelendiğinde farklı ülkelerde, farklı dönemlerde, farklı yöntemler kullanılarak yapılan ampirik çalışmaların birbirinden oldukça farklı sonuçlar ortaya çıkardığı görülmektedir. Dünya'da enerji tüketimi ile iktisadi büyüme arasındaki ilişkiyi inceleyen ilk çalışmalar Kraft ve Kraft'a aittir. Kraft ve Kraft (1978), ABD'de 1947-1974 döneminde GSYİH ve enerji tüketimi ilişkisini Sims metodolojisi aracılığıyla incelemiş, GSYİH'dan enerji tüketimine doğru işleyen bir nedensellik olduğu sonucuna ulaşmışlardır. Bu çalışmanın ardından enerji tüketimi ve ekonomik büyüme ilişkisi çok popüler bir inceleme alanı konumuna gelmiştir. İlk çalışmalardan biri olan Hamilton (1983)'da ABD üzerine yaptığı ampirik çalışmada, 1948-1972 yılları arasında ABD'de enerji fiyatları ve iktisadi büyüme için Granger nedensellik testi uygulamış, sonuç olarak enerji fiyatlarından iktisadi büyümeye doğru bir nedensellik saptamıştır.

Enerji kaynaklarının tüketimi ile iktisadi büyüme arasındaki nedensellik ilişkisinin yönü üzerine yapılan ampirik çalışmaların sonuçlarında bir görüş birliği sağlanamadığından değişik perspektif açıklamaları literatürde rastlanmaktadır. Bu farklılıkları açıklayabilmek için aşağıda açıklanan dört önemli kuram geliştirilmiştir. Bu kuramlar; "büyüme", "muhafaza", "yansızlık" ve "geri besleme" kuramlarıdır.

- Büyüme kuramına göre; enerji tüketiminden iktisadi büyümeye doğru tek yönlü bir nedensellik tespit edilecek olursa büyüme kuramı geçerli olacaktır. Yu ve Choi (1985), Stern (1993), Aqeel ve Butt (2001), Soytaş ve Sarı (2003), Altınay ve Karagöl (2005), Şengül ve Tuncer (2006), Narayan ve Smyth (2008), Mucuk ve Uysal (2009), Kasperowicz ve Streimikiene (2016), Ito (2017), Koçak ve Şarkgüneşi (2017) ve Durğun ve Durğun (2018) çalışmaları örnek verilebilir.
- Muhafaza (koruma) kuramına göre; iktisadi büyümeden, enerji tüketimine doğru tek yönlü bir nedensellik tespit edilecek olursa muhafaza kuramı geçerli olacaktır. Lee ve



Chang (2008), Karanfil (2008), Uzunöz ve Akçay (2012), Öcal ve Aslan (2013), Uzun, Emsen, Yalçıkaya ve Hüseyini (2013), Apergis ve Danuletiu (2014), Kula (2014), Bakırtaş ve Çetin (2015) ve Yıldırım ve Sakarya (2016) çalışmaları tarafından desteklenmiştir.

- Yansızlık (tarafsızlık) kuramına göre; enerji tüketimi ile iktisadi büyüme arasında nedensellik ilişkisi tespit edilmezse yansızlık kuramı geçerli olacaktır. Örneğin, Akarca ve Long (1980), Yu ve Hwang (1984), Yu ve Jin (1992), Altınay ve Karagöl(2004), Menegaki (2011), Marques ve Fuinhas (2012), Bulut ve Muratoğlu (2018)'nın çalışmalarında enerji tüketimi ile iktisadi büyümenin ilişkisiz olduğu ortaya konulmuştur.
- Geri besleme (Feed-Back) kuramına göre; enerji tüketimi ile iktisadi büyüme arasında nedensellik ilişkisi çift yönlü bir şekilde gerçekleşirse, geri besleme kuramı geçerli olacaktır. Hwang ve Gum (1992), Glasure ve Lee (1997), Terzi (1998), Jumbe (2004), Apergis ve Payne (2010, 2011), Kaplan, Öztürk ve Kalyoncu (2011), Tuğcu, Öztürk ve Aslan (2012), Shahbaz, Loganathan, Zeshan ve Zaman (2015), Doğan (2016), Kahia, Aissa ve Lanouar (2017), Rafindadi ve Öztük (2017) çalışmalarıyla ortaya konulmuştur.

Bizim çalışmamızda iktisadi büyümeden enerji tüketimine doğru tek yönlü bir nedensellik ilişkisi geçerlidir. Bu bağlamda “**muhafaza (koruma)**” kuramı geçerli olacaktır.

#### 4. EKONOMETRİK TESTLER VE ANALİZLER

Bu çalışma, 1962-2018 yıllarına ait 57 yıllık verileri kapsamaktadır. GSMH (milyar US Dolar), İktisadi Büyüme Oranları (%), Bor Madeni Miktarı, Elektrik Enerjisi Miktarı, Petrol Miktarı, Linyit Kömürü Miktarı, Taş Kömürü Miktarı olmak üzere toplam 7 değişken kullanılmıştır. Bağımlı değişken GSMH miktarı baz alınırken, bağımsız değişkenler ise İktisadi Büyüme Oranları, Bor Madeni Miktarı, Elektrik Enerjisi Miktarı, Petrol Miktarı, Linyit Kömürü Miktarı, Taş Kömürü Miktarı baz alınmıştır. Bu çalışmada Türkiye'nin ekonomik yapısı içerisindeki enerji kaynakları tüketimini belirleyen değişkenler ile GSMH ve iktisadi büyüme arasındaki ilişkisi ele alınmıştır. Dolayısıyla TÜİK, DPT, DİE, Hazine ve Maliye Bakanlığı, T.C. Merkez Bankası ve Dünya Bankasına ait veriler kullanılmıştır. Bu çalışmada test olarak, Birim Kök Testleri (ADF, P-P, KPSS), Granger Nedensellik Testi, EKK, ARCH, VAR Auto Regression testlerini içeren çalışmalar yapılmıştır. Çalışmada Eviews 10 sistemi kullanılmıştır.

Tablo 1: Ekonometrik Analizde Kullanılan Değişkenlere Ait Datanın Özet Bilgileri

Değişkenler	GSMH	BORMADENİ	BUYUME	ELEKTRIK_ENERJISI	TASKOMURU	LINYITKOMURU	PETROL
Mean	416102.2	7.16E+12	4.682105	5.08E+10	4.90E+10	1.00E+13	2.21E+11
Median	370686.0	4.12E+10	5.790000	1.40E+10	8.56E+09	7.08E+10	1.92E+10
Maximum	959800.0	1.03E+14	20.15000	3.17E+11	3.35E+11	1.31E+14	1.75E+12
Minimum	95224.00	18100000	-1.661.000	5.68E+08	4.06E+08	1.05E+08	4.39E+08
Std. Dev.	250792.2	1.95E+13	7.208097	7.79E+10	7.99E+10	2.56E+13	4.03E+11
Skewness	0.763385	3.455863	-0.732901	1.906561	2.045568	3.233080	2.258882
Kurtosis	2.497517	14.98928	4.305583	5.762975	6.413400	13.35294	7.434591
Jarque-Bera	6.135855	454.8474	9.151163	52.66310	67.42316	353.8623	95.17999
Probability	0.046517	0.000000	0.000300	0.000000	0.000000	0.000000	0.000000
Sum	23717828	4.08E+14	266.8800	2.89E+12	2.79E+12	5.71E+14	1.26E+13
Sum Sq. Dev.	3.52E+12	2.12E+28	2909.573	3.39E+23	3.57E+23	3.66E+28	9.10E+24
Observations	57	57	57	57	57	57	57

Jarque-Bera (prob) olasılık değerleri anlamlıdır. Probability = 0.000 seviyesindedir. 57 gözlem 2793 veri noktası kullanılmıştır. Skewness (çarpıklık değeri), Kurtosis (basıklığın değeri) normal değerlerindedir. Verilerin dağılımı normaldir.

### BİRİM KÖK TESTLERİ

Roots of Characteristic Polynomial

Endogenous variables: GSMH BORMADENI

BUYUME ELEKTRİK\_ENERJISI

TASKOMURU LINYITKOMURU PETROL

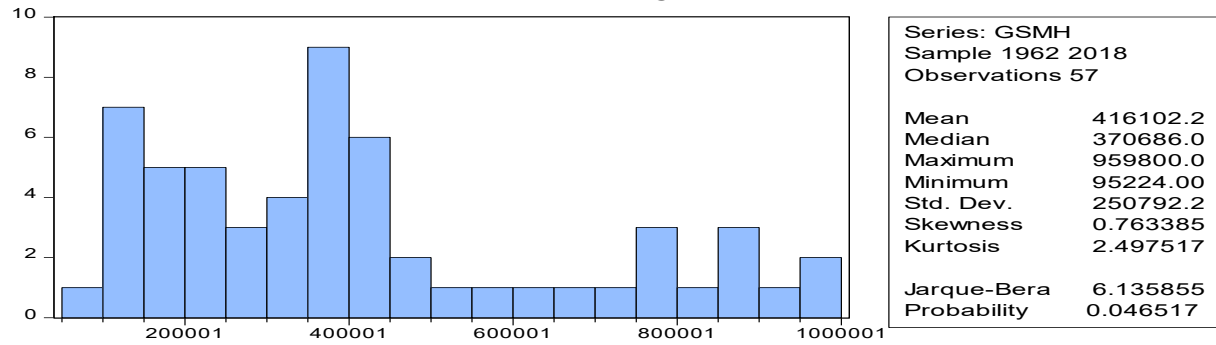
Exogenous variables: C

Lag specification: 1 2

Root	Modulus
0.926973	0.926973
-0.208099 - 0.577451i	0.613804
-0.208099 + 0.577451i	0.613804
0.504403 - 0.309335i	0.591701
0.504403 + 0.309335i	0.591701
-0.589982	0.589982
0.177013 - 0.280657i	0.331816
0.177013 + 0.280657i	0.331816
-0.236055 - 0.031433i	0.238138
-0.236055 + 0.031433i	0.238138

Değişkenler üzerine yapılan birim kök testleri sonucunda birim kök sorunu olan seri yoktur. Değişkenler Polynomial kök testleri sonucunda yuvarlak dairenin içersinde yer almıştır.

Şekil 4: GSMH Gözlem Değerleri ve Sonuçları



## VAR Lag Order Selection Criteria

Endogenous variables: GSMH BORMADENI BUYUME ELEKTRIK\_ENERJISI  
TASKOMURU LINYITKOMURU PETROL

Exogenous variables: C

Sample: 1962 2018

Included observations: 53

**Tablo 2: VAR Gecikme Değerleri  
Tablosu**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-7917.198	NA	1.7e+121	299.0264	299.2866	299.1264
1	-6869.489	1779.129*	7.5e+104*	261.3392*	263.4210*	262.1398*
2	-6826.386	61.80832	1.0e+105	261.5617	265.4651	263.0628
3	-6787.208	45.83104	2.0e+105	261.9324	267.6574	264.1339
4	-6725.079	56.26745	2.1e+105	261.4369	268.9835	264.3390

\* indicates lag order selected by the criterion, 1. Gecikmede durağanlık sağlanmıştır. \*\*Değişkenler için birim kök testi sonucuna göre, birim kök yoktur.

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

## GRANGER NEDENSELLİK TESTİ

Aşağıdaki tabloda Granger Nedensellik testi yapılmıştır. 1962-2018 yıllarını kapsayan değişkenlerin 2 gecikmeli olarak farkı alınıp, analizi yapılmıştır. Ekonometrik testlerin yapımında Eviews 10 sistemi kullanılmıştır.

Pairwise Granger Causality Tests

Sample: 1962 2018

Lags: 2

**Tablo 3 : Granger Nedensellik Testi Tablosu**

Null Hypothesis:	Obs	F-Statistic	Prob.
BORMADENI does not Granger Cause GSMH	55	11.6453	0.0045
GSMH does not Granger Cause BORMADENI		1.12342	0.3332
BUYUME does not Granger Cause GSMH	55	1.80076	0.0157
GSMH does not Granger Cause BUYUME		0.93605	0.0389
ELEKTRIK_ENERJISI does not Granger Cause GSMH	55	4.43367	0.0169
GSMH does not Granger Cause ELEKTRIK_ENERJISI		0.70929	0.4969
TASKOMURU does not Granger Cause GSMH	55	4.51938	0.0157
GSMH does not Granger Cause TASKOMURU		0.06524	0.9369

LINYITKOMURU does not Granger Cause GSMH	55	10.5442	0.0002
GSMH does not Granger Cause LINYITKOMURU		2.35949	0.1049
PETROL does not Granger Cause GSMH	55	5.78452	0.0055
GSMH does not Granger Cause PETROL		2.22612	0.1185
BUYUME does not Granger Cause BORMADENI	55	1.71907	0.0197
BORMADENI does not Granger Cause BUYUME		0.69824	0.0022
ELEKTRIK_ENERJISI does not Granger Cause BORMADENI	55	0.03088	0.0696
BORMADENI does not Granger Cause ELEKTRIK_ENERJISI		0.14169	0.0682
TASKOMURU does not Granger Cause BORMADENI	55	0.20225	0.9176
BORMADENI does not Granger Cause TASKOMURU		0.58055	0.8633
LINYITKOMURU does not Granger Cause BORMADENI	55	0.02508	0.9752
BORMADENI does not Granger Cause LINYITKOMURU		0.36979	0.9928
PETROL does not Granger Cause BORMADENI	55	0.09173	0.0125
BORMADENI does not Granger Cause PETROL		0.67614	0.0132
ELEKTRIK_ENERJISI does not Granger Cause BUYUME	55	0.08170	0.9217
BUYUME does not Granger Cause ELEKTRIK_ENERJISI		0.54560	0.0529
TASKOMURU does not Granger Cause BUYUME	55	0.12102	0.9863
BUYUME does not Granger Cause TASKOMURU		0.18906	0.9283
LINYITKOMURU does not Granger Cause BUYUME	55	0.52922	0.5923
BUYUME does not Granger Cause LINYITKOMURU		2.84421	0.0676
PETROL does not Granger Cause BUYUME	55	0.56283	0.5732
BUYUME does not Granger Cause PETROL		2.69796	0.0471
TASKOMURU does not Granger Cause ELEKTRIK_ENERJISI	55	14.1594	1.E-05
ELEKTRIK_ENERJISI does not Granger Cause TASKOMURU		0.16084	0.0519
LINYITKOMURU does not Granger Cause ELEKTRIK_ENERJISI	55	0.21187	0.9098
ELEKTRIK_ENERJISI does not Granger Cause LINYITKOMURU		0.01092	0.0291
PETROL does not Granger Cause ELEKTRIK_ENERJISI	55	4.50211	0.0159
ELEKTRIK_ENERJISI does not Granger Cause PETROL		0.22167	0.8020
LINYITKOMURU does not Granger Cause TASKOMURU	55	0.01523	0.0173
TASKOMURU does not Granger Cause LINYITKOMURU		0.07036	0.0242
PETROL does not Granger Cause TASKOMURU	55	0.04130	0.9596
TASKOMURU does not Granger Cause PETROL		0.42162	0.6583
PETROL does not Granger Cause LINYITKOMURU	55	0.75658	0.4746
LINYITKOMURU does not Granger Cause PETROL		1.18601	0.3139

Granger nedensellik testinin analizi, I(2) gecikmeli olarak 57 gözlem sonucunda değişkenler arasında ortaya çıkan nedensellik ilişkilerini şu şekilde belirtmek mümkündür; Enerji kaynak türleri ile GSMH arasında Granger nedensellik ilişkisi mevcuttur. GSMH'dan bor madeni, elektrik enerjisi, petrole, linyit kömürü ve taş kömürüne doğru tek yönlü pozitif bir nedensellik ilişkisi tespit edilmiştir. Elektrik enerjisi tüketimi ile Petrol tüketiminin iktisadi büyüme üzerinde tek yönlü ve pozitif nedensellik ilişkisi saptanmıştır.

Tablo 4: Granger Nedensellik Testinin İlişki Yönü

BAĞIMSIZ DEĞİŞKENLER	NEDENSELLİK İLİŞKİSİNİN YÖNÜ	BAĞIMLI DEĞİŞKEN
BÜYÜME ORANI (%)	↔	GSMH
BOR MADENİ	←	GSMH
ELEKTRİK ENERJİSİ	←	GSMH
PETROL	←	GSMH
TAŞ KÖMÜRÜ	←	GSMH
LİNYİT KÖMÜRÜ	←	GSMH

Yukarıdaki tabloda yer alan → işareti, ilgili bağımsız (ve/veya bağımlı) değişkenin, bağımlı (ve/veya bağımsız) değişkenin Granger nedeni olduğunu ifade etmektedir. Yukarıda ifade edildiği üzere, bu ideal durumu yansıtmaktadır. ↔ İşareti, GSMH'nin ilgili değişkenin Granger nedeni olduğunu, aynı zamanda, ilgili değişkenin de GSMH'nin Granger nedeni olduğunu ifade etmektedir. X İşareti, değişkenler arasında Granger nedensellik ilişkisinin söz konusu olmadığını ifade etmektedir.

**EKK (Least Squares) TESTİ**

Dependent Variable: GSMH

Method: EKK (Least Squares) TESTİ

Sample: 1962 2018

Included observations: 57

Tablo 5: EKK Test Değerleri Tablosu

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGBORMADENİ	1.450707	4.98E-08	2.902408	0.0055
LOGBUYUME	6.997549	1.567.810	4.463264	0.0000
LOGELEKTRİK_ENERJİSİ	2.637306	1.64E-06	1.599592	0.0159
LOGTASKOMURU	6.237605	6.66E-06	9.359692	0.0000
LOGLİNYİTKOMURU	1.602307	4.87E-08	3.279470	0.0019
LOGPETROL	1.540605	1.89E-06	8.133514	0.0000
R-squared	0.875423	Mean dependent var		416102.2
Adjusted R-squared	0.863210	S.D. dependent var		250792.2
S.E. of regression	92755.80	Akaike info criterion		2.581.263
Sum squared resid	4.39E+11	Schwarz criterion		2.602.769
Log likelihood	-7.296.599	Hannan-Quinn criter.		2.589.621
Durbin-Watson stat	0.911219	F-statistic		2073.659
		Prob (F-Statistic)		0.000000

\*\*Denklemden eğim terimleri ve sabit terim ( $p = 0.0000$ ) anlamlıdır. Hesaplanan F değeri 2073.659 ve F istatistiğine ait p (olasılık) değeri 0.000 olarak bulunmuştur. Bu sonuçlara göre model tümüyle anlamlıdır. AIC, SC, HQ değerleri birbiriyle anlamlı durumdadır. 6 bağımsız değişken bağımlı değişkeni (GSMH'nın) açıklama değerini gösteren R açıklayıcı değeri 0.98 gibi yüksek bir değer ihtiva etmektedir. Durbin-Watson (DW) test istatistiği 0.911 ile 1'e yaklaşmaktadır. Otokorelasyon yoktur. Eğim terim yorumunu ve

etkilerini şu şekilde belirtmek mümkündür; \*Bor Madenindeki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 1.45 arttırmaktadır (diğer değişkenler sabitken). \*Elektrik Enerjisindeki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 2.63 arttırmaktadır (diğer değişkenler sabitken). \*Taşkömürü Madenindeki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 6.237 oranında arttırmaktadır (diğer değişkenler sabitken). \*Linyit Kömürü Miktarındaki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 1.60 yükseltmektedir (diğer değişkenler sabitken). \*İktisadi Büyüme Oranındaki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 6.99 oranında yükseltmektedir (diğer değişkenler sabitken). \*Petrol Miktarındaki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 1.54 arttırmaktadır (diğer değişkenler sabitken). Bütün değişkenlerin GSMH üzerinde arttırıcı etkisi bulunmaktadır.

## İKİ AŞAMALI EN KÜÇÜK KARELER TESTİ (TSLs)

Dependent Variable: GSMH

Method: **Two-Stage Least Squares**

Sample: 1962 2018

Included observations: 57

Instrument specification: GSMH BORMADENI BUYUME  
ELEKTRIK\_ENERJİ

SI TASKOMURU LINYITKOMURU PETROL

Constant added to instrument list

Tablo 6: İki Aşamalı En Küçük Kareler Testi (TSLs) Tablosu

Variable	Coefficient	Std. Error	t-Statistic	Prob.
<b>BORMADENI</b>	1450.707	4.98E-08	2.902408	0.0055
<b>BUYUME</b>	6997.549	1.567.810	4.463264	0.0000
<b>ELEKTRIK_ENERJISI</b>	2637.306	1.64E-06	1.599592	0.0159
<b>TASKOMURU</b>	6237.605	6.66E-06	9.359692	0.0000
<b>LINYITKOMURU</b>	160E-07	4.87E-08	3.279470	0.0019
<b>PETROL</b>	1540.605	1.89E-06	8.133514	0.0000
<b>R-squared</b>	0.875423	<b>Mean dependent var</b>		416102.2
<b>Adjusted R-squared</b>	0.863210	<b>S.D. dependent var</b>		250792.2
<b>S.E. of regression</b>	92755.80	<b>Sum squared resid</b>		4.39E+11
<b>Durbin-Watson stat</b>	0.811219	<b>Second-Stage SSR</b>		4.39E+11
<b>J-statistic</b>	5.100.000	<b>Instrument rank</b>		8
<b>Prob(J-statistic)</b>	0.000000			



$$\text{GSMH} = 1.44584726378\text{e-}07 * \text{BORMADENI} + 6997.54932863 * \text{BUYUME} + 2.62706606414\text{e-}06 * \text{ELEKTRİK\_ENERJISI} + 6.23451775286\text{e-}05 * \text{TASKOMURU} + 1.59725733865\text{e-}07 * \text{LINYITKOMURU} + 1.54083878476\text{e-}05 * \text{PETROL}$$

### VAR Modeli Tahmin Analizi

Vector Autoregression Estimates

Sample (adjusted): 1964 2018

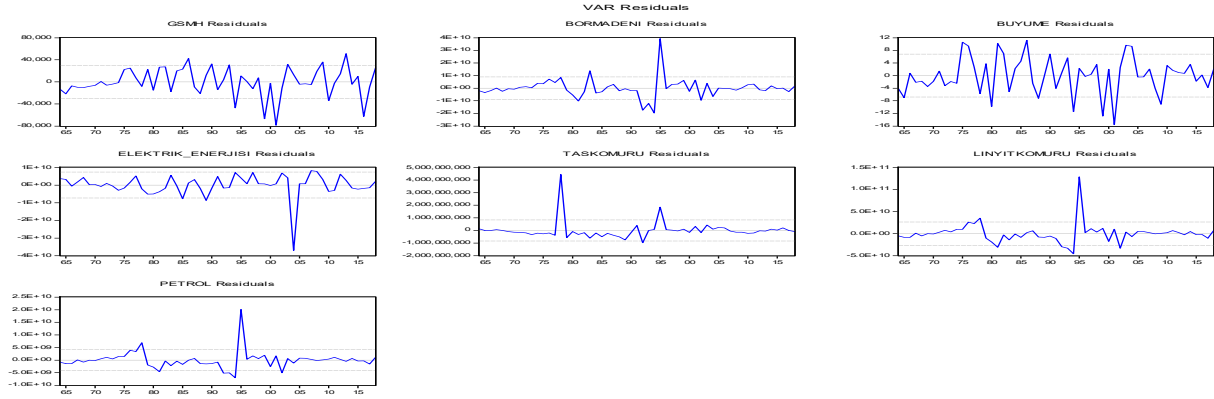
Included observations: 55 after adjustments

**TABLO 7: VAR TESTİ TAHMİNİ DEĞERLERİ**

DEĞİŞKENLER	GSMH	BORMADENİ	BUYUME	ELEKTRİK_ENERJISI	TASKOMURU	LINYITKOMURU	PETROL
R-squared	0.989325	0.999997	0.715718	0.993562	0.999922	0.999983	0.999923
Adj. R-squared	0.985588	0.999996	0.603502	0.991308	0.999894	0.999976	0.999896
Sum sq. resids	3.54E+10	3.26E+21	1849.208	2.15E+21	2.76E+19	2.78E+22	6.90E+20
S.E. equation	29747.71	9.02E+09	6.799279	7.34E+09	8.31E+08	2.64E+10	4.15E+09
F-statistic	264.7812	18507351	1.599777	440.9069	36418.88	3736925.	37262.38
Log likelihood	-6.358.120	-1.330.056	-1.747.091	-1.318.662	-1.198.897	-1.389.033	-1.287.389
Akaike AIC	23.66589	48.91112	6.898511	48.49679	44.14170	51.05574	47.35960
Schwarz SC	24.21335	49.45858	7.445966	49.04425	44.68916	51.60319	47.90706
Mean dependent	427577.1	7.42E+12	4.570545	5.26E+10	5.07E+10	1.04E+13	2.29E+11
S.D. dependent	247796.3	1.98E+13	7.308822	7.87E+10	8.08E+10	2.60E+13	4.08E+11
Determinant resid covariance (dof adj.)		1.4E+104					
Determinant resid covariance		1.5E+103					
Log likelihood		-7.079.346					
Akaike information criterion		261.2490					
Schwarz criterion		265.0811					
Number of coefficients		105					

VAR Model:

$$\begin{aligned} \text{GSMH} = & C(1,1)*\text{GSMH}(-1) + C(1,2)*\text{GSMH}(-2) + C(1,3)*\text{BORMADENI}(-1) + \\ & C(1,4)*\text{BORMADENI}(-2) + C(1,5)*\text{BUYUME}(-1) + C(1,6)*\text{BUYUME}(-2) + \\ & C(1,7)*\text{ELEKTRİK\_ENERJISI}(-1) + C(1,8)*\text{ELEKTRİK\_ENERJISI}(-2) + C(1,9)*\text{TASKOMURU}(-1) + \\ & C(1,10)*\text{TASKOMURU}(-2) + C(1,11)*\text{LINYITKOMURU}(-1) + C(1,12)*\text{LINYITKOMURU}(-2) + \\ & C(1,13)*\text{PETROL}(-1) + C(1,14)*\text{PETROL}(-2) + C(1,15) \end{aligned}$$



## 5. SONUÇLAR

Enerji tüketimi ile iktisadi büyüme ilişkisi, Cobb-Doglas üretim modelinde olduğu gibi, üretimi artırıcı ve büyümeyi sağlayan en önemli faktörlerin başında gelmektedir. Bu çalışmamızdan elde edilen sonuçlara göre, Bor Madenindeki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 1.45 arttırmaktadır (diğer değişkenler sabitken). \*Elektrik Enerjisindeki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 2.63 arttırmaktadır (diğer değişkenler sabitken). \*Taşkömürü Madenindeki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 6.237 oranında arttırmaktadır (diğer değişkenler sabitken). \*Linyit Kömürü Miktarındaki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 1.60 yükseltmektedir (diğer değişkenler sabitken). \*İktisadi Büyüme Oranındaki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 6.99 oranında yükseltmektedir (diğer değişkenler sabitken). \*Petrol Miktarındaki (logaritması alınmış) bir birimlik artış, GSMH'yı (logaritması alınmış) 1.54 arttırmaktadır (diğer değişkenler sabitken). Bütün değişkenlerin GSMH üzerinde arttırıcı etkisi bulunmaktadır. GSMH'dan enerji kaynakları tüketimine doğru tek yönlü ve pozitif bir nedensellik tespit edilmiştir. Granger nedensellik testinin analizi, I(2) gecikmeli olarak 57 gözlem sonucunda değişkenler arasında ortaya çıkan nedensellik ilişkilerini şu şekilde belirtmek mümkündür; Enerji kaynak türleri ile GSMH arasında Granger nedensellik ilişkisi mevcuttur. GSMH'dan bor madeni, elektrik enerjisi, petrole, linyit kömürü ve taş kömürüne doğru tek yönlü pozitif bir nedensellik ilişkisi tespit edilmiştir. Elektrik enerjisi tüketimi ile Petrol tüketiminin iktisadi büyüme üzerinde tek yönlü ve pozitif nedensellik ilişkisi saptanmıştır. Çalışmamızda, iktisadi büyümeden enerji tüketimine doğru tek yönlü bir nedensellik ilişkisi geçerlidir. Bu bağlamda “**muhafaza (koruma)**” kuramı geçerli olacaktır.

## KAYNAKLAR

- AKARCA, Ali T. & LONG, Thomas Veach, (1980). “On the Relationship Between Energy and GNP: A Reexamination”, *Journal of Energy and Development*, 5, pp.326-331.
- AKSU, Levent, (2018). “Türkiye’de Bilim ve Teknoloji ile İktisadi Büyüme İlişkilerinin; Sosyal, Ekonomik ve Stratejik Analizi”, *Social Sciences Studies Journal*, Volume:4, Issue:20, pp. 2635-2670.
- AKSU, Levent, (2020). “Para Arzı, Enflasyon ve Faiz Oranları ile İktisadi Büyüme İlişkisi: Türkiye Örneği”, (içinde), *Sürdürülebilir Kalkınma İşletme, Finans ve Ekonomi:Teorik ve Ampirik Katkıları*, (editör:Salih Öztürk), İKSAD Publishing House, s.115-218.
- ALTINAY, Galip & KARAGÖL, Erdal, (2004). “Structural Break, Unit Root, and the Causality Between Energy Consumption and GDP in Turkey”, *Energy Economics*, 26, pp.985-994.

- ALTINAY, Galip & KARAGÖL, Erdal, (2005). “Electricity consumption and Economic Growth: Evidence from Turkey”, *Energy Economics*, 27, pp.854-855.
- ASLAN, Alper, & ÖCAL, Oğuz, (2016). “The Role of Renewable Energy Consumption in Economic Growth: Evidence from Asymmetric Causality”, *Renewable and Sustainable Energy Reviews*, 60, pp.953-959.
- APERGIS, Nicholas, & PAYNE, James E. (2010). “Renewable Energy Consumption and Growth in Eurasia. *Energy Economics*”, 32(6), pp.1392-1397.
- APERGIS, Nicholas, & PAYNE, James E. (2011). “The Renewable Energy Consumption–Growth nexus in Central America. *Applied Energy*”, 88(1), pp.343-347.
- APERGIS, Nicholas, & DANULETIU, Dan Constantin, (2014). “Renewable Energy and Economic Growth: Evidence From The Sign Of Panel Long-Run Causality”, *International Journal of Energy Economics and Policy*, Volume:4, No:4, pp.578-587.
- ARROW, Kenneth J. (1962). “The Economic Implications of Learning by Doing”, *Review of Economic Studies*, Vol:29, June 1962, s.155-173.
- AQEEL, A. & BUTT, M.S. (2001). “The Relationship Between Energy Consumption And Economic Growth In Pakistan”, *Asia-Pacific Development Journal*, 8 (2), pp.101-110.
- BAKIRTAŞ, İbrahim & ÇETİN, Mümin Atalay (2016). “Yenilenebilir Enerji Tüketimi ile Ekonomik Büyüme Arasındaki İlişki: G-20 Ülkeleri”, *Sosyoekonomi*, 24(28), s.131-145.
- BARRO, Robert J. & SALA-I-MARTIN, Xavier, (2004). *Economic growth*, M.I.T. Press, Second Edition, USA. pp.1-654.
- BROYLES, David, (2001). *What Is Energy?*, Trafford Publishing House, 1. Edith, Canada.
- BULUT, Umit, & MURATOĞLU, Gönül, (2018). “Renewable Energy in Turkey: Great Potential, Low but Increasing Utilization, and an Empirical Analysis on Renewable Energy-Growth nexus”, *Energy Policy*, 123, pp. 240-250.
- COBB, Charles W., & DOUGLAS, Paul H., (1928), “A theory of production”, *American Economic Review*, 18(1), pp.39-165.
- DESTEK, Mehmet Akif, & ASLAN, Alper, (2017). “Renewable and Non-renewable Energy Consumption and Economic Growth in Emerging Economies: Evidence from Bootstrap Panel Causality”. *Renewable Energy*, 111, pp.757-763.
- DOĞAN, Eyyup (2016). “Analyzing the Linkage between Renewable and Non-renewable Energy Consumption and Economic Growth by Considering Structural Break in Time-series Data”, *Renewable Energy*, 99 (Supplement C), pp.1126-1136.
- DURĞUN, Burhan & DURĞUN, Funda, (2018). “Yenilenebilir Enerji Tüketimi İle Ekonomik Büyüme Arasında Nedensellik İlişkisi: Türkiye Örneği”, *International Review of Economics and Management*, Volume:6, Number:1, 2018, s.1-27.
- EROĞLU, Gonca & ŞAHİNER, Mesut, (2017). “Dünyada ve Türkiye’de Uranyum ve Toryum”, MTA Genel Müdürlüğü Yayınları, Maden Serisi No:3, Ankara.
- GEORGESCU-ROEGEN, Nicholas, (1971), *The Entropy Law and the Economic Process*, Harvard University Press, Cambridge, MA. USA.
- GEORGESCU-ROEGEN, Nicholas, (1975) “Energy and Economic Myths”, *Southern Economic Journal*, 41(3), pp.347-381.
- GLASURE, Yong U., & LEE, A. Rie, (1997). “Cointegration, Error Correction And The Relationship Between Gdp And Energy: The Case Of South Korea and Singapore”, *Resource and Energy Economics*, 20 (1), pp.17-25.

- GÜNGÖR, Özlem, (2016). “Enerji Tüketimi Ve Ekonomik Büyüme İlişkisi: Var Analizi”, Yayınlanmamış Yüksek Lisans Tezi, Balıkesir Üniversitesi, Sosyal Bilimler Enstitüsü, iktisat Anabilim dalı, Balıkesir 2016.
- HWANG, Dennis B. K. & GUM, Burel, (1991). “The Causal Relationship Between Energy and GNP: The Case of Taiwan”, *The Journal of Energy and Development*, 16(2), pp.219-226.
- ITO, Katsuya, (2017). “CO2 Emissions, Renewable and Non-renewable Energy Consumption, and Economic Growth: Evidence from Panel Data for Developing Countries”, *International Economics*, 151, pp.1-6.
- JUMBE, Charles, (2004). “Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi”, *Energy Economics*, 2004, Volume:26, Issue:1, pp.61-68.
- KAHIA, Montassar; AISSA, Mohammed S. B., & LANOUAR, Charfeddine (2017). “Renewable and Non-renewable Energy use-Economic Growth nexus: The Case of MENA Net Oil Importing Countries”, *Renewable and Sustainable Energy Reviews*, 71, No:C, pp.127-140.
- KALKINMA BAKANLIĞI, (2018), 11. Kalkınma Planı (2019-2023), Enerji Arz Güvenliği ve Verimliliği, ÖİK Raporu, Ankara.
- KARANFİL, Fatih, (2008). “Energy Consumption and Economic Growth Revisited: Does the Size of Unrecorded Economy Matter?”, *Energy Policy*, Cilt 36, 2008, pp.3019-3025.
- KASPEROWICZ, Rafal & STREIMIKIENE, Dalia, (2016). “Economic growth and energy consumption: comparative analysis of V4 and the “old” EU countries”, *Journal of International Studies*, Volume:9, No:2, pp.181-194.
- KOÇAK, Emrah, & ŞARKGÜNEŞİ, Aykut, (2017). “The Renewable Energy and Economic Growth nexus in Black Sea and Balkan Countries”, *Energy Policy*, 100, pp.51-57.
- KRAFT, John, & KRAFT, Arthur, (1978). “On the Relationship between Energy and GNP”, *The Journal of Energy and Development*, pp.401-403.
- KULA, Ferit, (2014). “The Long-run Relationship between Renewable Electricity Consumption and GDP: Evidence from Panel Data”, *Energy Sources, Part B: Economics, Planning, and Policy*, 9(2), pp.156-160.
- LEE, Chien-Chiang & CHANG, Chun Ping, (2008). “Energy consumption and economic growth in Asian economies: A more comprehensive analysis using panel data” *Resource and Energy Economics*, 30(1), pp.50-65.
- MANKIW, N. Gregory; ROMER, David & WEIL, David, N. (1992). “A Contribution to The Empirics of Economic Growth”, *Quarterly Journal of Economics*, Volume:107, Issue:2, May 1992, pp.407-437.
- MARQUES, A. C., & FUINHAS, J. A. (2012). “Is Renewable Energy Effective in Promoting Growth?”, *Energy Policy*, 46, pp.434-442.
- MENEGAKI, Angeliki N. (2011). “Growth and renewable energy in Europe: A Random Effect Model with Evidence for Neutrality Hypothesis”, *Energy Economics*, 33, pp.257-263.
- MUCUK, Mehmet & UYSAL, Doğan, (2009). “Türkiye Ekonomisinde Enerji Tüketimi Ve Ekonomik Büyüme”, *Maliye Dergisi*, 157, s.105-115.
- NARAYAN, Paresh Kumar & SMYTH, Russel, (2008). “Energy Consumption and Real GDP in G7 Countries: New Evidence from Panel Cointegration with Structural Breaks”, *Energy Economics*, 30, pp.2331-2341.

- ÖCAL, Oğuz, & ASLAN, Alper, (2013). “Renewable Energy Consumption–Economic Growth nexus in Turkey”. *Renewable and Sustainable Energy Reviews*, 28, pp.494-499.
- ÖZAYDIN, Özgür, (2019). Türkiye’de enerji Tüketimindeki Makro Ekonomik Etkileri, Gece Kitaplığı, 1. Baskı, No:15476, Ankara.
- ÖZSOY, Ceyda, (2008). “Türk Yükseköğretim Sisteminin Durumu Ve İktisadi Büyüme Performansına Katkısı”, Nigde Üniversitesi, İktisadi ve İdari Bilimler Fakültesi Dergisi, Aralık 2008, Cilt: 1, Sayı: 2, s. 31-48.
- PAMİR, Necdet, (2016). Enerjinin İktidarı, Hayy Kitap yayınları, 2. Baskı, No:327, İstanbul.
- RAFINDADI, Abdulkadir A., & ÖZTÜRK, İlhan (2017). “Impacts of renewable energy consumption on the German economic growth: Evidence from combined cointegration test”, *Renewable and Sustainable Energy Reviews*, 75(Supplement C), pp.1130-1141.
- ROMER, Paul, M. (1986). “Increasing Returns and long-Run Growth”, *Journal of Political Economy*, Volume:94, Issue:5, October 1986, pp.1002-1037.
- SHAHBAZ, Muhammad; LOGANATHAN, Nanthakumar, ZESHAN, Mohammad, & ZAMAN, Khalid, (2015). “Does renewable energy consumption add in economic growth? An application of auto-regressive distributed lag model in Pakistan”, *Renewable and Sustainable Energy Reviews*, 44(Supplement C), pp.576-585.
- SOLOW, Robert, M. (1956). “A Contribution to the Theory of Economic Growth”, *Quarterly Journal of Economics*, Volume:70, Issue:1, February 1956, pp.65-94.
- SORRELL, Steve & DIMITROPOULOS John, (2007) “UKERC Review of Evidence for the Rebound Effect, Technical Report 5: Energy, productivity and economic growth studies”, UKERC Report Working Paper, October 2007, UKERC/WP/TPA/2007/013. UKERC. pp.1-192.
- SOYTAŞ, Uğur, & SARI, Ramazan, (2009). “Energy Consumption, Economic Growth, and Carbon Emissions: Challenges faced by an EU Candidate Member”, *Ecological Economics*, 68(6), pp.1667-1675.
- STERN, David I. (1993). "Energy and economic growth in the USA: A multivariate approach," *Energy Economics*, 15(2), pp.137-150.
- ŞENGÜL, Seda & TUNCER, İsmail, (2006). “Türkiye’de Enerji Tüketimi ve Ekonomik Büyüme: 1960- 2000”, *İktisat, İşletme ve Finans*, 21, s.69-80.
- ŞENTÜRK, İsmail, (2012). “Kaynaklarına Göre Enerji Tüketiminin Ekonomik Büyümeye Etkileri”, yayınlanmamış Doktora tezi, Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü İktisat Anabilim Dalı, Ankara 2012.
- TERZİ, Harun, (1998). “Türkiye’de Elektrik Tüketimi ve Ekonomik Büyüme İlişkisi: Sektörel Bir Karşılaştırma”, *İktisat İşletme ve Finans*, Bilgesel Yayıncılık, Cilt:13 (144), s.62-71.
- TUĞCU, Can T.; ÖZTÜRK, İlhan, & ASLAN, Alper, (2012). “Renewable and non-renewable energy consumption and economic growth relationship revisited: Evidence from G7 countries”, *Energy Economics*, 34(6), pp.1942-1950.
- UZUN, Ahmet; EMSEN, Selçuk Ö., YALÇIKAYA, Ömer, HÜSEYİNİ, İbrahim, (2013). “Toplam Elektrik Üretimi ve Ekonomik Büyüme İlişkisi: Türkiye Örneği (1980-2010)”, *Atatürk Üniversitesi, Sosyal Bilimler Enstitüsü Dergisi*, 17 (3), pp.327-344.
- UZUNÖZ, Meral, & AKÇAY, Yaşar, (2012). “Türkiye’de Büyüme ve Enerji Tüketimi Arasındaki Nedensellik İlişkisi: 1970-2010”, *Çankırı Karatekin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, Yıl 2012, Cilt 3 , Sayı 2, s.1-16

- YENMEZ, Neceti, (2009). “Stratejik Bir Maden Olarak Bor Minerallerin Türkiye İçin Önemi”, İstanbul Üniversitesi, Edebiyat Fakültesi Coğrafya Bölümü, Coğrafya Dergisi, Sayı:19, istanbul, s.59-94.
- YILDIRIM, Hasan H. & SAKARYA, Şakir, (2016). “Economic Growth and CO2 Emissions in Turkey, 8th International Ege Energy Symposium”, May 11-13, Afyonkarahisar, s.294-304.
- YU, Eden S. H. & HWANG, Been-Kwei (1984). “The relationship between energy and GNP, further results”, Energy Economics, 6, pp.186–190.
- YU, Eden S. H. & CHOI, Jai Young, (1985). “The Causal Relationship Between Energy and GNP:An International Comparison”, The Journal of Energy and Development, 10(2), pp.249-272.
- YU, Eden S. H. & JIN, Jang C. (1992). “Cointegration tests of energy consumption, income, and employment”, Resources and Energy, 14, pp.259-266.

**ELEKTRONİK ADRESLER:**

- [http://www.maden.org.tr/genel/bizden\\_detay.php?kod=117&tipi =5&sube=0](http://www.maden.org.tr/genel/bizden_detay.php?kod=117&tipi =5&sube=0); erişim tarihi: 05.04. 2019.



**BRAIN VOLUME CHANGES IN MAJOR DEPRESSIVE DISORDER: A NOVEL METHOD****Asli Beril KARAKAS<sup>1\*</sup>, Ali Saffet GONUL<sup>2</sup>**

<sup>1</sup>*Kafkas University, School of Medicine, Department of Anatomy, Kars, Turkey.  
ORCID:0000-0001-6504-6489*

<sup>2</sup>*Ege University, School of Medicine, Department of Psychiatry, İzmir, Turkey.  
ORCID:0000-0003-3522-1359*

**Abstract**

**Introduction:** Recent advances in MRI represent a range of useful signals to identify neurodegenerative diseases. Major depressive disorder (MDD) is one of the most common illnesses that falling under the category of mental and behavioral disorders. Although many diseases have been treated or stopped as a result of technological and medical developments, the prevalence of MDD is increasing rapidly all over the world. The aim of this study was to demonstrate the brain volumetric changes in MDD and the healthy controls by using MRICloud method.

**Methods:** This study has been carried out using the archived MRI sections of 18 MDD patients and 19 healthy controls who were screened in the department of Psychiatry, Ege University between the dates of January 2008 and February 2011. Volumetric analyses in whole-brain structures were done with fully-automatic MRICloud method. MRICloud is an online cloud-computing platform, which provides atlas-based whole-brain segmentation of T1-weighted images at multiple granularity levels, and thereby, enables us to access the regional features of brain anatomy.

**Results:** We have found that cerebral cortex, limbic and parietal lobe volumes and, thalamus, pons, postcentral, supramarginal, angular, lingual, cingulate, superior and middle frontal gyrus significantly decreased in MDD patients compared to healthy controls.

**Conclusions:** Statistically significant decrease was observed in the cortical and subcortical brain volumes in MDD patients. As a result with long-term illness and improper use of drugs, different brain regions may be affected by MDD.

**Keywords:** Magnetic resonance imaging, Major depressive disorder, MRICloud, Segmentation, Volumes.

**1. INTRODUCTION**

Major depressive disorder (MDD) is one of the most common illnesses that fall under the category of mental and behavioral disorders. Although many ailments have been treated or stopped as a result of technological and medical developments, the prevalence of MDD is increasing rapidly all over the world. According to the World Health Organization (WHO) data, while unipolar (unipolar) depressive disorders were in the third rank in terms of disease burden in 2004, it is expected to rise to the first rank in 2030. It is estimated that approximately 350 million individuals in the world and approximately 2 million individuals in Turkey are affected by MDD (WFMH, 2012; Moussavi et al. 2007; Savrun, 1999; Kessler et al. 2009). The lifetime prevalence of MDD in the world varies between 4-10%. Its prevalence in Turkey increased to 1.6% in 1998, 1.9% in 2012, and 2.8% in 2014. In addition, at the beginning of 2013, it was revealed that the use of antidepressants increased by approximately 162% in Turkey (WFMH, 2012; Moussavi et al. 2007; Savrun, 1999; Kessler et al. 2009; Iwata et al. 2002; Bora Başara et al. 2 April 2014).

Modern brain imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) are used in the non-invasive examination of brain structures. With these techniques,

it has become possible to observe pathological changes in certain structures in neuropsychiatric diseases such as MDD, Alzheimer's, Parkinson's, and schizophrenia and to compare structures in healthy individuals. There is no radiation risk in MRI, it can be used safely in pregnancy, and its contrast and imaging properties in soft tissues are higher than other radiological imaging techniques. For this reason, it is used in imaging the anatomical structures in detail, in explaining the pathophysiology of neurodegenerative diseases, and in the pre-diagnosis, definitive diagnosis, treatment and specific evaluation of the patient's response to treatment.

Structural and functional MRI studies have shown that changes in some neuroanatomical structures in the brain are associated with MDD. In MDD patients, a decrease in the volume of the hippocampus, prefrontal cortex, cerebellum and basal ganglia, and an increase in the volume of the ventriculus lateralis and cerebrospinal fluid volume were observed (Oyar, 2008; Kempton et al. 2011).

In the studies, manual segmentation software such as ImageJ and automatic software such as FreeSurfer, FSL and MRICloud are used to calculate the volumes of cortical and subcortical structures. MRICloud is provide a high-throughput neuroinformatics platform for automated brain MRI segmentation and analytical tools for quantification via distributed client-server remote computation and web-based user interfaces (Mori et al., 2016).

The aim of our study is to show the volumetric changes cortical and subcortical structures in the brain in patients with major depressive disorder (MDD) and the healthy individuals by using MRICloud.

## **2. MATERIALS AND METHODS**

### **2.1 SUBJECTS**

The present study involved 18 patients with MDD (12 women and 6 men; mean age  $46,11 \pm 8,50$  years) and 19 healthy controls (10 women and 9 men; mean age  $37,56 \pm 6,16$  years). The study was approved by the Celal Bayar University Medical School Ethics Committee.

Hamilton Depression Rating Scale (HAM-D), Hamilton Anxiety Rating Scale (HAM-A) and Montgomery-Asberg Depression Rating Scale (MADRS) were used to measure the severity of depression in the patient group. The patient group consisted of individuals who were diagnosed with MDD after a detailed psychiatric examination by an experienced psychiatrist and clinical interviews, while the control group consisted of healthy individuals who did not have any neurological or psychiatric disease.

### **2.2 IMAGE ACQUISITION**

MRI scans were performed in a 1.5 Tesla MRI unit (Siemens Symphony, Vision to Symphony Upgrade, Erlangen, Germany). For volume measurements, images were taken in the coronal plane in T1-weighted 3D multiplanar turbo spin echo sequence. Voxel size:  $0.49 \times 0.49 \times 0.07$  mm, TR: 1600 TE: 393 TI: 1100, FoV:  $187 \times 250$ , Matrix:  $256 \times 144$ , Flip Angle (FA): 15, slice thickness: 2 mm, GAP: 0 mm.

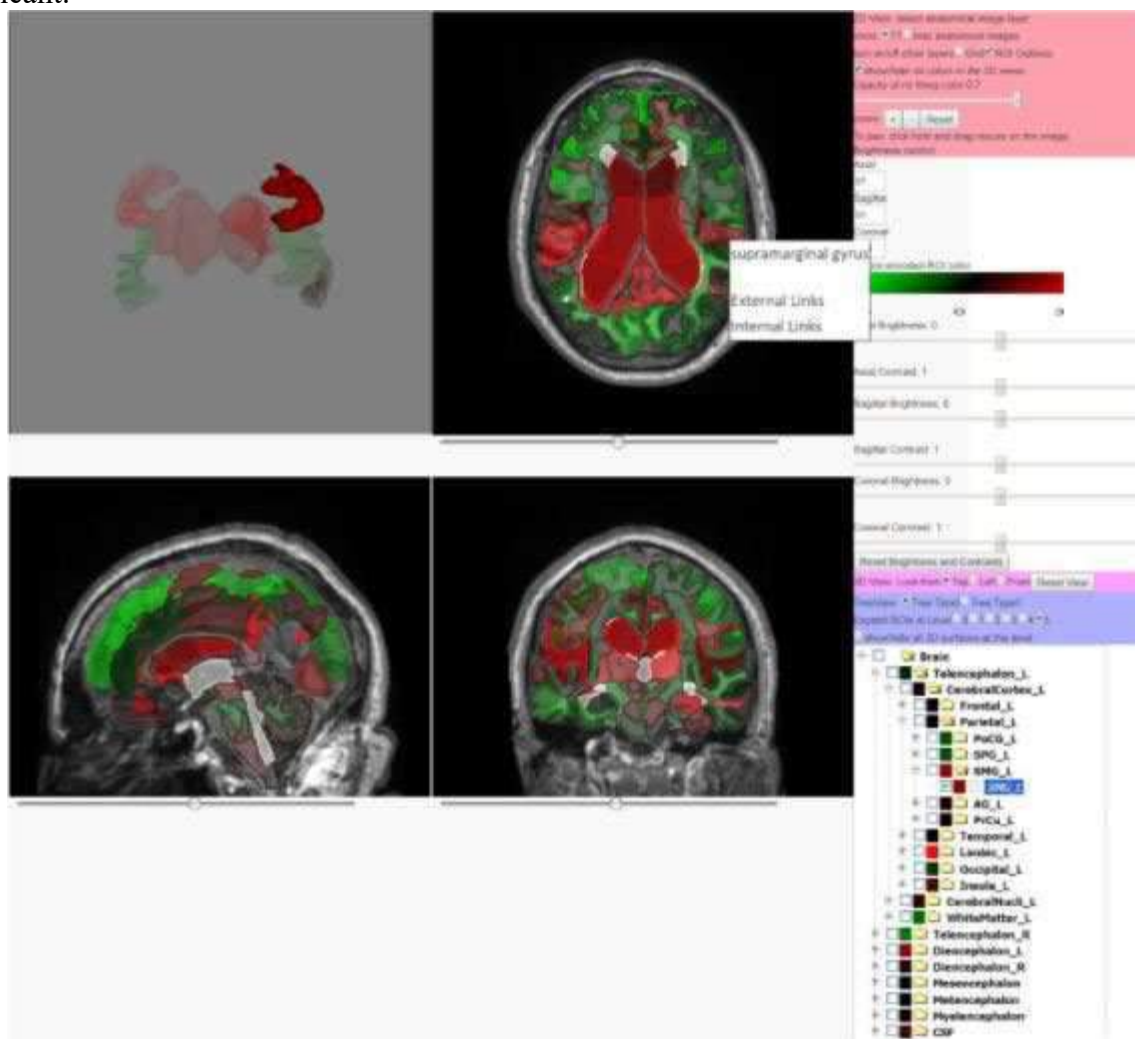
### **2.3. ATLAS-BASED ANALYSIS USING MRICLOUD**

DICOM formatted files were converted HDR and IMG files. HDR and IMG files were uploaded to a free

web-based module ([www.mricloud.org](http://www.mricloud.org)) which is an automatic volumetric analysis system that works remotely through a web interface and provides volumetric information of any submitted case (Fig.1). Volumetric results were calculated and sent as separate files automatically by the system.

### **2.4. STATISTICAL ANALYSIS**

Analysis of volumetric data was performed using the statistical analysis program "SPSS for Windows 18.0". Volumetric values were shown as mean  $\pm$  standard deviation. Since the data were not normally distributed according to the normality test, the "Mann-Whitney U test" was used to evaluate the volumetric data of the patient and control groups. Statistically,  $p < 0.05$  was considered significant.



**Figure 1.** A view of the segmentation process using MRICloud.

### 3. RESULTS

The present study included 18 patients with MDD (12 women and 6 men; mean age  $46.11 \pm 8.50$  years) and 19 healthy controls (10 women and 9 men; mean age  $37.56 \pm 6.16$  years). Significant decreases in the volumes of the left side of the superior frontal gyrus (prefrontal cortex), left side of the middle frontal gyrus, left side of the angular and lingual gyrus, both sides of the pons, postcentral gyrus, limbic lobe, cingulate gyrus were found in the MDD group ( $p < 0.05$ ). The volumes of the other structures (Table 1) were also found to be lower in the MDD group than in the control group, although the difference was not statistically significant ( $p > 0.05$ ).

**Table 1.** Regional brain volumes of subjects with MDD versus control subjects (L: left, R: right, cm<sup>3</sup>).

Region	Status	N	Mean	Std. Deviation	p-value
Telencephalon_L	depression	18	521049	46864	0.064
	control	19	554471	66628	
Telencephalon_R	depression	18	571134	56865	0.316

	control	19	594224	80096	
<b>Diencephalon_L</b>	depression	18	7401	1093	0,073
	control	19	8161	1210	
<b>Diencephalon_R</b>	depression	18	5529	1579	0,042*
	control	19	6499	1602	
<b>Mesencephalon</b>	depression	18	10630	1235	0,447
	control	19	10976	1717	
<b>Metencephalon</b>	depression	18	148403	16293	0,121
	control	19	157755	18685	
<b>Myelencephalon</b>	depression	18	3429	1521	0,121
	control	19	4128	1497	
<b>CSF</b>	depression	18	69517	19389	0,761
	control	19	65889	12612	
<b>CerebralCortex_L</b>	depression	18	259111	25255	0,039*
	control	19	278007	29918	
<b>CerebralCortex_R</b>	depression	18	284697	27738	0,191
	control	19	300490	37374	
<b>CerebralNuclei_L</b>	depression	18	10696	1927	0,138
	control	19	11419	1652	
<b>CerebralNuclei_R</b>	depression	18	11168	1965	0,145
	control	19	10383	1870	
<b>Thalamus_L</b>	depression	18	4450	778	0,056
	control	19	4987	964	
<b>Thalamus_R</b>	depression	18	1835	716	0,023
	control	19	2752	1346	
<b>Parietal_L</b>	depression	18	37930	4731	0,004**
	control	19	42712	3910	
<b>Parietal_R</b>	depression	18	39095	4251	0,003**
	control	19	43055	3783	
<b>Limbic_L</b>	depression	18	22488	2557	0,002**
	control	19	25821	3521	
<b>Limbic_R</b>	depression	18	31360	2565	0,025*
	control	19	33996	3697	
<b>Superior frontal gyrus_L</b>	depression	18	20129	2097	0,042*
	control	19	22166	3219	
<b>Superior frontal gyrus_R</b>	depression	18	22619	2866	0,316
	control	19	24043	3779	
<b>Middle Frontal Gyrus_L</b>	depression	18	20737	3132	0,042*
	control	19	23202	3707	
<b>Middle Frontal Gyrus_R</b>	depression	18	25254	4164	0,162
	control	19	26759	4658	
<b>Postcentral Gyrus_L</b>	depression	18	10629	1630	0,027*
	control	19	11486	1253	

<b>Postcentral Gyrus_R</b>	depression	18	11288	1891	0,029*
	control	19	12442	1406	
<b>Angular Gyrus_L</b>	depression	18	5945	942	0,006***
	control	19	7011	975	
<b>Angular Gyrus_R</b>	depression	18	10962	1462	0,068
	control	19	12032	1689	
<b>Lingual Gyrus_L</b>	depression	18	4715	655	0,000***
	control	19	5989	1249	
<b>Lingual Gyrus_R</b>	depression	18	5216	922	0,261
	control	19	5685	1133	
<b>Cingulate_L</b>	depression	18	15325	1814	0,002**
	control	19	18265	3072	
<b>Cingulate_R</b>	depression	18	17694	1847	0,000***
	control	19	20994	2593	
<b>Pons_L</b>	depression	18	151	91	0,012*
	control	19	228	84	
<b>Pons_R</b>	depression	18	411	145	0,029*
	control	19	519	143	

#### 4. DISCUSSION

Calculating the volume of a particular organ or region in diagnosing and arranging the treatment of diseases is frequently used in scientific research as well as clinical use. Clinically over 30 years MRI, which is a non-invasive method used and does not contain ionizing radiation, can display multi-axis images without changing the patient's position, provides high-resolution soft tissue contrast, and can show anatomical structures in detail because of its high sensitivity. With the development of imaging techniques such as MRI, many ideas have been gained about understanding the course, etiology and pathophysiology of brain-related diseases and the treatment of these diseases. Morphological changes in the brain in diseases such as major depressive disorder, Alzheimer's, multiple sclerosis, schizophrenia, leukoaraiosis, Behçet's disease and Huntington's can be detected on MRI sections and a preliminary diagnosis or diagnosis of the disease can be made (Avnioğlu et al, 2021; Wu et al, 2018; Konez, 1995; Odacı et al. 2005; Filippi et al. 2005; Sartor, 2005).

In volumetric calculations made with different methods in various brain regions in MDD patients, cerebral cortex, prefrontal cortex (PFC), anterior cingulate cortex (ACC), orbitofrontal cortex (OFC), subgenual prefrontal cortex (SGPFC), superior frontal gyrus, middle frontal gyrus, postcentral gyrus, angular gyrus, lingual gyrus, gyrus cinguli, gyrus rectus, hippocampus and basal ganglia volume was decreased (Soares ve Mann, 1997; Koolschijnet al. 2009; Bora et al. 2012; Kühn ve Gallinat, 2013; Lorenzetti et al. 2009; Kempton et al. 2011; Kang et al. 2012).

Similar to our findings, in another study where the gender distribution was similar and the mean age of the patient group was lower than our study; It has been determined that MDD patients have a decrease in diencephalon volume (Pujol et al. 2002). In another study whose mean age is consistent with our study; a decrease in the total brain volume of the patient group was found (Hickie et al., 2005). In a study conducted with 34 controls and 102 MDD patients using MRI, they stated that parietal lobe volume decreased in MDD patients (Grieve et al., 2013). In a study conducted with 37 MDD patients and 18 healthy individuals using MRI, it was reported that there was a significant

decrease in limbic lobe in MDD patients (Lin et al., 2005).

Boisgueheneuc et al. demonstrated that (i) the lateral and posterior portions of the left superior frontal gyrus are key components of the neural network associated with the working memory, (ii) the participation of this region in the working memory is triggered by the highest level of executive processing, and (iii) the left superior frontal gyrus is also involved in spatially oriented processing (Boisgueheneuc et al., 2006).

To the best of our knowledge, no volumetric studies have previously been conducted via MRICloud with MDD. To segment the subcortical structures, semi-automatic methods have been suggested. However, these segmentation methods pose certain problems due to the anatomical structures' spatial locations, intensities and relative spatial relations varying among different groups of subjects (Zhou et al., 2005).

It is important to note that the present study had a few limitations. The sample size was relatively small. Larger populations should be investigated in future studies to ensure more accurate statistical results are obtained.

In conclusion, this study describes the brain volume abnormalities observed with MDD via MRICloud. Our data provide further evidence of the decreased volumes of several brain structures in individuals with MDD, with the identified decreases being found to be statistically significant in the case of the pons, cingulate gyrus, both side of the parietal and limbic lobe and the left superior frontal gyrus (prefrontal cortex). These findings suggest that the brain volume reduction associated with MDD may be primarily due to early developmental differences rather than neurodegenerative changes.

## REFERENCES

- Avnioglu, Seda, Halil Aziz Velioglu, Seyda Cankaya, and Burak Yulug. 2021. "Quantitative Evaluation of Brain Volumes in Drug-Free Major Depressive Disorder Using MRI-Cloud Method." *NeuroReport* 32(12):1027–34. doi: 10.1097/wnr.0000000000001682.
- Bora Başara B, Güler C, Yentür GK, Birge B, Pulgat E, Mamak Ekinci B. Sağlık İstatistikleri Yıllığı 2012. Sağlık Araştırmaları Genel Müdürlüğü, T.C Sağlık Bakanlığı, Ankara, 2013. <http://www.saglik.gov.tr/TR/dosya/1-87578/h/istaturk2012.pdf>. 2 April 2014.
- Bora E., Harrison BJ, Davey CG, Yücel M, Pantelis C. 2012. Meta-analysis of volumetric abnormalities in cortico-striatal-pallidal-thalamic circuits in major depressive disorder. *Psychol Med*, 42, 671–81.
- Du Boisgueheneuc, F., Levy, R., Volle, E., Seassau, M., Duffau, H., Kinkingnehun, S., Samson, Y., Zhang, S., Dubois, B. 2006. Functions of the left superior frontal gyrus in humans: a lesion study. *Brain*. 129 (12), 3315-3328.
- Filippi M, De Stefano N, Dousset V, McGowan JC. Preface. In: Filippi M, De Stefano N, Dousset V, McGowan JC, editors. 2005. MRG Imaging in White Matter Diseases of the Brain and Spinal Cord. Medical Radiology Diagnostic Imaging. Berlin-Heidelberg: Springer.
- Grieve SM, Korgaonkar MS, Koslow SH, Gordon E, Williams LM. 2013. Widespread reductions in gray matter volume in depression. *Neuroimage Clin*, 3: 332–9.
- Hickie I, Naismith S, Ward PB, Turner K, Scott E, Mitchell P, Wilhelm K, Parker G. 2005. Reduced



hippocampal volumes and memory loss in patients with early- and late-onset depression. *Br J Psychiatry*, 186:197–202.

- Iwata N, Turner RJ, Lloyd DA. 2002. Race/ethnicity and depressive symptoms in community-dwelling young adults: A differential item functioning analysis, *Psychiatry Res*, 110(3): 281-289.
- Kang HJ, Voleti B, Hajszan T, Rajkowska G, Stockmeier CA, Licznarski P, Lepack A, Majik MS, Jeong LS, Banasr M, Son H, Duman RS. 2012. Decreased expression of synapse-related genes and loss of synapses in major depressive disorder. *Nat Med*, 18:1413–1417.
- Karakaş, Aslı Beril. 2015. “Majör Depresif Bozukluğu Olan Bireylerde Beyin Ventrikül Hacimlerinin Stereolojik Yöntem İle Değerlendirilmesi.” Balıkesir University.
- Kempton MJ, Salvador Z, Munafò MRG, Geddes JR, Simmons A, Frangou S et al. 2011. Structural neuroimaging studies in major depressive disorder: meta-analysis and comparison with bipolar disorder. *Arch Gen Psychiatry*, 68: 675–690.
- Kessler RC, Aguilar-Gaxiola S, Alonso J, Chatterji S, Lee S, Ormel J, Üstün TB, Wang PS. 2009. The global burden of mental disorders: An update from the WHO World Mental Health (WMH) Surveys. *Epidemiol Psychiatr Soc*, 18(1): 23–33.
- Konez O. 1995. Manyetik Rezonans Görüntüleme Temel Bilgiler. 1.baskı, Nobel Tıp Kitabevleri, İstanbul, 1-3.
- Koolschijn PCMP, van Haren NEM, Lensvelt-Mulders GJLM, Hulshoff Pol HE, Kahn RS. 2009. Brain volume abnormalities in Major Depressive Disorder: A Metaanalysis of Magnetic Resonance Imaging Studies. *Human Brain Mapping*, 30:3719–3735.
- Kühn S, Gallinat J. 2013. Resting-state brain activity in schizophrenia and major depression: A quantitative meta-analysis. *Schizophrenia Bulletin*, 39(2):358– 365.
- Lin, H. F., Kuo, Y. T., Chiang, I. C., Chen, H. M. & Chen, C. S. 2005. Structural abnormality on brain magnetic resonance imaging in late-onset major depressive disorder. *Kaohsiung J Med Sci* 21(9):405-11.
- Lorenzetti V, Allen NB, Fornito A, Yücel M. 2009. Structural brain abnormalities in major depressive disorder: a selective review of recent MRGI studies. *J Affect Disord*, 117: 1–17.
- Mori, Susumu, Dan Wu, Can Ceritoglu, Yue Li, Anthony Kolasny, Marc A. Vaillant, Andreia V. Faria, Kenichi Oishi, and Michael I. Miller. 2016. “MRICloud: Delivering High-Throughput MRI Neuroinformatics as Cloud-Based Software as a Service.” *Computing in Science and Engineering* 18(5):21–35. doi: 10.1109/MCSE.2016.93.
- Moussavi S, Chatterji S, Verdes E, Tandon A, Patel V, Ustun B. 2007. Depression, chronic diseases, and decrements in health: results from the world health surveys, *Lancet*; 370:851–858.
- Odacı E, Bahadır A, Yıldırım Ş, Şahin B, Canan S, Baş O, Bilgiç S, Kaplan S. 2005. Cavalieri prensibi kullanılarak bilgisayarlı tomografi ve manyetik rezonans kesitleri üzerinden hacim hesaplaması ve klinik kullanımı. *Türkiye Klinikleri J Med Sci*, 25: 421–428.
- Oyar O. 2008. Manyetik Rezonans Görüntüleme (MRGG)’nin Klinik Uygulamaları ve Endikasyonları. *Harran Üniversitesi Tıp Fakültesi Dergisi*, 5(2):31-40.
- Oz, Fatma, Niyazi Acer, Yasin Ceviz, Recep Eroz, Halit Canatan, and Bircan Yucekaya. 2021. “Volumetric Analysis of the Brain Structures of Children with down’s Syndrome: A 3D MRI

Study.” *Journal of Experimental and Clinical Medicine (Turkey)* 38(2):197–203. doi: 10.52142/omujecm.38.2.26.

Pujol JP, Cardoner N, Benlloch L, Urretavizcaya M, Deus J, Losilla JM, Capdevila A, Vallejo J. 2002. CSF spaces of the Sylvian fissure region in severe melancholic depression. *Neuroimage*, 15(1):103-106.

Sartor K. Foreword. In: Filippi M, De Stefano N, Dousset V, McGowan JC, editors. 2005. MRG Imaging in White Matter Diseases of the Brain and Spinal Cord. Medical Radiology Diagnostic Imaging. Berlin-Heidelberg: Springer.

Savrun BM. 1999. Depresyonun Tanımı ve Epidemiyolojisi. Depresyon, Somatizasyon ve Psikiyatrik Aciller Sempozyumu, İstanbul, Sempozyum Bildiri Özetleri Kitabı,: 11-17.

Soares JC, Mann JJ. 1997. The anatomy of mood disorders— review of structural neuroimaging studies. *Biological Psychiatry*, 41(1):86–106.

WFMH, World Federation for Mental Health. Depression: A Global Crisis World Mental Health Day. [http://wfmh.com/wpcontent/uploads/2013/11/2012\\_wmhday\\_english.pdf](http://wfmh.com/wpcontent/uploads/2013/11/2012_wmhday_english.pdf). 4 April 2015.

Wu, Dan, Andreia V. Faria, Laurent Younes, Christopher A. Ross, Susumu Mori, and Michael I. Miller. 2018. “Whole-Brain Segmentation and Change-Point Analysis of Anatomical Brain Mri—Application in Premanifest Huntington’s Disease.” *Journal of Visualized Experiments* 2018(136):1–9. doi: 10.3791/57256.

Zhou, J., Rajapakse, J.C., 2005. Segmentation of subcortical brain structures using fuzzy templates. *Neuroimage*. 28, 915–924.

**YALNIZLIK PROBLEMLERİNE İSLAMÎ ÇÖZÜMLER****ISLAMIC SOLUTIONS to LONELY PROBLEMS****Mehmet ÖZBAŞ<sup>1</sup> Adem DÖLEK<sup>2</sup>**<sup>1</sup>*Erzincan Binali Yıldırım Üniversitesi, Eitim Fakültesi, Eitim Bilimleri B lümü retim Üyesi, Erzincan, Türkiye.*<sup>2</sup>*Erzincan Binali Yıldırım Üniversitesi, İlahiyat Fakültesi, Temel İslam Bilimleri B lümü retim Üyesi, Erzincan, Türkiye.**ORCID: 0000-0002-7830-4763**ORCID: 0000- 0001-7494-1151***Özet**

İnsan, diğer varlıkların aksine sosyal bir varlık olarak yaratılmıştır. Eskiden beri filozoflar bu gerçeği “İnsan tabiatı itibariyle medenidir.” şeklinde ifade etmişlerdir. İnsanın sosyalleşmesi için birçok sebep mevcuttur. Sosyalleşme ve kültürlenmenin en önemli şartlarından biri aidiyet ihtiyacının karşılanmasıdır. Bu nedenle başta aile olmak üzere, ilgili bütün sosyal yapı ve kurumlar, hangi yaş ve sosyal statüde olursa olsun insanların sosyal bir yaşam ağı içinde bulunmasını sağlayıcı tedbir ve önlemleri almak zorundadırlar. Bütün sosyal tarafların, insanları yalnızlığın yol açabileceği tehlikelerden korumaları gerekir. Sosyal çevrelerin, insanlara birliktelik ve aidiyet duygusu kazandırmaları önemlidir. İnsanların, sosyal sorumluluk ve sosyal yaşam şuuru edinerek yaşamlarını idame ettirici etkinliklere yönlendirilmesi sağlanmalıdır. Çünkü bir insanın tek başına her türlü ihtiyacını tedarik etmesi çok zordur. Bu sebeple de farklı şekillerde ihtiyaçlarının karşılanabilmesi için yine başka insanların ve meslek sahiplerinin varlığına zaruraten ihtiyacı vardır.

İnsanları yalnızlığa iten sebepler; bencillik, kibir/büyükleme, makamına/mevkisine güvenme, malına güvenmek, dünyevileşme, cimrilik, sosyal medya ve iletişim araçları, özgüven kavramının yanlış anlaşılması, cehalet ve hırs-haset gibi durumlardır. Yalnızlığa temel teşkil eden bu amiller, fertler üzerinde mutsuzluklar, psikolojik ve sosyal travmalar, bunalımlar; hatta intihar gibi durumlar meydana getirmektedir. İnsanları yalnızlığa iten bu âmiller tek tek ele alınarak bu amillerin oluşturacağı problemlere İslami kaynaklarda belirtilen çözüm yolları açıklanacaktır.

Bu araştırmanın amacı, insanları yalnızlığa sevk eden sebepler, bu sebeplerin oluşturduğu problemler ve bu problemlere İslami çözüm yollarının neler olduğunu tespit etmek olarak belirlenmiştir. Bu araştırmada yalnızlık probleminin araştırılmasında yöntem olarak, literatüre dayalı kaynak taraması modeli kullanılacaktır. Yalnızlık probleminin çözümüne ilişkin İslami çözüm yolları ile ilgili olarak geniş kapsamlı ve oldukça objektif bir literatür taraması yapılacaktır.

**Anahtar Sözcükler:** Yalnızlık, Sosyalleşme, Bencillik, İslami Çözüm.

**Abstract**

Man was created as a social being, unlike other beings. Philosophers have long recognized this truth as “Man is civilized by nature.” Have expressed. There are many reasons for human socialization. One of the most important conditions of socialization and acculturation is to meet the need for belonging. All social partners need to protect people from the dangers of loneliness. It is important that social circles give people a sense of to get harness and belonging. It should be ensured that people are guided to activities that sustain their lives by acquiring social responsibility and social life

consciousness. Because it is very difficult for a person to supply all his needs alone. For this reason, in order to meet their needs in different ways, they necessarily need the presence of.

Reasons that push people to loneliness; selfishness, arrogance/arrogance, confidence in one's position/position, trusting in his/her property, worldliness, stinginess, social media and communication tools, misunderstanding of the concept of self-confidence, ignorance and greed-envy. These factors that form the basis of loneliness, unhappiness on individuals, psychological and social traumas, depressions; and even commit suicide. These factors that push people to loneliness will be handle done by one and the solutions to the problems that these factors will create will be explained from Islamic sources.

The aim of this research is to determine the reasons that lead people to loneliness, the problems caused by these reasons and what are the Islamic solutions to these problems. In this research, literature-based literature review model will be used as a method to investigate the loneliness problem. A comprehensive and quite objective literature review will be conducted on Islamic solutions to the problem of loneliness.

**Keywords:** Loneliness, Socialization, Selfishness, Islamic Solution.

## INTRODUCTION

Man, unlike other beings, is essentially civilized; that is, he was created as a social being:

**Firstly;** When we look at the creation of man, it is stated that he was created as a family (Hz. Adam and his wife Havva) and generations were derived from them.

**Secondly;** When we look at the creation character of man, it is seen that he forms the family as a small social circle with legitimate marriage.

**As the third;** It is seen that other people and professionals contribute to each person to meet their different needs.

**Fourthly;** When attention is paid to man's creation, he needs a spouse or friend or a sincere friend with whom he can share his joys and sorrows and with whom he will be more happy.

**Fifthly;** Another issue that compels people to socialize is the strong need for social assistance.

When these factors are removed from people, people become introverted and break their ties with the social environment and become anti-social, restless, unhappy, psychopathic, and harmful.

## THE REASONS THAT LEAD PEOPLE TO LONENESS

There are many reasons that lead people to loneliness. Let's try to point out the Islamic solutions (as an example):

- 1- Selfishness
- 2- Gratitude
- 3- To Trust The Pozition
- 4- To Rely on Property
- 5- Secularization
- 6- Stinginess
- 7- Social Media And Communication Tools
- 8- Misunderstanding Of Confidence
- 9- Ignorance
- 10- To Increase Greed and Envy

## 1- SELFISHNESS

Man has a sense of self in his creation. However, while this feeling is given to him to know and recognize his Creator with a sense of self and belonging, many people use this feeling in the wrong way and want everything to work for them and everything to belong to them. When such a thought turns into action, it is not accepted by the other people and such a person is excluded. For this reason, he pushes himself into loneliness.

**Solution:**

The treatment of such a disease is to understand the nature of the self-sense of the person, to think empathetically, to want for others what he wants for himself, to say "we" instead of "me" and to act with this consciousness.

**2- ARROGANCE**

One of the reasons that push people to loneliness is to be arrogant and haughtiness, to belittle others, and to ignore them.

**SOLUTION:**

The cure for such a disease is to be humble. Because those whose value is greater than their body will be humble. In one of his hadiths, the Holy Prophet (PBOH) said: "*He who is humble in the name of Allah, Allah exalts. And whoever is arrogant, Allah will humiliate him.*" (See, Kuzâi, *Musnad*, 1/219).

**3- TO TRUST THE POSITION**

Some people come to a position on certain occasions. In other words, there are some people who are elevated by rank and position.

These people have the feeling that they will stay in the position they are in forever, and they lose the dignity or respect that their position brings to them when they leave their office.

Thus, when they do not receive the respect, they expect from the environment, they push themselves into loneliness.

**SOLUTION:**

In fact, the superiority is not in the rank, but in the one who raises the rank. In the words of the ancients, it is "Şerefu'l-mekân bil-mekân".

Those who are valuable in person do not lose anything from their reputation when they leave their positions, and they are even more loved by the social environment. For this reason, what elevates people is not their rank, but their own worth. Ranks and positions are temporary, what is permanent is inherent beauty.

Many people rely on property that they have either inherited from their past or acquired through their own efforts and see themselves as detached from society.

He comes to the conclusion that his property will save him, that he will never get sick or be harmed, that he will not be in need of anyone, and he distances himself from society.

**4- TO RELY ON PROPERTY**

Many people rely on property that they have either inherited from their past or acquired through their own efforts, and see themselves as detached from society.

He comes to the conclusion that his property will save him, that he will never get sick or be harmed, that he will not be in need of anyone, and he distances himself from society.

**SOLUTION:**

The treatment of this disease is to think that the goods in the hands of a person are a trust from the Creator, to realize that they can always get out of hand and that a person can not take anything to the grave, which is the land of loneliness, to do good to others from the opportunities one has; It is to cooperate that will make people happy in this world and in the hereafter and that will enable people to bond with each other.

While it is stated in the Qur'an that "*wealth and children are the temporary adornment of the world, and the good and permanent works done for Allah are better and eternal*" (see Qur'ân, 18/46).

The Qur'an warns those who trust in their property: “*Woe to those who backbite and make fun of people, and hoard and treasure their property and think property will make them immortal.*” (Qur’ân, 104/3).

### 5- SECULARIZATION

One of the biggest diseases of this century is worldliness, that is, he wants to earn more, acquire more property, live an extremely luxurious life as if he will never die and stay in the eternal world, and therefore be happy with worldly capital.

With this thought, people will try to workday and night in order to work harder and earn money without saying halal and haram.

However, many people do not even realize that while doing this, they impair both their physical and social health (For more information, see Burhan İşliyen, *Dünyevileşme*, Ankara, TDV Yayınları, 201).

### SOLUTION:

At this point, the treatment of this disease; to establish very well the balance of the world and the hereafter is to work to protect health, not to spoil health.

### 6- STINGINESS

To be stingy; It is also the stinginess of a person that he does not spend the blessings he has even for himself even though he has the opportunity, to not share it with others or to prevent him from helping others.

In this regard, some people do not give to others and do not spend for the needs of their children, and they do hesitate to spend even for themselves.

As this type of stinginess becomes widespread in society, it becomes socio-psychological. It is stated in the hadiths that being stingy causes many negative and undesirable results in sociological terms. (For more information, see Dölek, “Dölek, “Sünnet Işığında Cimrilik Hastalığı ve Tedâvî Yolları”, *Dinbilimleri Akademik Araştırma Dergisi*, IV, 2004, sayı, 2, s. 95-128, dinbilimleri.com).

### SOLUTION:

For this reason, there are many verses in the Qur'an that order material and spiritual cooperation. For example, the most obvious examples of this are the commandments such as giving charity, giving zakat, and giving charity in addition to the command "*Cooperate in goodness and piety, and do not cooperate in sin and enmity*" (Qur'an, 5/2). (For more information, see Geniş bilgi için bk. Dölek, *Hadisler Işığında Sosyal Dayanışma*, İstanbul, Rağbet Yayınları, 2016).

### 7-SOCIAL MEDIA AND COMMUNICATION TOOLS

One of the biggest diseases of our century, the spread of social media and communication tools, and the fact that everyone has a phone with the internet or that a few televisions or computers and tablets have entered every room in every house has made people lonely. Even family members have been communicating their wishes to each other by messaging each other.

### SOLUTION:

To cure of this disease, social media communication tools should be used for essential needs and efforts should be made to be in more physical and verbal communication. For this reason, it is not to be busy with daily and temporary events that do not concern us, which are not beneficial for us. Particular attention should be paid to visiting relatives and friends, dealing with the problems of our relatives, and physical efforts should be made to meet their material and spiritual needs. For this reason, Islam attaches great importance to visits to parents, relatives, friends, and neighborly relations, which are called sila-i rahim, and even those who cut off the womb are cursed.

### 8-MISUNDERSTANDING OF SELF- CONFIDENCE

Self-confidence which expresses the meaning of self-confidence, is narrowly understood by today's people as living on one's own, doing one's own work, being able to overcome these conditions in the fulfillment of life's conditions, that is, not being dependent on others.



**SOLUTION:**

It is necessary to understand the necessities of social life due to the civilized creation of human beings, that they cannot be won alone, and to learn how much they need the social environment for this, and to have the courage to be in harmony with the social environment, geographical environment and physical environment in order to overcome the conditions. In this regard, a person; always needs family, relatives, friends, school and work environments.

And these units are essentially one of the most basic elements of socialization. That's why, Islam aims to establish a family home (See Qur'ân, 24/32), to have children (See. Qur'ân,, 16/72), to education/school, to work, to communicate with people (sila-i rahim), Islam attaches great importance to helping people and to have mercy to creatures. When these situations are achieved, real self-confidence will be attained. (For more information, see Dölek, "Hadisler Işığında Akrabalarla İletişim Kurmak ve Sosyal Yardımlaşmada Akrabalık Hakkını Korumak (Sıla- Rahim), *C.Ü. İlahiyat Fak. Dergisi*, 2010, c.17, S.2, s.33-56).

**9- INCREASED AMBITION AND ENVIRONMENT**

Greed; It means craving, greed, increasing one's desire for something, endless desire, excessive passion, anger, clinging to something excessively, being stingy, ruthlessness, aggression. Also psychologically ambition; an insatiable hunger is expressed as a state of unlimited satisfaction. When the sense of ambition is used in a negative way, it leads people to cruelty, arrogance, envy, selfishness and many other negative behaviors and loneliness. (Dölek, "Hadisler Işığında Hırs Hastalığı ve Korunma Yolları", *Harran Üniversitesi İlahiyat Fak. Dergisi*", c.x1, sayı, 6, Şanlıurfa: 2003).

**Solution:**

Treatment of this disease; A person's contentment with what he has achieved as a result of being content with the division Allah has made for him, working and striving, is thinking about those who are worse off.

It is seeing and thinking that he also has the features and beauties that others do not have.

**10- IGNORANCE**

One of the reasons that push people to loneliness is that the person does not fully understand the value of socialization. This is what is meant by ignorance. Otherwise, uneducated does not mean illiterate. Because when we look at the causes of some sad events around the world, it is clear that the disastrous fate of many university graduates is due to loneliness.

**SOLUTION:**

It is seen that many proposals are presented in Islam for the solution of such a problem. For example, the order to pray five times a day in mosques, to perform Friday prayers once a week, and Eid prayers twice a year in congregation in mosques, to observe the zakat and alms to the poor, to visit relatives and friends, to receive guests and offer treats, to establish science councils in homes, taking care of the widows, orphans, worrying about the problems of neighbors as individuals, families etc.

As a matter of fact, Holy Prophet said: "He who sleeps full while his neighbor is hungry is not a believer." (Ahmed b. Ali Abu Ya'la, *Musnad*, (Beirut: Dâru'l-Me'mûn, ts.), 5/92), and the fact that many other social activities such as to give gifts, condolences and congratulations, visits to the sick were ordered to be performed. These orders save people from loneliness and selfishness, brings sociality and cure people spiritually. Those who do not know or do not live these principles of Islam condemn themselves to loneliness.

**CONCLUSION**

By leaving the reasons that push people to loneliness, when the issues specified in the solutions are taken into consideration and implemented, people will get rid of loneliness and will be happy in life. It should not be forgotten that more than the efforts made for unhappiness, should be done for happiness. Otherwise, there will be no point in living.

## YALNIZLIK PROBLEMLERİNE İSLAMÎ ÇÖZÜMLER

### ISLAMIC SOLUTIONS TO LONELY PROBLEMS

#### GİRİŞ

İnsan, diğer varlıkların aksine esas itibariyle medenî; yani sosyal bir varlık olarak yaratılmıştır. Eskiden beri filozoflar bu gerçeği “İnsan tabiatı itibariyle medenidir.”<sup>1</sup> şeklinde ifade etmişlerdir.

**İlk olarak;** tarihe, insanın yaratılışına bakıldığında da aile olarak Hz. Âdem ile eşi Havva’nın yaratıldığı ve bunlardan da nesillerin türetildiği belirtilmektedir.<sup>2</sup>

**İkinci olarak;** insanın yaratılış karakterine bakıldığında, onun fitratında, kendi cinsinden olan karşı cinse ve çocuk sahibi olmaya, bunun için de bir yuva kurmaya ihtiyaç duyduğu ve böylelikle küçük bir sosyal çevre olarak aileyi oluşturduğu görülmektedir.

**Üçüncü olarak;** bir insanın her türlü ihtiyacını tek başına tedarik etmesi çok zordur. Bunun için her insana, farklı ihtiyaçlarını karşılamak üzere başka insanların ve meslek sahiplerinin katkıda bulunduğu görülmektedir. Zaten insanların yaratılış bakımından karakterleri, farklı işler yapabilecek özellikler donatılmıştır. Nitekim Kur’ân’da “*Şüphesiz, çalışmalarınız farklı farklıdır*”<sup>3</sup> buyrulmuştur. İnsanın bu farklılığı, sosyal bir gerçeklik olmanın yanında aynı zamanda da ekonomik bir gerçekliktir.

**Dördüncü olarak;** insanın yaratılışına dikkat edildiğinde, sevinç ve üzüntülerini paylaşabileceği, sıkıntılarını anlatarak rahatlayacağı, sevinçlerini paylaşarak daha çok mutlu olacağı bir eş veya dost ya da samimi bir arkadaşına ihtiyaç hisseder. Bunun en bariz örneği öncelikle kalb-i sâni denilen bir eşe sahip olma arzusudur. Bu durum bile insanın sosyal bir varlık olduğunu ve sosyalleşmeye ne kadar çok ihtiyacının olduğunu göstermektedir. Hatta eşler kendi başlarına yaşamakla yetinmezler, çocuk sahibi olmak isterler, böylece sosyal çevreyi genişletmiş olurlar. Daha ileride çocuklarının da evlenmeleri ikinci kuşak, üçüncü kuşak aileler oluşturmak suretiyle toplumsal bir sosyal çevreyi oluştururlar.

**Beşinci olarak;** İnsanı sosyalleşmeye mecbur eden bir diğer husus da sosyal yardımlaşmaya şiddetli ihtiyacının olmasıdır. Çünkü bir insanın, her arzu ettiğini ya da yapmak istediğini tek başına yapması çok zordur. Meselâ, hastalandığında tedavi edecek bir doktora, imkânını kaybettiğinde kendisine maddi yardımda bulunabilecek imkân sahiplerine, psikolojisi bozulduğunda bir psikoloğa, başı dara düştüğünde derdini anlatabileceği bir yakın dosta ihtiyacı vardır. Kısaca hayatının her alanında kendisini maddî ve mânevî olarak destekleyecek aile büyüklerine ya da devlet gücüne ihtiyacı vardır. İşte bütün bunlar bir insanın sosyalleşmesi bakımından çok önemli etmenlerdir. Bu etmenler insandan uzaklaştırıldığı zaman, insanlar kendilerini içe kapanık hâle getirirler ve sosyal çevreyle olan bağlarını kopararak tabiri caiz ise ipek böceği misali kendi kozasına çekilerek en sonunda kendisini helâke ve yokluğa mahkûm eder. Böylece kişi, anti sosyal, huzursuz, mutsuz, psikopat olur, zararlı hâle gelir, kendine ya da başkalarına zarar vermeye başlar.

Bu çalışmada, geniş kapsamlı bir literatür taraması ile insanları yalnızlığa sevk eden sebepler, bu sebeplerin oluşturduğu problemler ve bu problemlerin İslâmî çözüm yolları üzerinde durulmaya çalışılacaktır.

#### A-YALNIZLIK PROBLEMİ İLE İLGİLİ SOSYAL, EĞİTSEL VE PSİKOLOJİK DEĞİŞKENLER

21. Yüzyıl insanının yaşadığı yalnızlık problemlerinin depresyon, bunalım, sosyal dışlanmışlık ve aidiyet duygusundan yoksun olma gibi sonuçlarının olduğu saptanmıştır. Yalnızlık hem psikolojik hem duygusal hem de sosyal bir problemdir. Bireyle birlikte, bireyin içinde yaşadığı topluma da çok önemli olumsuz etkileri olan bir problemdir. Bu araştırmada yalnızlık probleminin araştırılmasında

<sup>1</sup> Mâverdi, *Edebu 'd-Dünyâve 'd-Dîn*, 132.

<sup>2</sup> Bk, el-Mümin, 40/67; en-Nahl, 16/72.

<sup>3</sup> el-Leyl, 92/4.

yöntem olarak, alanyazına dayalı kaynak tarama modeli kullanılmıştır. İnsanların yetişme uygulamaları bağlamında, aile ile okulun ortaklaşa olarak paylaştıkları işlevler olan sosyalleşme ve kültürlenme etkinlikleri üzerinde durulmuştur. Öğrencilerin sağlıklı bireyler olarak kendilerini gerçekleştirme süreçleri bağlamında, okul-aile işbirliği ve etkileşiminin önemi vurgulanmıştır. Öğrencilerin sosyal grup ve etkinlikler içerisinde bulunarak sağlıklı sosyal birer varlık olabilecekleri düşünceleri ortaya konulmuştur. Araştırma sürecinde, yalnızlık probleminin ortaya çıkardığı olumsuz sonuçların kavramsal yönden analizleri yapılmıştır. Yalnızlık üzerine yapılan bilimsel çalışmalar, yalnızlığın insanlarda, psikolojik ve sosyal travmalara yol açtığını göstermektedir. Bu araştırma ile yalnızlığa neden olan en önemli değişkenlerden birinin insanların manevi ihtiyaçlarını yeterince ya da hiç karşılayamamaları olduğu saptanmıştır. İnsanların içine düştükleri manevi boşluk ve bunalımların; onları yalnızlığa götürdüğü sonuçlarına ulaşılmıştır.

İnsanın sağlıklı bir sosyal kişilik yapısı geliştirmesinde ebeveynin; özellikle annenin önemi oldukça büyüktür. Bu nedenle her çocuğun sağlıklı bir aileden başka sahip olabileceği daha önemli bir şeyin olamayacağı açıktır. İnsanın ilk çocukluk yılları; bu bağlamda öncelikle 0-2 yaş dönemindeki psikolojik ve sosyal gelişimi çok önemlidir. Ardından çocuğun okul çağına kadar aile sosyal yapısı içerisindeki yaşantılarının önemini özellikle vurgulamak gerekir. Eğitim yaşantılarıyla birlikte, okulların topluma sağlıklı bireyler kazandırmak açısından taşıdıkları önem son derece büyüktür. Okullarda, formal öğretim yaşantıları profesyonel bir anlayışla ve yüz yüze gerçekleştirilerek öğrenciler, amaçlı sosyal gruplar içerisinde yetiştirilir. Okul ile ailenin ortaklaşa paylaştıkları en önemli noktalardan biri, öğrencilerin kendilerini sağlıklı olarak gerçekleştirebilecek şekilde yetiştirilmeleridir. Okul ile ailenin bu işlevi, etkili işbirliği ve etkileşim imkânlarıyla paylaşılır. Aile ile okul arasındaki etkileşim ve işbirliği süreçleri, öğrencilerin okullarına kaydolması ile başlar; öğrencinin bulunduğu öğrenim kademesi ve okul türündeki eğitimi boyunca kesintisiz devam eder. Bu süreç boyunca öğrencinin öncelikle ait olma ihtiyacına istinaden aidiyet duygusu kazanması sağlanır. Öğrencilerin bütün okul kademelerinde, hiçbir şekilde yalnızlık baskısı ve problemi yaşamadan sosyal gruplar ve sosyal etkinlikler içerisinde yer almaları temin edilmek durumundadır. İnsanlar, sosyal varlıklardır. Her insan, öncelikle aile denilen sosyal bir yapı içerisinde dünyaya gelmektedir. İnsanların, sosyal birer varlık olmaları, onların sosyalleşme ve kültürlenmeleri gerektiği ihtiyacını ve aynı zamanda bireyin başka insanlarla birlikte ait olma duygusunun öncellenmesi gereken bir durum olduğu sonucu ortaya çıkmaktadır. Sosyalleşme ve kültürlenmenin ön koşulu sosyal ilişki ve etkileşimler bağlamında ait olmadır. Başta aile olmak üzere, ilgili bütün sosyal yapı ve örgütler, hangi yaş grubunda olursa olsun insanların sosyal bir yaşam ağı içinde bulunmasını sağlayıcı tedbir ve önlemleri almak durumundadırlar. Bütün sosyal tarafların, insanları yalnızlığın yol açabileceği tehlikelerden korumaları gerekir. Sosyal çevrelerin, insanlara birliktelik ve aidiyet duygusu kazandırmaları önemlidir. İnsanların sosyal sorumluluk ve örgütlü yaşam bilinci edinerek, yaşamlarını idame ettirici etkinliklere yönlendirilmesi sağlanmalıdır.

Yalnızlık insanın çevresine olan güvensizliğini artırmakta; başta insanın sosyal çevreye uyumu olmak üzere herhangi bir gruba ait olma duygusunu yok etmektedir. Bireyin sosyal çevreler içerisinde yer almasını, statüsünü, kabul görüp tanınmasını ve onaylanmasını zorlaştırmaktadır. Kısaca insanın sosyal yaşamını sorunlu hale getirmektedir. Bu nedenle yalnızlık sosyo-psikolojik yönden yaralayıcı ve bireyi yok edici ve duygusal açıdan öldürücü bir etkiye sahiptir. Yalnızlık, psikolojik rahatsızlıkların; bu bağlamda özellikle depresyon oluşumunu sağlayan çok önemli bir etkidir. Yalnızlığı tetikleyen birçok değişken mevcuttur. Bunlar arasında, cinsiyet, yaş, sosyal sınıf ve statü, sosyal yönden dışlanmışlık, yaşam çevresi ve koşullarına dayalı olarak sosyo-ekonomik koşullar büyük önem taşımaktadır.<sup>4</sup> Yalnızlık duygusunun ortaya çıkmasında, bireyin benlik saygısının yok olması ile birlikte sosyal benliğine ilişkin saygınlığını kaybetmesinin de önemi büyüktür (Brown vd.,

<sup>4</sup> Yaşar, M. R. "Yalnızlık-loneliness". *Firat Üniversitesi Sosyal Bilimler Dergisi-Firat University Journal of Social Science*, 17, 1, 2007, ss. 237-260.

1989). Bireyin yaşadığı psiko-sosyal ya da duygusal bunalımlar, mânevî boşluk gibi etkenler de yalnızlığın ortaya çıkmasında önemli etkilere sahiptir.

Başta aile olmak üzere, okullar, özellikle okul öncesi eğitim ile ilk ve ortaokulların oluşturduğu temel eğitim süreci, bireyin sağlıklı kişilik gelişimi ve sosyalleşip kültürlenmesinde önemli işlevler üstlenmektedirler. Yalnızlığın önlenmesinde, sosyalleşme ve kültürlenme yaşantıları oldukça etkili roller oynamaktadırlar. Başlangıç kademe ve düzeylerinde daha önemli olmakla birlikte bütün okulların asli işlevleri, öğrencilerini sosyalleştirmek, etkili sosyalleşmiş bireyler haline getirmektir.<sup>5</sup> Yalnızlık, insanın psikolojik sağlığı üzerinde yıkıcı, yıpratıcı ve bozucu bir etkiye sahiptir. Açıkça belirtmek gerekirse yalnızlık ruhsal bunalımlara ve hastalıklara da yol açmaktadır.<sup>6</sup>

Yalnızlık problemine ekonomik yaşam pratikleri açısından, liberal ekonomik yapılanmanın önemli etkilerde bulunduğu görülmektedir. Aşırı liberal ekonomik uygulamaların bir sonucu olarak, ben merkezli bir sosyal proje hayata geçirilmiş; bu durum bazı insanların narsistik bir ruhsal temelde davranışlar sergilemelerine yol açmıştır. Narsist ruh kimsesizliğin açısından kurtulabilmek için kendini önceller ve kutsar; kendini kutsadıkça da yalnızlığın pençesine daha çok mahkûm olur. Sosyal medya bağımlılığı ile internet düşkünlüğünün de bireylerde yalnızlık yaşantısının, probleminin oluşmasında önemli etkilerinin olduğu görülmektedir.

## B- İNSANI YALNIZLIĞA İTEN SEBEPLER

İnsanı yalnızlığa iten birçok sebep vardır. Bu sebepleri maddeler hâlinde zikrederek bu problemlerin çözümlerini belirtmeye çalışalım.

### 1-Bencillik

İnsanın yaratılışında benlik duygusu vardır. Ancak bu duygu, kendisine benlik ve aidiyet hissiyle Yaratana bilmesi ve tanınması için verilmişken birçok insan, bu duyguyu yanlış yerde kullanarak her şeyin kendisine çalışmasını ve her şeyin kendisine ait olmasını istemektedir. Böyle bir düşünce, eyleme dönüştüğünde sosyal çevre tarafından kabullenilmez ve böyle bir kişi dışlanır. Bu sebeple de kendisini yalnızlığa itmiş olur. Çevresi tarafından sevilmeyen ve istenilmeyen kişi hâline gelir. Böylece bu kişi de bir takım psikolojik travmalara ve bunalımlara düşebilir.

Böyle bir hastalığın tedavisi, kişinin, kendisinde mevcut olan benlik duygusunun mahiyetini iyi anlayıp diğergâm olmak, empatik düşünmek, kendisi için istediğini başkaları için de istemek, “ben” değil “biz” diye bilmek ve bu şuurla hareket etmektir. Nitekim Hz. Muhammed (sav), “Sizden hiçbiriniz kendisi için istedi i (hayırlı) bir şeyi, kardeşi için de arzu etmedikçe iman etmiş olamaz/ لَا يُوْمِنُ أَحَدُكُمْ حَتَّىٰ يُحِبَّ لِأَخِيهِ مَا يُحِبُّ لِنَفْسِهِ”<sup>7</sup> buyurmuş ve insanların bencil değil diğergâm olmasını tavsiye etmiştir.

Kendi haklarına riâyet edilmesini isterken başkalarının haklarına da riayet edebilmektir. Mesela, bir aile veya grup içerisinde “Ben burada olduğum gibi başkaları da var, ben başkalarının olumsuz davranışlarından rahatsız olabildiğim gibi başkaları da benim olumsuz davranışlarımdan rahatsız olacaklardır. Dikkatli olmalıyım”, başkalarından saygı görmek isteyen de “Ben de başkalarına saygılı olmalıyım” diyebilmesi gerekir.

### 2-Kibir / Büyüklenme

<sup>5</sup> Özbaş, M. E *itim Sosyolojisi* (1. Baskı). Editörler: M. Türkkahraman & İ. Keskin. Zorunlu Eğitim Kurumu Olarak Okul (ss. 137-163). İstanbul: Lisans Yayıncılık, 2013; Özbaş, M. *Sosyo-Kültürel Bir Sistem Olarak Okul* (1. Baskı). (Editörler: Prof. Dr. Nazmi AVCI & Prof. Dr. Yaşar ERJEM). Eğitim Sosyolojisi (ss. 245-272). ISBN: 978-605-9498-26-5; www.lisansyayincilik.com.tr İstanbul: Lisans Yayıncılık, 2018.

<sup>6</sup> Baron, C. R., Foxall, M. J., Von Dollen K., Jones, P. A. & Shull, K. A., “Marital Status, Social Support And Loneliness in Visually Impaired People”, *Journal of Advanced Nursing*, 19, 1994, pp. 272-280; Jackson, J. And Cochran, S. D., “Loneliness and Psychological Distress”. *The Journal of Psychology*, 125, 3, 1991, pp. 257-262.

<sup>7</sup> Muhammed b. İsmail el-Buhârî, *Sahih*, “İman”, 7.



İnsanı yalnızlığa iten sebeplerden biri de kibirlenmek diğer bir ifade ile tekebbür/büyükleme, kendisini başkalarından büyük görmek, başkalarına tepeden bakmak, başkalarını küçük görmek ve onları hiçe saymaktır. Tekebbür, kelime olarak; büyük olmadığı hâlde kendisini büyük görmek, büyüklük taslamaktır. Buradaki büyüklemeden maksat, gerçek mânâda büyük olmadığı hâlde yapmacık, sun'î davranışlarla kendisini büyük göstermektir. Meselâ, bir insan, içinde bulunduğu odadan dışarıya bakmak istediğinde eğer pencere boyundan yukarıda ise o kişi ayaklarının üzerine dikilerek dışarı bakacaktır. Ancak kişinin boyu pencereden yukarıda ise o zaman da eğilerek dışarı bakacaktır. İşte bunun gibi kameti kıymetinden aşağı olanların, toplum içerisinde kendilerini yüksek göstermek için büyüklemeleri tekebbürdür. Böyle bir davranış, kişinin çevresi tarafından tasvip görmeyecek ve bu kişi sürekli soğuk ve sevimsiz karşılanacaktır. Dolayısıyla tekebbür eden kişi yalnızlığa maruz kalacaktır.

Böyle bir hastalığın tedavisi, mütevazı ve alçak gönüllü olmaktır. Çünkü kıymeti kametinden büyük olanlar mütevazı olurlar. Hz. Muhammed (sav), bir hadisinde “*Allah için mütevazı olanı Allah yüceltir. Kim de tekebbür eder ise Allah onu alçaltır.*”<sup>8</sup> buyurmuştur. Gerçek mânâda büyük olmanın yolu, mahlûkata karşı mütevazı olmaktan geçer. Çünkü yaratılma noktasında bütün mahlûkat eşittir. Sadece özellikleri bakımından üstünlük dereceleri vardır. Bu özellikler tekebbür vesilesi değil sorumluluk vesileleridir. Mütevazı olanı herkes sever ve onu içinde barındırır, ona yardım eder, onunla irtibatını devam ettirir. Herkes tarafından sevilen ve sahiplenilen bir insan mutlu olur ve hayatından zevk ve lezzet alır.

### 3- Makam / Mevkie Güvenme

Bazı insanlar, birtakım vesilelerle bir makâma ya da bir mevkie gelmişlerdir. Diğer bir ifade ile makâm ve mevkilerin yükselttiği kişiler vardır. Bu kişiler, kendilerinin bulundukları makâmda ebedî kalacakları hissiyatına kapılırlar ve makâmlarının kendilerine kazandırdığı itibarı ya da saygıyı makâmlarından ayırdıklarında kaybederler, çevreden bekledikleri itibarı ve saygıyı göremediklerinde kendilerini yalnızlığa iterler. Esas itibarıyla üstünlük makâmda değil, makâmı yükseltendedir. Eskilerin ifadesiyle “*Şerefu'l-mekân bil-mekân*”dır. Zatında kıymetli olanlar, makâmlarından ayırdıklarında itibarlarından hiçbir şey kaybetmezler, hatta sosyal çevre tarafından daha çok istenir ve aranılır. Onun için makâmın yükselttiği insanlar değil makâmı yücelten, makamlardan şeref alan değil makâmı şerefliendiren kişiler, bizatihi değerli kişiler olmak böyle bir hastalığın tedavisi için yeterlidir. Makam ve mevkiler geçicidir, kalıcı olan ise zatî güzelliklerdir.

### 4- Mâla Güvenmek

Birçok insan ya geçmişinden miras aldığı ya da kendi çabasıyla elde ettiği mâla mülke güvenip kendisini toplumdan müstağni görmektedir. Mâlinin kendisini kurtaracağı, hiç hastalanmayacağı ya da hiç zarar etmeyeceği dolayısıyla kimseye muhtaç olmayacağı kanaatine varmakta ve kendisini toplumdan uzaklaştırmaktadır. Bu noktada bu hastalığın tedavisi, mâlin da mülkün de insanın elinde, Yaradanın birer emaneti olduğunu, bu mâlin her zaman elden çıkabileceğini ya da kişinin mâldan ayrılarak yalnızlık ülkesi olan kabre hiçbir şey götüremeyeceğinin idrakinde olması, sahip olunan imkânlardan başkalarına da iyilikte bulunması, dünya ve ahirette mutlu edecek ve insanların birbirlerine kaynaşmasını sağlayacak yardımlaşmalarda bulunmaktır. Kur'an-ı Kerim'de, “*Mâl ve evladın dünyanın geçici ziyneti oldu u, Allah için yapılan hayırlı ve kalıcı işlerin ise daha hayırlı ve ebedî oldu u*”<sup>9</sup> bildirilirken mâlın mülküne güvenenleri uyarmak için de “*İnsanları arkalarından çekiştiren ve yüzlerine karşı da alay etmeyi adet edinenlerin vay haline ki o mal toplar ve sayar durur. O, malının kendisini lümsüzleştirece ini sanır*”<sup>10</sup> denilmektedir.

### 5- Dünyevîleşme

Bu asrın en büyük hastalıklarından biri de dünyevîleşme hastalığıdır. Yani hiç ölmeyecekmiş, ebedî dünyada kalacakmış gibi daha çok kazanmak, daha çok mâl mülk edinmek, son derece lüks bir hayat yaşamak dolayısıyla dünyalık sermaye ile mutlu olmak istediğidir. İşte insan bu düşünce ile

<sup>8</sup> Bk. Kuzâî, *Müsned*, 1/219.

<sup>9</sup> Bk. el-Kehf, 18/46.

<sup>10</sup> el-Hümeze, 104/3.

daha çok çalışmak, helâl haram demeden mâl kazanmak için gece gündüz mesai yapma çabasında olacaktır. Ancak birçok insan bunu yaparken gerek beden sağlığını gerekse sosyal sağlığını bozduğunun farkında bile olamamaktadır.<sup>11</sup>

Bu noktada bu hastalığın tedavisi, dünya ahiret dengesini iyi kurmak, sağlığı bozmak için değil, tam aksine sağlığı korumak için çalışmaktır. Çünkü çoğu insan, para kazanmak için sağlığını bozar, sonra da bozulan sağlığını düzeltmek için kazandığı sermayeyi tüketir. Böylece hem beden ve ruhî sağlığını hem de mâlîni mülkünü kaybeder. Bu sebeple de hem dünyevî hem de uhrevî mutluluğunu kaybeder.

## 6- Cimrilik

Kelime olarak; eli sıkılık, pintilik ve nekeslik<sup>12</sup> olarak ifade edilen cimrilik, terim olarak da kerem ve cömertliğin zıddı olup, başkasına verilmesi gereken bir hakkı vermemek veya verilmesine engel olmaktır.

Cimrilik yapmak, kişinin; sahip olduğu nimetleri başkalarıyla paylaşmaması ya da başkalarına yardımda bulunmasına engel olması gibi imkânı olmasına rağmen kişinin kendisi için dahi harcamaması da kişinin kendisine olan cimriliği olmaktadır. Bu bakımdan bazı kişiler, başkalarına vermediği ve çoluk çocuğunun ihtiyaçları için harcama yapmadığı gibi kendisi için dahi harcamaya kıyamamaktadır. Bu tarz cimrilik, toplumda yaygınlaştıkça sosyo-psikolojik duruma gelir. Hadîslerde cimrilik yapmanın sosyolojik açıdan birçok olumsuz ve istenilmeyen sonuçlar doğurduğu belirtilmiştir.<sup>13</sup>

Gazâlî (v.505/1111), cimrilik hastalığının tedâvîsinin, cimriliğin zıddı olan cömertlik yapmakla, diğer bir ifadeyle mâlî harcamak ve infak etmekle mümkün olabileceğini söyler.<sup>14</sup> Bu kişi kendisine verilen imkânları meşru ölçüler içerisinde başkalarıyla paylaşabildiği nisbette sosyalleşmenin gereğini yapmış, başkalarının gönüllerinde taht kurar ve başkaları tarafından yalnızlığa atılmamış olur. Çünkü cömertlik yapan, maddî ve mânevî yardımlaşmalarda bulunan kişiler de yardım görenler tarafından kendisine yardım edilecek ve iltifat edilecektir. Böylece kişi yalnızlığa düşmemiş olacaktır.

Bunun için olmalıdır ki Kur'ân-ı Kerim'de maddî ve mânevî olarak yardımlaşmayı emreden birçok ayet bulunmaktadır. Mesela “*İyilikte ve takvâda yardımlaşın, gûnahta ve düşmanlıkta yardımlaşmayın*”<sup>15</sup> emrinin yanında infakta bulunmak, zekât vermek, tasaddukta bulunmak gibi emirlerin bulunması bunun en açık örnekleridir.<sup>16</sup>

## 7- Sosyal Medya ve İletişim Araçları

Asrımızın en büyük hastalıklarından biri, sosyal medya ve iletişim araçlarının yaygınlaşması ve herkesin elinde internetli bir telefonun olması ya da her evde birkaç televizyon veya bilgisayar ve tabletin her odaya girmiş olması insanları yalnızlaştırmıştır. Çünkü aile fertleri, birbirleri ile iletişim kurmak yerine sosyal medya iletişim araçlarıyla iletişim kurarak hem Yaradanından hem de en yakın sosyal çevresi olan anne-baba, kardeş, diğer aile büyükleriyle ve akrabalarıyla nitelikli iletişimlerini koparmıştır. Hatta ziyaretleşmeler ortadan kalkmış, başkalarının dertleri ile dertlenmek bitmiş; sadece birkaç kelimelik mesajlaşmalar sosyal münasebetlerin yerini alır hâle gelmiştir. Öyle ki ev içerisinde bile aile fertleri birbirleriyle mesajlaşmak suretiyle birbirlerine isteklerini iletir olmuştur.

Bu noktada bu hastalığın tedavisi, sosyal medya iletişim araçları, zaruri ihtiyaçlar için kullanılmalı ve daha çok fiziksel ve sözlü iletişim içerisinde olmaya çaba gösterilmelidir. Bunun için

<sup>11</sup> Geniş bilgi için bk. Burhan İşliyen, *Dünyevîleşme*, Ankara, TDV Yayınları, 2018.

<sup>12</sup> Devellioğlu, Ferit, *Osmanlıca-Türkçe Ansiklopedik Lügat*, Ankara, 1997, s.143; *Türkçe Sözlük*, T. T. Kurumu Yay., Ankara, 1988, I, 261-262.

<sup>13</sup> Geniş bilgi için bk. Dölek, “*Sünnet Işığında Cimrilik Hastalığı ve Tedâvî Yolları*”, *Dinbilimleri Akademik Araştırma Dergisi*, IV, 2004, Sayı, 2, s. 95-128, Dinbilimleri.com.

<sup>14</sup> Gazâlî, III, 63.

<sup>15</sup> el-Mâide, 5/2.

<sup>16</sup> Geniş bilgi için bk. Dölek, *Hadisler Işığında Sosyal Dayanışma*, İstanbul, Rağbet Yayınları, 2016.



günlük ve geçici, kendimizi ilgilendirmeyen dünyevî ve uhrevî faydası olmayan hâdiselerle meşgul olmamaktır. Özellikle akraba ve dost ziyaretlerine önem verilmeli, yakınlarımızın dertleri ile ilgilenmeli, maddî ve manevî ihtiyaçlarını karşılanması için fiziksel olarak çaba sarf edilmelidir. Onun için İslâm, sıla-i rahim denilen anne-baba, akraba, dost ziyaretlerine ve komşuluk ilişkilerine büyük önem vermiş, hatta sıla-i rahimi kesenler lanetlenmiştir. Yine aile içerisinde yemekleri birlikte yemek, günlük birlikte çay sohbetleri ihdas etmek, kitap okuma saatleri tespit edilerek o saatte konu müzakereleri yapmak aile içi yalnızlığı gidermede en etkili tedbirler olacaktır.

#### 8- Özgüvenin Yanlış Anlaşılması

Kişinin kendisine güvenmesi mânâsını ifade eden özgüven, günümüz insanları tarafından anlamı daraltılarak kendi başına yaşama, kendi işini kendisi yapabilme, hayatın şartlarının yerine getirilmesinden bu şartların üstesinden kendisinin gelebilme yani başkalarına muhtaç olmama şeklinde anlaşılmaktadır. Hâlbuki böyle bir anlayış, insanın kendi içerisine kapanmasına diğer bir ifadeyle yalnızlığa düşmesine sebep olmaktadır. Hâlbuki insanın medenî yaratılması sebebiyle sosyal hayatın gerekliliklerinin tek başına kazanılamayacağı, bunun için de sosyal çevreye ne kadar çok muhtaç olduğunun öğrenilmesi ve şartları üstesinden gelebilmek için sosyal çevre, coğrafi çevre, fizikî çevre ile uyum içerisinde olabilme cesaretine sahip olabilmek şeklinde anlaşılması gerekir.

Bu bakımdan bir kişinin, aile, akraba, dost, okul ve çalışma ortamlarına her zaman ihtiyacı vardır. Ve bu birimler esas itibarıyla sosyalleşmenin de en temel unsurlarından olmaktadır. Onun için İslâm, aile yuvası kurmaya<sup>17</sup>, çocuk sahibi olmaya<sup>18</sup>, eğitime/okula, çalışmaya, insanlarla iletişim kurmaya (sıla-i rahime)<sup>19</sup>, her vesile ile yardımlaşmaya,<sup>20</sup> mahlûkata şefkat ve merhamet göstermeye<sup>21</sup> çok büyük önem vermiştir. İşte bu durumlar elde edildiğinde gerçek anlamda özgüvene kavuşulmuş olacaktır.

#### 9- Hırs ve Hasedin artması

Hırs; şiddetli istek, açgözlülük<sup>22</sup>, bir şeye rağbeti çok artmak, sonu gelmeyen istek, aşırı tutku, öfke, kızgınlık<sup>23</sup>, bir şeye aşırı tutunmak, cimrilik yapmak<sup>24</sup>, azgınlık, tûl-i emel<sup>25</sup>, saldırganlık, tama' mânâlarına gelmektedir. Psikolojik açıdan dahırs; doymak bilmeyen bir açlık, sınırsız bir tatminsizlik durumu olarak ifade edilmektedir<sup>26</sup>. Hırs duygusu olumsuz yönde kullanıldığında insanı, zulme, kibre, hasede, bencillığe ve daha birçok olumsuz davranışlara ve yalnızlığa sevk eder.

Haset; bir kişinin, başkasında bulunan üstün nitelik (nimet ve fazilet)'lerin yok olmasını ve sadece kendisinde olmasını temenni etmesi ya da o üstünlüklerin kendisinde olmamakla birlikte çekemediği kişide de bulunmamasını istemesidir. Böylece hasette esas olan, başkasındaki nimetin yok olmasını veyahut sadece bencil/egoist bir düşünce ile yalnız kendisinde olmasını arzu etmektir.<sup>27</sup> Durum böyle olunca haset eden kişi, kendi içinde huzursuz olduğu gibi sürekli başkalarının elindeki varlıkları kıskanmakta ve onları da rahatsız etmektedir. Aynı zamanda haset eden kişi, başkalarına yardım etmeyi istemez ve sevmez, insanların da yardımlaşmalarını arzu etmez, hatta elinden gelse engellemeye çalışır. İnsanlardan uzak kalmayı tercih eder.

<sup>17</sup> Bk. en-Nur, 24/32.

<sup>18</sup> Bk. en-Nahl, 72.

<sup>19</sup> Geniş bilgi için bk. Dölek, "Hadisler Işığında Akrabalarla İletişim Kurmak ve Sosyal Yardımlaşmada Akrabalık Hakkını Korumak (Sıla- Rahim), C.Ü. İlahiyat Fak. Dergisi, 2010, c.17, S.2, s.33-56.

<sup>20</sup> Konu ile ilgili bk. Dölek, *Hadisler Işığında Sosyal Dayanışma*.

<sup>21</sup> Ahmed b. Hanbel, *Müsned*, 12/17; Beyhakî, *Şuabu'l-İman* 13/357.

<sup>22</sup> Râğib el-İsfahânî, *el-Müfredât fî Garîbi'l-Kur'ân*, (Beyrut: ts.), 113; Şemseddin Sâmî, *Kâmûs-i Türkî*, (Beyrut:1989), 544.

<sup>23</sup> *Türkçe Sözlük*, (Ankara: T.D.K.,1988), 1/ 640-641.

<sup>24</sup> Mesud, Cübrân, *er-Râid*, (Beyrut: ts.), 1/561.

<sup>25</sup> Devellioğlu, Ferit, *Osmanlıca-Türkçe Ansiklopedik Lügat*, (Ankara: 1993), 433.

<sup>26</sup> Hökelekli, Hayati, "Hırs" *İslâm'da İnanç İbadet ve Günlük Yaşayış Ansiklopedisi*, (İstanbul: 1997), II, 257; Dölek, "Hadisler Işığında Hırs Hastalığı ve Korunma Yolları", *Harran Üniversitesi İlahiyat Fak. Dergisi*, c. XI, Sayı, 6, (Şanlıurfa: 2003), 50-76.

<sup>27</sup> Geniş bilgi için bk. Dölek, "Hadisler Işığında Haset Hastalığı ve Psikoterapi", *HRÜ İlahiyat Fak. Dergisi*, S.7, 2002, s.39-82.

## 10- Cehalet

İnsanı yalnızlığa iten sebeplerden biri de kişinin, sosyalleşmenin kıymetini ve değerini tam anlamıyla bilmemesidir. Buradaki cehaletten kastedilen mânâ budur. Yoksa hiç eğitim-öğretim görmemiş okuma yazma bilmeyen demek değildir. Çünkü dünya çapında bazı üzücü olayların sebeplerine bakılınca birçok üniversite mezunu insanın feci akıbetlerinin yalnızlıktan kaynakladığı açıkça görülmektedir.

Böyle bir problemin çözümü için İslâm'da birçok tekliflerin sunulduğu görülmektedir. Mesela, günde beş vakit namazın camilerde birlikte kılınması emri, haftada bir Cuma namazının ve yılda iki defa bayram namazlarının camilerde cemaatle kılınması, zenginlerin zekât ve sadakaları ile fakir fukarayı gözetmeleri, akraba ve dost ziyaretleri, misafir kabul etme ve ikramlarda bulunma, evlerde ilim meclislerinin oluşturulması, dul, yetim ve kimsesizlerin gözetilmesi, gerek fert gerek aile gerekse devlet olarak komşuların dertleriyle dertlenmenin istenmesi ki “*Komşusu aç iken tok yatanın mümin kabul edilmemesi*”<sup>28</sup> buyrulması, hediyeleşmeler, taziye ve tebrikleşmeler, hasta ziyaretleri gibi daha birçok sosyal faaliyetlerin yerine getirilmesinin emredilmiş olması, insanı yalnızlıktan ve bencillikten kurtararak sosyallik kazandırır ve insanı mânen tedavi eder. İşte İslâm'ın bu emirlerini bilmeyenler ya da yaşamayanlar, kendilerini yalnızlığa mahkûm ederler.

## SONUÇ

21. Yüzyıl insanı, daha önce hiçbir çağda, hiçbir insan evladının yaşamadığı korkunç, dehşet verici ve bireysel azap yaşatan problemlerle karşı karşıya kalmaktadır. Yalnızlık problemi, bu elem verici problemlerden biridir. Yalnızlık, sonucu bazen intihara kadar varabilen ve daha çok insanın mânevî boşluk içinde kalmasından kaynaklanan bir problemdir. Yalnızlık, insanlığın temel bazı sorunlarını çözememekten dolayı yaşadığı psikolojik problemlerin en önemlilerinden biridir. Yalnızlık öncelikle psikolojik olarak ortaya çıkmakla birlikte, insana sosyal dışlanma ve mânevî boşluk hissi ile sonuçlanan etkiler yaşatmaktadır. Bu araştırmada, insanın içine düştüğü “yalnızlık problemi”nin; onu mânevî bir boşluğa, ruhsal bunalımlara sürüklediği sonuçlarına ulaşılmıştır. Yalnızlık probleminden kaynaklanan mânevî boşluk hissi, yalnızlığın insanda ortaya çıkardığı psikolojik, sosyal ve duygusal bir hastalıktır. Bu araştırma ile yalnızlık probleminin yol açtığı mânevî boşluk ve ıstırapları yenmenin en önemli çözüm yollarının İslâm'ın gösterdiği, inanç ve uygulama esaslarıyla giderilebileceği hususunda aydınlatıcı çözümlere ulaşılmıştır. Bencillik duygusunun engellenmesi, kibir/büyükleme hırsından arınma, makâm/mevki ve mâl edinme duygularına güvenmeme, sosyal bir bütün içinde yaşama, bencillik duygusunu engelleme, hırs ve hasetten uzak durma, özgüven duygusuna mahkûm olmama, cimrilik etmeme, sosyal medya ve diğer iletişim araçlarına teslim olmama, dünyevileşme hırsına yenilmeme, İslâmî hayatın yalnızlık probleminin çözümüne ürettiği en etkili çözümlerdendir.

Bunun için insanı yalnızlığa iten sebepler ve bu sebeplere götüren durumlar terk edilerek çözümlerde belirtilen hususlara dikkat edildiğinde ve hayata geçirildiğinde, insan yalnızlıktan kurtulacak ve hayatta mutlu olacaktır. Bütün insanlığı ilgilendiren bu yalnızlık problemi de ancak ve ancak insanların, aileden başlayarak hayat boyu iyi ve sağlam bir eğitimle bilinçlendirilmesi suretiyle çözülebilir.

Unutulmamalıdır ki, mutsuzluk için gösterilen gayretlerden çok daha fazlası mutluluk için gösterilmelidir. Aksi hâlde hayatta yaşamamanın bir mânâsı kalmayacaktır.

<sup>28</sup> Ahmed b. Ali Ebû Ya'lâ, *Müsned*, (Beyrut: Dâru'l-Me'mûn, ts.), 5/92.

## KAYNAKÇA

- Ahmed b. Hanbel. *el-Müsned*.thk. Şuayb el-Arnaût. 50 cilt. Beyrut: Müessesetü'r-Risale, 1995.
- Baron, C. R.,Foxall, M. J., Von Dollen K., Jones, P. A. & Shull, K. A. (1994). "Marital Status, Social Support And Loneliness in Visually Impaired People". *Journal of Advanced Nursing*, 19, pp. 272-280.
- Beyhakî, Ahmed b. el-Hüseyn. *Şuabu'l-İman*. 14 Cilt. Riyad: Mektebetü'r-Reşîd, 2003.
- Brown, G.et al. (1989). *Social Origins of Depression*. Cambridge: Cambridge University Press.
- Buhârî, Muhammed b. İsmail. *el-Câmiu'l-Müsnedu's-Sahîhu'l-Muhtasar min Umûri Rasûlillah (s.a.v.) ve Sünenihî ve Eyyâmihî*, 8 Cilt. İstanbul: Çağrı Yayınları, 1992.
- Burhan İşliyen, *Dünyevîleşme*, Ankara: TDV Yayınları, 2018.
- Devellioğlu, Ferit, *Osmanlıca-Türkçe Ansiklopedik Lügat*, Ankara: 1997.
- Dölek, Adem. "Hadisler Işığında Akrabalarla İletişim Kurmak ve Sosyal Yardımlaşmada Akrabalık Hakkını Korumak (Sıla- Rahim)", *C.Ü. İlahiyat Fak. Dergisi*, 2010, c.17, S.2, s.33-56.
- Dölek, A. "Hadisler Işığında Hırs Hastalığı ve Korunma Yolları", *Harran Üniversitesi İlahiyat Fak. Dergisi*", c.XI, Sayı, 6, Şanlıurfa: 2003, s.50-76.
- Dölek, A. "Sünnet Işığında Cimrilik Hastalığı ve Tedâvî Yolları", *Dinbilimleri Akademik Araştırma Dergisi*, IV, 2004, Sayı, 2, s. 95-128, Dinbilimleri.com
- Dölek, A. *Hadisler Işığında Sosyal Dayanışma*, İstanbul, Rağbet Yayınları, 2016.
- Dölek, A. "Hadisler Işığında Haset Hastalığı ve Psikoterapi", *HRÜ İlahiyat Fak. Dergisi*, S.7, 2002, s.39-82.
- Ebû Ya'lâ, Ahmed b. Ali. *Müsned*. Thk: Hüseyin Selim Esed.15 Cilt. Beyrut: Dâru'l-me'munli't-Türâs, 1986.
- Gazâlî,
- Hökelekli, Hayati. "Hırs" *İslâm'da İnanç İbadet ve Günlük Yaşayış Ansiklopedisi*, (İstanbul: 1997).
- Jackson, J. And Cochran, S. D., "Loneliness and Psychological Distress". *The Journal of Psychology*,125, 3, 1991, pp. 257-262.
- Kur'ân-ı Kerim*.
- Kuzâî, Muhammed b. Selâm.*Müsnedü's-Şihâb*. Thk: Hamdi Abdulmecid es-selefî. 2 Cilt. Beyrut: Müessesetü'r-Risale, 1985.
- Mâverdî, *Edebu'd-Dünyâve'd-Dîn*,
- Mesud, Cübrân, *er-Râid*, (Beyrut: ts).
- Özbaş, M. (2013). Eğitim Sosyolojisi (1. Baskı). Editörler: M. Türkkahraman & İ. Keskin. Zorunlu Eğitim Kurumu Olarak Okul (ss. 137-163). İstanbul: Lisans Yayıncılık.
- Özbaş, M. (2018). Sosyo-Kültürel Bir Sistem Olarak Okul (1. Baskı). (Editörler: Prof. Dr. Nazmi AVCI & Prof. Dr. Yaşar ERJEM). Eğitim Sosyolojisi (ss. 245-272). ISBN: 978-605-9498-26-5 Toplam Sayfası: 328 www.lisansyayincilik.com.tr İstanbul: Lisans Yayıncılık.
- Râğîb el-İsfehânî, *el-Müfredât fî Ğarîbi'l-Kur'ân*, (Beyrut: ts.).
- Şemseddin Sâmi, *Kâmûs-i Türkî*, Beyrut:1989.
- Takan, R. (2020). *Yalnızlık ve Çocukluk Ça ı Travmalarının Ergenlerde Sosyal Medya Ba ımlılı ı Üzerinde İlişkisinin İncelenmesi*. Yayımlanmamış Yüksek Lisans Tezi. Yakın Doğu Üniversitesi Sosyal Bilimler Enstitüsü Klinik Psikoloji Anabilim Dalı. Lefkoşa: Kuzey Kıbrıs Türk Cumhuriyeti.
- Türkçe S zlük*, Ankara: TDK.1988.
- Türkçe S zlük*, T. T. Kurumu Yay., Ankara, 1988.

-Yaşar, M. R. (2007). “Yalnızlık-loneliness”. *Fırat Üniversitesi Sosyal Bilimler Dergisi-Fırat University Journal of Social Science*, 17, 1, ss. 237-260.

**DEİZMİN ÇIKMAZLARI****DAILS OF DEISM****Dr. Mehmet Cüneyt GÖKÇE***Harran Üniversitesi*<https://orcid.org/0000-0002-8382-3787>**Özet**

Deizm, felsefî bir terimdir. Aristo'nun Allah anlayışından esinlenen ve XVI. Yüzyıl Avrupa'sında ortaya çıkmış bir inanç biçimidir. Bildiğiniz gibi Aristo, Allah'ı yaratan olarak kabul ediyor, yöneten olarak kabul etmiyor. "Allah âlemi ve içindekileri yarattı bir kenara çekildi" diyor. Bu zihniyete göre Allah'ın insanlarla bir ilişkisi yoktur. "Akıl olduktan sonra, ne peygambere ve ne de vahye ihtiyaç vardır. İnsan yaşam ilkelerini kendi aklıyla belirler. Dua ve ibadetlere de ihtiyaç yoktur." İşte bu görüşleri benimseyen kimselere de "deist" denilir. Bildiğiniz gibi Kur'an'a göre Allah hem yaratan ve hem de yönetendir. Yöneten olmasaydı Peygamber ve Kitap gönderir miydi?

**Anahtar Kelimeler:** Deizm, Deist, Nebi**Abstract**

Deism is a philosophical term. Inspired by Aristotle's understanding of God and XVI. It is a form of belief that emerged in 19th century Europe. As you know, Aristotle accepts Allah as the creator, not as the ruler. "God created the world and everything in it and stepped aside," he says. According to this mentality, God has no relationship with humans. "After there is reason, neither prophet nor revelation is needed. Man determines the principles of life with his own mind. There is no need for prayers and worship." Those who adopt these views are called "deists". As you know, according to the Qur'an, Allah is both the creator and the ruler. If there was no ruler, would he have sent the Prophet and the Book?

**Keywords:** Deism, Deist, Prophet**GİRİŞ:**

Deizm, felsefî bir terimdir. Aristo'nun Allah anlayışından esinlenen ve XVI. Yüzyıl Avrupa'sında ortaya çıkmış bir inanma şeklidir. Bilindiği gibi Aristo, yüce Allah'ı yaratan bir varlık olarak kabul ediyor ancak yöneten olarak kabul etmiyor. Yüce Allah'ın âlemi ve içindekileri yarattığını ardından bir kenara çekildiğini iddia ediyor. Bu anlayışa göre yüce Allah'ın insanlarla bir ilişkisi yoktur. Akıl olduktan sonra, peygambere ve vahye ihtiyaç olmadığını ileri sürerler. Bu zihniye göre insan yaşam ilkelerini kendi aklıyla belirler. Dolayısıyla dua ve ibadetlere de ihtiyaç yoktur.

İşte bu görüşleri benimseyen kimselere de "deist" denilir.

Kur'an'a göre Allah hem yaratan ve hem de yönetendir. Yöneten olmasaydı Peygamber ve Kitap gönderilmesi söz konusu olmazdı.

**DEİZME ORTAYA ÇIKARAN AMİLLER:**

Tarihi seyir içerisinde tahrif edilmiş Hristiyanlığın inanç ve ibadet boyutları değişime uğramıştır. Bu değişimlerin deizmin doğmasında etkili olduğunu söyleyebiliriz. Başka bir deyimle, deizm; Hz. İsa'nın ilahlaştırılması, Teslis inancı, aslî günah ve keffaret öğretisi ve Kilise'nin yanılmazlığı gibi anlayışlara karşı bir tepki olarak doğmuştur. Yukarıda ifade edildiği gibi deistler, “Allah’ın varlığına ve birliğine inandıkları halde, dinlerin yönetsel emir ve yasaklarına inanmamaktadırlar. Bu konuda akla, mutlak bir yaptırım gücü yüklemektedirler. Doğal din zihniyetinden hareketle dinî ve ahlakî değerlerin menşei akıldır, görüşünü savunurlar. Tabiatı, makineye, Allah’ı da makiniste benzetirler. Onlara göre Allah, zemberekli bir saat gibi tabiatı kurmuştur, bir daha bozulmaz. Allah, yeryüzüne karışmaz. Çekim yasasının kabulüyle birlikte ilahi müdahalenin etkin gücü de zayıflatılmıştır.” Bu görüşleriyle deistler, ateizme doğru yaklaşmışlardır. Onların bu inançları, hevânın ilahlaştırılmasından başka bir şey değildir.

### **İSLAMİYET VE DEİZM:**

Deistleri, ateistlerden ayıran, “onların biz Allah’ı sadece yaratan olarak kabul ediyoruz” görüşleridir. Vahye muhatap kılındıktan sonra deist olduğunu söyleyenler inanç bakımından Müslüman kalır mı? Bu sorunun cevabı gayet açıktır. İslamiyet insanları kazanma yolunu tercih eder. Hiçbir ferden bilerek kaybedilmesi lüksü düşünülemez. Bu yüzden bize düşen görev deistlere tekfir damgasını vurup uzaklaştırmak değil, aksine onları İslam’ın kıyısından merkeze doğru çekmenin yollarını aramaktır. Hatta kendisini Müslüman deist olarak tanımlayan insanların, İslam’ı bir bütün olarak benimsemeyip deizmi tercih etmelerinin arkasında yatan saikin Dâiş türü terör örgütlerinin cihad anlayışları olduğu söylenebilir. Makul hiçbir insan kendisini şiddet ile aynı safta görmek istemez.

Bu durum İslam’a yapılacak en büyük haksızlıklardan bir tanesidir. İslam ve Müslümanlar için vahim bir durumdur. Bu tip hareketler yapay oluşumlardır. Kullanılmak için üretilmiş, görevlerini tamamlayınca kaybolup gideceklerdir. Bunlar İslam’ın cihad anlayışını şiddet, merhamet anlayışını zulüm şeklinde sunuyorlar. İslam’ı, İslam’ın değerler sistemini terör, Müslümanları ise terörist olarak gösterme çabalarına hizmet ediyorlar. Gerçekten Dâiş gibi hareketler, emperyalizmin İslam topraklarını bölme planlarının ön açıcı işlevini görmektedir. Ancak Müslüman gençlerin çoğu bu ve benzeri sinsî planlardan habersizdir. Bu sebeple başta İslam’ın cihad anlayışı olmak üzere doğru İslamiyeti net bir şekilde ortaya koymak gerekmektedir.

### **DEİZMİN YANILGILARI:**

#### **1-Allah’ın aşkınlığı ve aleme müdahalesi:**

Deizme göre, “Allah âlemin işleyişine müdahale etmez, O aşkındır.” Kuşkusuz búaşkınlık Hristiyanların, “Allah Hz. İsa’da bedenleşip yeryüzüne inmiştir” öğretilisine karşı geliştirilmiş bir anlayıştır. Amaç, Allah’ın aşkınlığını korumak ve insanbiçimci Allah tasavvurundan uzak durmaktır. İslam’da da Allah aşkın, müteâl bir varlıktır. İslam’ın bu konuda deistlerden ayrıldığı nokta, “Allah’ın zatıyla aşkın, sıfatlarıyla içkin olmasıdır.” Evet, biz O’nun İlâhi Zâtını bilemeyiz, ama O’nun isim ve sıfatları bize Kur’an’da bildirilmiştir. O, her an bir işte, yaratmaya ve yönetmeye devam etmektedir.

#### **2-Aklın değeri:**

Deistlerin aklı yüceltmeleri son derece hatalıdır. Her ne kadar onlar, Hristiyanlığın, mitoloji, sır, gizem, hurafe ve azizler kültüyle örölü inanç yapısına karşı çıkmak için katı akılcılığı tercih etmişlerse de bu doğru değildir. Genellemeci bir bakış açısıyla Hristiyanlığın vahiy anlayışına karşı çıkararak katı akılcılığı seçmişler ve akla kaldıramayacağı bir yük yüklemişlerdir.



Elbette İslam da akla büyük değer verir. Kur'an'da geçen birçok âyette “aklını kullanmayanlar” kınanır. Dini kurallar, akıl sahipleri için vardır. Fakat sonuçta akıl da yaratılmıştır. Her yaratılmış, hata ile maluldür.

Akıl muhtaç olduğumuz her şeyin bilgisini veremez. Duyular gibi onun da bir sınırı vardır. İnsan akli; arzu, dürtü, alışkanlık, çevre ve toplum gibi dâhili ve harici faktörlerin etkisi altındadır. Aklın salt yaptırım gücü yoktur. Bu sebeple akıl, peygamberlerin getirdiği vahyin kılavuzluğuna ihtiyaç duyar. Dolayısıyla dini yükümlülüğün temeli akıl değil, nakildir. Dini inancın malzemeleri vahiyden çıkarılır. Akıl, dinden önce, adaletin iyi, zulmün kötü, doğruluğun iyi ve yalanın kötü, ilmin iyi, cehaletin kötü olduğunu kendi gücüyle algılayabilir. Ancak çoğu hükümleri bilemez. Akıl, sınırları belirlenmiş ve yaratılmış bir varlık olduğu için belirlenmiş olan sınırı aşamaz. Bu sebeple, dinde tafsilat, peygambere aittir. Örneğin, akıl, ibadetlerin keyfiyetini, miktarını bilemez ve âhiret ahvalini açıklamak hususunda yeterli değildir. Ayrıca çeşitli hâdiseler için şer'î hükümler tesis edemez. Bütün bunlar için nübüvvetin rehberliğine ihtiyaç duyar. Dinde emir, nehiy, va'd, va'id, mubah, haram ve duyuy-ötesi alanla ilgili konular, ancak vahiyyle bilinir. Akıl, düşünce açıklamak için bir âlet ve olağan bir sebeptir, tek başına farz-vacip kılma anlamında hüküm ortaya koyan değildir. Özetle deistlerin, insan hayatını düzenleyen vahye gerek yoktur, son derece gelişmiş olan insan akli vahyin görevlerini yerine getirir demeleri, kendilerini kandırmaktan öteye geçemez.

### 3-Deizm ve determinizm:

Deistler, âlemin işleyişinin tek yolunu katı determinizm olarak görürler. Bu bakış açısıyla birlikte mu'cizenin varlığını inkâr ederler. Onlara göre Yüce Allah, bir eliyle koyduğu yasaları diğer eliyle boşa çıkarmaz. Bu sebeple, mu'cize ve olağanüstü olaylar yoktur, derler. Bilindiği gibi bugün kuantum fiziği, bilimde izafiyet teorisi ortaya çıkmıştır. Bilimde bile mutlak doğru yoktur, güncel doğru vardır. Bilim bugün doğru dediğini, yarın yalanlayabilir. Her zaman benzer sebepler benzer neticeleri doğurmaz. Kaldı ki yeni fizikte entropi yasası ve kuantum fiziği, mu'cizelerin varlığını sonlandırmaya ya da inkâr etmeye imkan tanımaz. Dolayısıyla, “doğa yasaları ihlal edilemez” fikriyle mu'cizeye karşı çıkmak anlamsızdır. İslam'a göre tabiat yasalarını yaratan Yüce Allah'ın bu yasalar üzerinde her zaman tasarruf yetkisinde bulunma hakkı vardır. Çünkü O, dilediğini yapabilen mutlak bir irade ve kudrete sahiptir.

### SONUÇ:

Deizm tutarsızlıklar üzerine inşa edilmiş bir fikri yapıdır. İnsanın Allah'a rağmen kişisel arzu ve isteklerine göre şekillendirilmiş felsefi bir inanç biçimidir. Bunun daha ilerisi Yüce Allah'a din öğretmeye kalkmaktır. Meselâ, Allah'ın kâdir-i mutlak, her şeye gücü yeten, irade sahibi ve her şeyi mükemmel bir şekilde yaratan olduğuna inanan bir kimse nasıl olur da Allah-âlem ilişkisi, Allah-insan ilişkisi gibi alanlarda Yüce Allah'ın iradesini sınırlandırma cihetine gidebilir? Elbette bizi yaratan yüce Allah, bizim kuvvetli ve zayıf yönlerimizi bizden daha iyi bilir. Bu sebeple bize İlâhi katalog ya da yaşam rehberi diyebileceğimiz vahyi göndermiştir. İnsanı başıboş ne halin varsa gör diye bu âlemde kendi başına bırakmamıştır. İnsan, diğer varlıklardan akıl, beyan ve fehmetme melekeleriyle ayrılır. Bununla beraber insan her türlü kötülüğü emreden nefisle birlikte yaratılmıştır. İnsan, vahiy bilgisi ve terbiyesi olmadan nefsin türevlerine, bencil hallerine karşı nasıl duracaktır? Vahye ihtiyaç yoksa o takdirde Yüce Allah'ın bizden istediklerini nereden öğreneceğiz? Aklın böyle bir misyonu yoktur. Hatta aklın bir yaptırım gücü de yoktur. Vahiy inkâr, dolaylı olarak peygamberin gerekliliğini de inkâr demektir. Peygamberler, bizim için rahmet elçileri olup, dini yaşama konusunda “güzel model” dirler. Yine eğer vahiy ve vahyin ete-kemiğe büründüğü nebevî sünnet yoksa ibadetleri salt erdemli bir yaşam ve ahlaki davranışlarla sınırlandırmak ne derece doğrudur? Akıl, evrensel ahlak yasaları ortaya koyabilir, ama ibadet düzenlemesi yapamaz. İbadetleri ancak Şârii Teâla olan Yüce Allah düzenler. Dolayısıyla bu konularda da deizm tutarsızlıklarla doludur.

**KAYNAKÇA**

- Altıntaş, Ramazan, Kur'an'da Hidâyet ve Dalâlet, İstanbul, 1995.
- Altıntaş, Ramazan, Din ve Sekülerleşme, İstanbul: Pınar Yayınları, 2005.
- Ateş, Süleyman, İnsan ve İnsanüstü, İstanbul: Yeni Ufuklar Neşriyat, 1995.
- Bağdâdî, Abdülkâhir, Usûlü'd-din, İstanbul, 1928.
- Cürcânî, Seyyid Şerif, et-Ta'rîfât, Kahire, 1987.
- Dihlevî, Şah Veliyullah, Huccetullahi'l-Bâliğa/İslam Düşünce Rehberi, çev. M. Erdoğan, İstanbul, 1990.
- Dini Kavramlar Sözlüğü, Ankara: DİB Yayınları, 2010.
- Elmalılı, M. Hamdi Yazır, Hak Dini Kur'an Dili, İstanbul, 1979.
- Gazzâlî, Ebû Hâmid Muhammed, el-İktisâd fi'l-İ'tikâd, Beyrut, 1983.
- İsfehâni, Râgıb, el-Müfredât fi Garibi'l-Kur'an, İstanbul, 1986.
- İzmirli, İsmail Hakkı, Yeni İlm-i Kelam, İstanbul, 1920.
- Kılavuz, Ahmed Saim, İman-Küfür Sınırı, İstanbul, 1990.
- Sorularla İslam, editör: Ramazan Altıntaş, Ankara: DİB Yayınları, 2015.
- Temel Yeşilyurt, Çağdaş İnanç Problemleri, Ankara: DİB Yayınları, 2014.
- Topaloğlu, Bekir, Allah İnancı, İstanbul, 2006.

## II. MEŞRUTİYET DÖNEMİNDE EĞİTİM ALANINDAKİ BAŞLICA DÜZENLEMELER VE YAYINLAR (1908-1918)

### INITIAL REGULATIONS AND PUBLICATIONS IN THE FIELD OF EDUCATION DURING II. CONSTITUTIONAL PERIOD (1908-1918)

**Hayati DOKDEMİR<sup>1\*</sup>, Mehmet ÖZBAŞ<sup>2</sup>**

<sup>1\*</sup>Ege Üniversitesi, Sosyal Bilimler Enstitüsü, Türk Tarihi Anabilim Dalı, Doktora Öğrencisi,  
İzmir, Türkiye.

<sup>2</sup>Erzincan Binali Yıldırım Üniversitesi, Eğitim Fakültesi, Eğitim Bilimleri Bölümü Öğretim Üyesi,  
Erzincan, Türkiye.

ORCID: 0000-0003-0735-4859

ORCID: 0000-0002-7830-4763

#### Özet

Bu araştırmanın amacı, II. Meşrutiyet Dönemi'nin Türk eğitim sistemine etkilerini ortaya koymaktır. Araştırma sürecinde, alanyazına dayalı olarak, II. Meşrutiyet Dönemi'nde, Türk eğitim sisteminde meydana gelen başlıca yasal ve yönetsel düzenlemelerin neler olduğu belirlenmeye çalışılmıştır. Ayrıca çalışmada, II. Meşrutiyet Dönemi'nde, eğitim bağlamında yapılan başlıca yayınların neler olduğu saptanmaya çalışılmıştır. Araştırma sürecinde, öncelikle II. Meşrutiyet Dönemi'ne ilişkin geniş kapsamlı bir alanyazın çalışması yapılmıştır. II. Meşrutiyet Dönemi eğitim hayatının özelliklerini ve bu konuda sürdürülen reform çabalarının karakterini anlayabilmek açısından, dönemin siyasi gelişmeleri ile tarihi arka planının kısaca hatırlanmasına çalışılmıştır. II. Meşrutiyet Dönemi, Padişah II. Abdülhamid Dönemi'ni kapsamaktadır. Sultan II. Abdülhamid'in yaklaşık otuz yıl süren mutlakiyet rejimi, daha baştan itibaren kendini şiddetli eleştirilerin hedefi haline getirmiştir. II. Meşrutiyet Dönemi, İttihat ve Terakki Cemiyeti (Partisi)'nin liderliğinde, gelişen bir dizi olay sonucunda, 23 Temmuz 1908 tarihinde Anayasanın tekrar yürürlüğe konulması ile başlamıştır. II. Meşrutiyet Dönemi'nde, 1869 tarihli *Maarif-i Umûmiye Nizamnâmesi*'nin oluşturduğu eğitim sisteminin yeniden reforma tâbi tutulması sağlanmıştır. 1913 Tarihinde, *Tedrisat-ı İptidaiye Kânun-ı Muvakkatı* kabul edilmiştir. Bu kanunla iptidâi ve rüşdî olarak ikiye ayrılmış olan ilköğretim okulları "*Mekâtib-i İptidâiye-i Umûmiye*" adı altında birleştirilmiş ve altı yıllık iptidâi mektepler açılmaya başlanmıştır. 1915'te *Ana Mektepleri Nizamnâmesi* yayımlandıktan sonra büyük kentlerde anaokullarının sayısı artmaya başlamıştır. Dârülfünûn ve Dârümuallimîn mezunları *Encümen-i Muallimîn* adında bir örgüt kurmuşlardır. İstanbul'da İdâdî, Rüşdî ve İptidâî okulların öğretmenleri tarafından *Muhafaza-i Hukuk-ı Muallimîn Cemiyeti* adında ikinci bir meslek örgütü kurulmuştur. Bu iki meslek örgütü, 1908 yılı sonlarında *Cemiyet-i Muallimîn* adı altında birleşmişlerdir. Özellikle İstanbul merkezli olmak üzere eğitimi konu alan birçok dergi yayın hayatına başlamıştır. II. Meşrutiyet Dönemi'nde orta eğitim alanında yeni bir uygulama başlatılmış, ilki İstanbul'da olmak üzere Vilâyet merkezlerindeki 10 idâdî, sultani'ye dönüştürülerek, bu sultanilere rüşdiye üzerine üçer yıllık iki devresi olan, ikinci devresi fen ve edebiyat kollarına ayrılan bir yapı kazandırılmıştır. II. Meşrutiyet dönemi, çeşitli alanlarda iyi eğitilmiş memur ihtiyacını karşılamaya dönük okulların açıldığı ve geliştirildiği bir dönem olmuştur. Medrese eğitiminin ıslâhı konusunda ilk ciddi çabalar II. Meşrutiyet döneminde gündeme gelmiştir. Meşrutiyet Dönemi'nin nisbî özgürlük havasından yararlanan Azınlıklar da eğitim örgütlerine yönelik her türlü denetim girişimine karşı çıkarak, bu yoldaki çabaları başarısızlığa uğratmışlardır.

**Anahtar Sözcükler:** II. Meşrutiyet, Türk Eğitim Sistemi, Osmanlı İmparatorluğu'nun Son Dönemi.

## Abstract

The purpose of this research is to reveal the effects of the II. Constitutional Period on Turkish education system. In the research process, It was tried to determine what main legal and administrative regulations occurred in the Turkish education system during the II. Constitutional Period based on the literature. In addition, main publications produced in the context of education in the II. Constitutional Period were tried to be determined in the study. In the research process, first of all, a comprehensive literature study on the II. Constitutional Period was conducted. In order to understand the characteristics of the education life of the II. Constitutional Period and the character of the reform efforts carried out, it was tried to briefly recall the political developments and historical background of the period. II. The Constitutional Period covers the period of the Sultan Abdulhamid II. The absolutist regime of Sultan Abdulhamid II, which lasted for nearly thirty years, made itself the target of severe criticism from the very beginning. The II. Constitutional Period started with the re-enactment of the Constitution on July 23, 1908, as a result of a series of events under the leadership of the Committee of Union and Progress (Political Party). In the II. Constitutional Period, the education system, which was formed by *General Regulations for National Education* of 1869, was reformed again. In 1913, *Tedrisat-ı İptidaiye Kânun-u Muvakkatı* was accepted. With this law, primary schools, which were divided into two as primary and secondary schools, were united under the name of "*Mekâtib-i İptidâiye-i Umûmiye*" and six-year primary schools began to be opened. After *the Regulation of Kindergartens* was published in 1915, the number of kindergartens started to increase in big cities. Dârülfünûn and Dârülmuaallimîn graduates established an organization called *Encümen-i Muallimîn*. A second professional organization named *Muhafaza-i Hukuk-ı Muallimîn Organization* was established by the teachers of İdâdî, Rüşdî and İptidâî schools in Istanbul. These two professional organizations united under the name of *Cemiyet-i Muallimîn* at the end of 1908. Many magazines on education, especially Istanbul-based, started their publication life. During the II. Second Constitutional Era, a new practice was initiated in the field of secondary education, and 10 high schools in the provincial centers, the first of which were in Istanbul, were converted into sultani, and these sultanis were given a structure that had two three-year terms over the junior high school and the second period was devoted to science and literature. The II. The Constitutional period was a period in which schools were opened and developed to meet needs for well-trained civil servants in various fields. The first serious efforts to improve the madrasa education came to the fore in the II. Constitutional Period. Minorities, who benefited from the relative freedom atmosphere of the II. Constitutional Era, opposed all kinds of control attempts against educational organizations and failed their efforts in this direction.

**Keywords:** II. Constitutional Period, Turkish Education System, Last Period of Ottoman Empire.

## GİRİŞ

II. Meşrutiyet Dönemi eğitim hayatının özelliklerini ve bu konuda sürdürülen reform çabalarının karakterini anlayabilmek açısından, dönemin siyasi gelişmelerini ve tarihi arka planını kısaca hatırlamak yararlı olacaktır. Sultan II. Abdülhamid'in yaklaşık otuz yıl süren mutlakiyet rejimi, daha baştan itibaren kendini şiddetli eleştirilerin hedefi haline getirmiştir. Osmanlı Devleti'nin iç ve dış politikada karşılaştığı çeşitli zorluklar ve Batılı devletlerin izlediği politikaya yönelik alınan tedbirler, ülke içerisinde Abdülhamid rejimine karşı muhalefet hareketlerini güçlendirmişti. Ülkenin birlik ve devamını sağlama amacıyla alınan polisiye tedbirler, basın-yayına yönelik sansür uygulamaları, çeşitli azınlık gruplarına ve muhalif çevrelerin faaliyetlerine karşı alınan önlemler, yönetime karşı oluşan endişe ve tepkilerin giderek daha örgütlü hale gelmesine yol açmıştır.

Abdülhamid rejimine karşı oluşan muhalefet cephesinin; Genç Osmanlılar-Jön Türkler, Azınlıklara mensup gruplar, Liberaller, Masonlar olmak üzere birçok farklı yapıdan oluştuğu görülmektedir. Ayrıca Osmanlı ülkesinde ekonomik bağlantıları olan yabancı sermaye grupları, Tanzimat

döneminin ürünü olan modern eğitim örgütlerinden yetişen aydın zümreler gibi oldukça geniş sosyal kesimleri kapsamı, rejimin kaderini ve Meşrutiyet hareketinin başarısını etkileyen en önemli unsur olmuştur. Uzun yıllardan beri uygulanan reform hareketlerinin birleştirici özelliği bu gelişmelerle somut hale gelmiş, anayasanın rafa kaldırılması ve parlamentonun kapatılmasına rağmen halkın, Osmanlı birlikteliği bilinci ile yapılan reformların sağladığı genel yükseliş hamlelerinden yararlandığı ortaya çıkmıştır.

### Amaç

“II. Meşrutiyet Döneminde Eğitim Alanındaki Başlıca Düzenlemeler ve Yayınlar (1908-1918)” araştırmasının temel amacı: Osmanlı İmparatorluğu’nun son dönemini oluşturan II. Meşrutiyet Dönemi’nde, Türk eğitim sistemini etkileyen başlıca yasal, yönetsel ve toplumsal düzenlemelerin neler olduğu konusunda, alanyazın taramasına dayalı saptamaların yapılmasıdır. Bu çalışmayı oluşturan araştırma sürecinde, II. Meşrutiyet Dönemi’nde, Türk Eğitim sistemini etkileyen, eğitim bağlamında yayın hayatına başlayan yayınlar üzerinde durulması amaçlanmıştır. Türk eğitim sisteminin çok önemli dönüm noktalarından birini oluşturan II. Meşrutiyet Dönemi’nin kuram ve uygulama bütünlüğünde geniş kapsamlı araştırmalara konu edinilmesi; eğitim sisteminin bağlı olduğu değişkenler açısından incelenmesi bağlamında önemi çok büyüktür. Türk toplumunun toplumsal değişme, gelişme ve kalkınmasına önemli katkıları olan II. Meşrutiyet’in eğitim tarihi açısından kültürel temellerinin araştırılması ve gelecek nesillere öğretilmesi; bu doğrultuda, demokratik yaşam bilinci kazandırılması oldukça önemli bir etkiye sahiptir.

### YÖNTEM

“II. Meşrutiyet Döneminde Eğitim Alanındaki Başlıca Düzenlemeler ve Yayınlar (1908-1918)” araştırması, geniş kapsamlı bir alanyazın taramasına dayalı “kuramsal bir betimleme” çalışmasıdır. Bu araştırma bağlamında, Osmanlı İmparatorluğu’nun asırlardır süregelen egemenlik döneminin en son aşamasını meydana getiren II. Meşrutiyet Dönemi, başta tarihi özellikleri olmak üzere Türk eğitim sistemine etki eden reform ve toplumsal dönüşüm hareketleriyle birlikte ayrıntılı bir şekilde ele alınmaya çalışılmıştır. Araştırma bağlamında, eğitim çalışanlarının örgütlenmesi için harcanan çabalar ve uygulama faaliyetleri ele alınmış; öğretmenlerin mesleki olarak örgütlenmelerinin önemi üzerinde durulmuştur.

Araştırma uygulamasının “betimsel bir tarama” modeli olduğu kabul edilerek, II. Meşrutiyet Dönemi, objektif bir yöntemle ve tarafsız bir anlayışla tasvir edilmeye çabalanmıştır. II. Meşrutiyet Dönemi’nin kültürel birikimini yansıtan eğitim yayınlarının neler olduğu konusunda da gerekli kaynak taramaları yapılmıştır. Eğitim yayınları ya da dergilerin eğitim sistemine olan etkileri üzerinde durulmuştur.

### II. MEŞRUTİYET DÖNEMİ

Osmanlı İmparatorluğu’nun son yönetim aşamasını oluşturan II. Meşrutiyet Dönemi’nde, birçok siyasi, askeri ve toplumsal olay, olgu meydana gelmiştir. Anayasal dönem boyunca birbiriyle yakın temas içinde bulunan muhalefet cephesi, Jön Türk Hareketinin siyasi yapılanması olarak ortaya çıkan İttihat ve Terakki Cemiyeti (Partisi)’nin liderliğinde, gelişen bir dizi olay sonucunda, 23 Temmuz 1908 tarihinde Anayasanın tekrar yürürlüğe konulmasını sağlamıştır. İstanbul’da 13 Nisan 1909 tarihinde meydana gelen Meşrutiyet karşıtı ‘‘31 Mart’’ olayı, Hareket Ordusu tarafından bastırılmış ve Sultan II. Abdülhamid tahttan indirilerek yerine kardeşi Sultan Mehmet Reşat (1909-1918) getirilmiştir.



II. Meşrutiyet Dönemi'nin diğer önemli olayları arasında; Trablusgarp Savaşı (1911), Balkan Savaşları (1912-1913 ), I. Dünya Savaşı (1914-1918) ve ardından gelen Mütareke Dönemi, süregiden siyasi çekişmeler ve öğrenci olayları sayılabilir. II. Meşrutiyet Dönemi ile başlayan, mutlakiyet dönemini izleyen aşırı hürriyetçi hava, gerek eğitim alanında gerekse siyasi alanda ortaya çıkan reform hareketlerine damgasını vurmuştur. Eğitim konusu üzerinde önemle durulmuş, bu çerçevede yeni eğitim akımları ve toplumu yeniden kalkındıracak öğretmenler yetiştirilmesi, başlıca ilgi alanlarını oluşturmuştur.<sup>1</sup>

Meşrutiyet'in ilanı ve Anayasal sisteme geçişin yaydığı hürriyetçi ortamda, basın-yayın hayatının özgürlüğe kavuşması, fikir hareketlerinin canlanması, aydın zümreleri toplumsal konularla daha fazla ilgilenmeye, düşüncelerini cesurca savunmaya yöneltmiştir. Eğitimin yeniden yapılandırılması sorunları da tartışılan konular arasında önemli yer tutmaktaydı.

1869 Tarihli *Maarif-i Umûmiye Nizamnâmesi*'nin oluşturduğu eğitim sisteminin yeniden reforma tâbi tutulması tartışmaları, fikir ayrılıklarına yol açmış, eğitim bürokrasisi topyekûn düzenleme yapmak veya eğitim örgütlerinin ayrı ayrı ele alınarak düzenlenmesi konusunda bölünmüştü. Ayrışma sadece bununla sınırlı kalmamış, reform çalışmalarına ilköğretim aşamasından mı yoksa yükseköğrenimden mi başlanması gerektiği, yoğun tartışmalara yol açmıştı. Eğitimin merkezileştirilmesi veya adem-i merkezîyetçi yapının muhafaza edilmesi; yani değişik kurumlar elinde farklılaştırılması konusu da ayrı bir sorun oluşturmaktaydı. Bununla bağlantılı bir başka tartışma konusu ise mahallî dillerde eğitime izin verilip verilmeyeceği etrafında yoğunlaşmıştı. Nihayet, kadın eğitiminin tüm aşamalarıyla yeniden gözden geçirilerek düzenlenmesi konusu da eğitim reformu çabalarının bir diğer önemli unsurunu oluşturmaktaydı.

Meşrutiyet döneminde eğitimin yeniden düzenlenmesiyle ilgili bu strateji sorunları, üstesinden kolayca gelinecek konular değildi. İttihatçıların ünlü Maarif Nâzırı Emrullah Efendi,<sup>2</sup> eğitimde topyekûn düzenlemeyi amaçlayan yeni bir Maarif-i Umûmiye kanun tasarısı hazırladı. Fakat pratikte ancak kısmen uygulanabildi.

II. Meşrutiyet Dönemi'nde eğitime ilişkin izlenecek strateji sorunlarının yanı sıra, öğrencilerin hangi eğitim yöntemleri uygulanarak yetiştirilecekleri konusu da oldukça çekişmeli tartışmalara zemin hazırlamıştır. Maarif Nâzırı Emrullah Efendi'ye göre *“Maarif, Cennet'teki Tûba ağacına benzer, bu ağacın kökleri yukarıda, dalları ve meyveleri aşağıdadır. Bizim eğitimimiz de yukarıdan aşağı geliştirilebilir. Çünkü bizde önce bilimsel zihniyet kurup geliştirmek önemlidir. Bunu da Darülfünun yapabilir. İnsanlığın gelişmesi de bilimlerin üniversitede geliştirilmesi ile sağlanmıştır. Ayrıca ülkelerin ivedilikle ihtiyaç duyduğu “yetişmiş insan” da ancak kısa sürede Üniversite tarafından yetiştirilebilir. Oysa eğitim reformuna ilköğretimden başlamak hem uzun sürede ürünlerini verir, hem de kapsamı nedeniyle çok masraflı olur”*. Fakat Emrullah Efendi *Tûba Ağacı Nazariyesi*'ni savunmakla beraber, aslında eğitimin temelini ilköğretim olduğunu söylemiştir. Bizde ancak, 1948'de gerçekleşecek olan *“İlkokul öğretmenlerine devlet bütçesinden maaş verilmesi”* ilkesini savunmuş, halkın yıllık olarak ya da bir süreliğine parayla tuttuğu *“yıllıkçı muallimler”*le ya da mahallî gelirlerle ücreti karşılanan muallimlerle ilköğretimin gelişemeyeceğini söylemiştir. Ona göre devlet ilkokul öğretmenlerinin maaşını kendisi vermeli, onlar üzerinde her türlü yetkiye sahip olmalı, fakat okul binalarının yapımında halkın katkısı istenmelidir. Eğitimde

<sup>1</sup> Berkes, N., s. 389 vdd.; Akyüz, Y., s. 157 vd., 265 vd.; Abdülhamid rejimine karşı mücadele ve Meşrutiyet'in ilanı konusunda İttihat Terakki Cemiyeti ile Osmanlı topraklarında faaliyet gösteren Mason locaları arasındaki işbirliği ile ilgili olarak bkz. ; Anduze, E., *Osmanlı Türkiye'sinde Masonluk 1908-1924*, Omnia yay., İstanbul 2012, s.33 vdd.; Akşin, S., *Siyasal Tarih 1908-1923*, Türkiye Tarihi, Cem yay., İstanbul, c. 4, s. 27 vdd.

<sup>2</sup> II. Meşrutiyet Dönemi'nin ünlü Maarif Nâzırı Emrullah Efendi (1858-1914), Mülkiye Mektebi mezunu olup, Mutlakiyet döneminde Yanya, Selânik, Halep, İzmir'de maarif müdürlüğü, sonra Meclis-i Maarif üyeliği, Darülfünun hocalığı yapmış, 1908'den sonra Galatasaray Sultânisi müdürlüğünde bulunmuş, 1910-1911 ve 1912'de iki kez Maarif Nâzırlığı yapmıştır. Emrullah Efendi'nin eğitim tarihimizdeki yeri ve katkıları için bkz., Ünal, U., s. 77-81.; Akyüz, Y., *age.*, s. 300-301.; Meşrutiyet Dönemi'nde eğitimde reform tartışmaları için bkz., Tekeli, İ. – İlkin, S., s.84 vdd.



izlenecek yöntem konusunda, dönemin önemli eğitimcilerinden Dârümuallimîn Müdürü Satı Bey ise bu düşüncenin tersini savunmaktaydı. Ona göre, “Çürük bir Dârümuallimîn, ilköğretime dayanacak bir yükseköğretim yaklaşımıyla hiçbir zaman gelişemez. Üstelik her ülkede eğitimin gelişmesi önce yükseköğretimden başlamamıştır. Fransa, İtalya, İspanya, İngiltere gibi uygarlık hayatı bir-iki asrı geçen ülkelerde önce üniversiteler gelişmiştir. Fakat Japonya, Bulgaristan, Yunanistan gibi uygarlık hayatı bir asrı geçmeyen ülkelerde üniversiteler, ilkokullardan sonra kurulmuştur. Örnek; Japonya’da ilkokullar ve öğretmen okulları 1870’de düzene konmuş, ilk üniversite 1877’de açılmış, ikinci bir üniversite açılmasına ise 1899’da girişilmiştir. Yunanistan’da ilkokulların ve öğretmen okullarının açılmasına 1824’te başlanmış, üniversite 1837’de açılmıştır. Bulgaristan’da da üniversitenin açılışı 1888’de olduğu halde, ilköğretim 1870’lerde geliştirilmeye başlanmıştır”. Satı Bey, bizde Tanzimat döneminde Dârülfünûn kurulması çalışmalarının başarısızlığını ‘önce yukarıdan’ başlanmakla, buna karşılık bazı okullarımızdaki başarılı öğretimi ise bunlara hazırlayıcı okulların bulunması ile açıklar. Der ki: ‘Eğitim tarihimizde, açılan kurumlar arasında faydalı olan ve devam edenlerin hepsi temeli ihmal edilmemiş olanlardan ibarettir: Mekteb-i Harbiye ve hatta Mekteb-i Tıbbiye, ancak altlarındaki Askerî Rüşdiye ve Askerî İdadiler sayesinde yaşadı. Mekteb-i Mülkiye ancak, bünyesindeki İdadî sınıfları sayesinde güç ve hayat buldu. İdadiye mektepleri hep içlerindeki Rüşdiye sınıfları sayesinde ürün verdi. Şu halde, bizim eğitim tarihimiz, yüksekte başlamanın sakıncalı olduğunu, her öğretim kurumunun temele muhtaç olduğunu gösteriyor. ‘Satı Bey, bizde eğitim ıslahatının ilköğretimden başlaması gerektiğini savunmakla beraber, eğitimin tüm düzeyleri arasında ilişkilerin bulunduğunu, hiçbirinin ötekilerden bağımsız ele alınamayacağını da ileri sürmüştür.<sup>3</sup>

Eğitim sistemini tüm yönleriyle ıslah etmek amacıyla hazırlanan *Maarif-i Umûmiye Kanun Layihası*, ülkenin içinde bulunduğu siyasi çalkantılar nedeniyle yasalaştırılmadı. Buna rağmen ilköğretimin iyileştirilmesini sağlamaya dönük olarak Dârümuallimîn’in (İstanbul Muallim Mektebi) başına getirilen Satı Bey, eğitimi yeniden düzenlemeye yönelik önemli adımlar attı. Pedagoji ve eğitim tekniği derslerine özel önem verdi. Beden Eğitimi, Resim, Elişi, Musıkî gibi yeni derslerin programda yer alması ve bu derslerin gelişmesinde büyük çaba sarfetti. Öğretmenlerin uygulama içinde tecrübe kazanmaları için muallim mektebine bağlı bir tatbikat (uygulama) okulu kuruldu. Daha önce eğitimde en önemli unsurlar olan öğretmen, kitap, hâfızanın yerini, Meşrutiyet döneminde tabiat, eşya, olay, deney unsurları aldı. Bu gelişme o dönem için eğitimde büyük reform ve anlayış değişikliği demektir. Başka bir ifadeyle, eğitim-öğretim yöntemlerinde klasik olandan kopuşu simgeleyen bu yeni anlayışa göre, artık kitap ve öğretmenden tabiata ve eşyaya, gözleme ve öğrencinin kendisinin araştırıp bulmasına dayanan (*usûl-i tekşîfî ve tedris-i ayanî*) bir tarz benimsenmeye başlandı. Bu bağlamda, öğrencilerin fizikî ve sosyal çevrelerini tanımaları amacıyla gözlem ve inceleme gezileri düzenlenmeye başlandı.

1913 Tarihli *Tedrisat-ı İptidaiye Kânun-ı Muvakkatı*, o zamana kadar iptidâi ve rüşdî olarak ikiye ayrılmış olan ilköğretimi ‘*Mekâtib-i İptidâiye-i Umûmiye*’ adı altında birleştirmiş ve altı yıllık iptidâi mektepler açılmaya başlanmıştır. Bu kânun ilköğretim öncesi eğitimle ilgili hükümler de getirmiş ve anaokulları ile sıbyan sınıflarını ilköğretimin içinde saymıştır. 1915’te *Ana Mektepleri Nizamnâmesi* yayımlandıktan sonra büyük kentlerde anaokullarının sayısı artmaya başlamıştır.<sup>4</sup>

<sup>3</sup> II. Meşrutiyet Dönemi’nin önemli eğitimcilerinden Dârümuallimîn Müdürü Satı Bey (1880-1968), aslen Arap’tır. Kaymakamlık ve öğretmenlik yapmış, II. Meşrutiyet’in ilanından sonra bir süre İstanbul Dârümuallimîni müdürlüğünde bulunmuştur. Satı Bey, Türkçü değil, Osmanlıcı görüşlere sahipti. Fakat Türkçüler kendisine büyük saygı duyuyor ve eğitim bilimi konusundaki çalışmalarını takdir ediyorlardı. Asya’daki Türk ülkelerinden birçok öğrenci gelip Dârümuallimîn’de ondan yararlanmaya çalışıyorlardı. Ancak, Satı Bey, 1918’de I. Dünya Savaşı’nın ülkeyi içine düşürdüğü felaket günlerinde ülkeden ayrılp Suriye’ye gitti ve Arap milliyetçiliğinin hizmetine girdi. Daha sonraları da bazı Arap ülkelerinde önemli eğitim görevleri üstlendi. Bkz., Akyüz, Y., *age.*, s. 301-304.; Tonguç, İ. H., *İlköğretim Kavramı*, Piramit yay., Ankara 2004, s. 196 vdd.; Eğitim alanını da kapsayan modernleşme çabaları hemen hemen aynı döneme rastlayan Türk ve Japon modernleşmesi üzerine mukâyeseli bir yaklaşım için bkz., Esenbel, S., *Japon Modernleşmesi ve Osmanlı*, İletişim yay., İstanbul 2012, s. 231-270.

<sup>4</sup> Akyüz, Y., *age.*, s. 267 vd.; Tekeli, İ. – İlkin, S., *age.* s. 86 vd.

II. Meşrutiyet döneminde, çocuk eğitimi ve genel olarak eğitim konularında *Johann Heinrich Pestalozzi* (1746-1827), *Friedrich Frobel* (1782-1852), *Maria Montessori* (1870-1952) gibi Batılı eğitimcilerin yöntem ve görüşleri araştırılıp incelenmeye başlanmıştır.<sup>5</sup>

**Tedrisat-ı İptidaiye Kânun-ı Muvakkatı** (İlköğretim Geçici Kânunu), adındaki “geçici” ibaresine rağmen Cumhuriyet döneminde de birçok maddesiyle yürürlükte kalmıştır. Tarihimizde parasız öğretim ilk kez bu kanunla kabul edilmiştir. İlköğretimin zorunlu ve Devlet okullarında meccani (parasız) olduğu hükme bağlanmıştır. İlköğretim 1913’lerden sonra, Satı Bey’in yetiştirmelerine katkıda bulunduğu öğretmenler sayesinde kısmen canlılık göstermiş, fakat öğretmen sayısı ihtiyacı karşılamaktan uzak olduğu için eski yöntem ve uygulamalar yeni okulların çoğunda sürüp gitmiştir. Meşrutiyet döneminde nitelikli öğretmenler yetiştirme konusuna önem verilmişse de öğretmenlik mesleğinin öneminin yeterince kavranmamış olması, kayırmacılık, dönemin siyasi şartları gibi nedenlerle meslekten öğretmen olanların dışında, kapıcılar, kahveci çıraqları gibi öğretmenlikle ilgisiz meslek mensupları da öğretmen olarak görevlendirilmiştir. Dönemin Maarif Nâzırı Emrullah Efendi, 1910’lu yıllarda gazetelerde yayınlattığı bir ilânla, **“yalnızca okuma yazma bilenlere bile muallimlik ehliyeti verileceğini, bunların muallim atanacaklarını”** duyurmuştur. Bütün bunların da gösterdiği üzere, Meşrutiyet döneminde öğretmenlik mesleğine dönük iyi niyetli çabalara, nitelikli öğretmen yetiştirilmesi için Satı Bey’in yönetimindeki Dârülmuallimîn’de yeni program ve yöntemlerle eğitim verilmesine rağmen, gerek sayıca ve gerekse nitelik bakımından istenen hedef tutturulamamıştır.

Öğretmenlere yönelik ilk meslek örgütü ise II. Meşrutiyet’in ilân edilmesinden hemen sonra (Temmuz 1908) İstanbul’da kurulmuştur. Dârülfünûn ve Dârülmuallimîn mezunları **Encümen-i Muallimîn** adında bir örgüt kurmuşlardır. Bunu takiben, yine İstanbul’da İdadî, Rüşdî ve İptidai okulların öğretmenleri tarafından **Muhafaza-i Hukuk-ı Muallimîn Cemiyeti** adında ikinci bir meslek örgütü kurulmuştur. Bu cemiyetin amacı öğretmenlerin haklarını savunmak ve halk arasında eğitimin yayılmasını sağlamaktır. Bu iki meslek örgütü, 1908 yılı sonlarında **Cemiyet-i Muallimîn** adı altında birleşmişler ve başkanlığına da Mercan İdadisi Fransızca öğretmeni Zeki Bey’i seçmişlerdir. 28 Aralık 1908 tarihinde **Cemiyet-i Muallimîn** başkanı sıfatıyla Zeki Bey tarafından, yeni Maarif Nâzırı Abdurrahman Şeref Efendi’ye bir mektup gönderilerek, Cemiyetin kuruluş amaçları ve eğitimle ilgili bazı önerileri sunulmuştur. Buna göre;

- Cemiyetin kuruluş amaçlarından biri, Meşrutiyet ve Hürriyet devrine lâyık şekilde genel eğitimin bütün ülkede yayılmasına çalışmak, bu konuda Maarif Nezâreti’ne yardımcı olmak
  - Avrupa ülkelerindeki ilmî kuruluş ve öğretim üyeleriyle temasa geçerek, Osmanlıların Avrupa kamuoyunda daha iyi tanınmalarına çalışmak
- Cemiyet’in kuruluş amaçları bu şekilde ifade edildikten sonra, eğitim ve öğretmenlerle ilgili görüşleri şu şekilde özetlenmiştir;
- İlköğretime önem verilmelidir.
  - Orta ve Yükseköğretim paralı olmalıdır.
  - Çeşitli düzeylerdeki öğretmenlerin maaşları “âdilce” belirlenmelidir, vs.

Türkiye’de ilk kurulan öğretmen meslek örgütlerinin dışında, Meşrutiyet döneminde öğretmenlerin çıkardıkları mesleki dergiler bakımından da bir canlılık dikkati çekmektedir. Bu tür yayınlar daha önceki dönemlerde de yapılmış, fakat bu konuda asıl gelişme Meşrutiyet döneminde olmuştur.

<sup>5</sup>Batılı ünlü eğitimci ve pedagoglar *Johann Heinrich Pestalozzi* (1746-1827), *Friedrich Frobel* (1782-1852), *Maria Montessori* (1870-1952) hakkında bilgi için bkz., Crystal, D., **The Cambridge Biographical Encyclopedia**, Cambridge University Press, Cambridge 1995.; Türkiye’de özgün eğitim kurumları olan Köy Enstitülerinin kurucusu İsmail Hakkı Tonguç’un da etkilendiği, İsviçreli eğitimci ve pedagog *Johann Heinrich Pestalozzi* (1746-1827) ve çalışmaları hakkında ayrıca bkz., Tonguç, İ. H., **age**, s. 86-93.; Rufer, A., **Pestalozzi ve Devrim**, Ekin yay., İstanbul 1962.

Meşrutiyet dönemi Eğitim tarihimizin incelenmesinde vazgeçilmez kaynaklar arasında yer alan bu dergilerin en önemli olanlarını şu şekilde özetleyebiliriz;

1- *İstanbul'da yayınlanan eğitim ve öğretmen dergileri:*

- **Mir'at-i Maarif:** Meşrutiyet döneminin ilk öğretmen meslek örgütlerinden *Cemiyet-i Muallimîn*'in yayın organı olan bu dergi, 15 günde bir yayınlanıyordu.
- **Tedrisat-ı İptidaiye Mecmuası:** 1910'da yayın hayatına giren dergi, 1912'de isim değiştirmiş ve *Tedrisat Mecmuası* adını almıştır. 2 ayda bir yayınlanmaktaydı. Yayın hayatına ilk başladığı sırada Satı Bey'in çabaları olmuştur. Maarif Nezâreti adına İstanbul Dârülmuallimîni öğretmenlerince yayınlanmıştır. Meşrutiyet döneminin en önemli meslek dergilerinden olup, Cumhuriyet'in ilk yıllarına kadar yayın hayatını sürdürmüştür.
- **Terbiye ve Oyun:** İstanbul Dârülmuallimîni Beden Eğitimi öğretmenlerinden Selim Sırrı (Tarcan) tarafından çıkarılmıştır.
- **Terbiye Mecmuası:** Başyazarı Satı Bey olan bu dergi, 1914 yılından itibaren yayın hayatına girmiştir.
- **Terbiye Mecmuası:** Bir önceki ile aynı adı taşıyan bu dergi, *Fenn-i Terbiye Encümeni* tarafından 1918'den itibaren yayınlanmaya başlamıştır.
- **Millî Tâlim ve Terbiye Cemiyeti Mecmuası:** 1916'da yayınlanmaya başlayan önemli bir dergidir.
- **Muallim:** 1916'dan itibaren çıkmaya başlamış önemli bir aylık dergidir. Dönemin başlıca eğitimci ve öğretmenleri bu dergide yazılar yazmışlardır.
- **İctihat, Sebîlürreşat, Türk Yurdu** gibi dergilerde de eğitim öğretim konularında önemli yazılar yayınlanmıştır.

2- *Taşrada çıkan eğitim ve öğretmen dergileri:*

- **Sây ve Tetebbu:** Edirne Dârülmuallimîni öğretmenlerinden Nafi Atuf (Kansu) ve Mehmet Vehbi tarafından, 1911 Şubatından itibaren yayınlanmaya başlamıştır.
- **Yeni Mektep:** Nisan 1911'de Üsküp Dârülmuallimîn-i Rüşdîsi müdürü Sabri Cemil tarafından çıkarılmaya başlanmış aylık bir dergidir.
- **Yeni Fikir:** Manastır Dârülmuallimîni müdürü Ethem Nejat ve okulun öğretmenlerinden Ferit tarafından, 1911 Aralık ayından itibaren yayınlanmaya başlanan aylık bir dergidir.

II. Meşrutiyet döneminde orta eğitim alanında yeni bir uygulama başlatılmış, ilki İstanbul'da olmak üzere Vilâyet merkezlerindeki 10 idâdi, sultani'ye dönüştürülerek, bu sultanilere rüşdiye üzerine üçer yıllık iki devresi olan, ikinci devresi fen ve edebiyat kollarına ayrılan bir yapı kazandırılmıştır. Bu uygulamanın alanı 1913 tarihinden itibaren genişletilerek, beş yıllık kendi iptidai kısmına veya altı yıllık umumi ilkokula dayanmak üzere dört yıllık birinci, fen ve edebiyat kollarına ayrılmış üç yıllık ikinci devresi bulunan, toplam eğitim süresi 12 yıl olan "sultani"ler, tüm vilayet merkezlerinde idadilerin yerini almıştır. Böylece oluşan Sultanîlerin sayısı, I. Dünya Savaşı yıllarında 50'ye ulaştı. Bu Sultanîlerin bir kısmı yatılı olup, erkeklere ve kızlara mahsus ayrı okullardı. 1911'de İstanbul'da açılan ilk kız İdadîsi, 1913'te İstanbul İnas ( Kız ) Sultanîsi adını almıştır. İlk Kız Lisesi budur ve 1915'te *Bezmiâlem Vâlide Sultanîsi* adını almıştır. Taşrada ilk kız Sultanîleri 1922 yılı sonunda İzmir'de, 1923 Ekim ayında Ankara'da açılan okullardır. Meşrutiyet döneminde Sultanîler, 5 veya 6 yıllık ilköğretim üzerinde, birinci devresi (devre-i ulâ) 4, ikinci devresi (devre-i sâniye) 3 yıl olmak üzere eğitim yapıyorlardı. Sultanîlere 1911'lerde "Lise" adı verilmesi düşünülmüş, ancak bu isim 1922 yılı sonundan itibaren kabul edilmiştir.

1912 tarihinde kabul edilen *Tedrisât-ı Ziraiye Nizamnâmesi* ile tarım okullarının sistemli hale getirildiğini görüyoruz. Tarım alanında dört kademeli bir eğitim sistemi tasarlanmıştır: Birinci

kademe, çiftlikler için amele başı yetiştirmeyi amaçlayan *Amele Mektepleri* idi. İkinci kademeyi oluşturan *Çiftçi Mektepleri*, çiftçi çocuklarına uygulamalı ziraat teknikleri eğitimi vererek, okuma yazma bilen, kendi tarlasını idare edebilecek çiftçi veya yarıcı yetiştirme amacını taşıyordu. Üçüncü kademe olan *Ziraat Ameliyat Mektepleri*, çiftlik kâhyası yetiştirmek için kurulmuştu. En üst kademe olan dördüncü kademe *Ziraat Mıntıka Mektepleri*, uygulamanın yanında teorik eğitimin de verileceği yüksekokullar şeklinde tasarlanmıştı. Ayrıca, büyük çiftlikleri yönetecek uzmanlar, memurlar ve ziraat mekteplerinin hocalarını yetiştirecekti. Dört kademedeki okulların tümü yatılı olacak ve öğrencilerin tüm masrafları karşılanacağı gibi, belli bir ücret de ödenecekti. *Nizamnâme*'nin uygulanması sınırlı olduysa da ülkenin birçok şehrinde yeni ziraat okulları açıldı. Daha önce Halkalı'da yüksekokul düzeyinde açılmış olan okula, Selânik'teki mektep de bu düzeye çıkarılarak eklendi. Ziraat Ameliyat Mekteplerine, Ankara, İzmir Bornova, Adana ve Bursa'da açılan yenileri eklendi. 1912 tarihinde Halep, Sivas, Erzurum, Üsküp, Serez ve Manastır'da birer çiftlik mektebi, Muş'ta ise bir *Köy Çiftlik Mektebi* bulunuyordu. Bunların dışında bazı özel alanlara has okullar da vardı. Antakya'da daha önce açılmış olan *Harir Dârüttalimlerine* (İpekçilik Okulu), Amasya, Beyrut, Gümüşhane ipekçilik okulları ilave edilmişti. Tarımda makinalaşmanın giderek yoğunlaşması üzerine 1914'te İstanbul Halkalı'da *Çiftlik Makinist Mektebi* açıldı.

II. Meşrutiyet döneminde meslekî ve teknik eğitimle ilgili başka okullar da açılmıştır. Bu cümleden olarak; 1909'da Polis Mektebi ile Mâliye Memurları Mektebi, 1911'de Belediye Memurları Mektebi ile Evkaf Memurları Mektebi, 1912'de Sıhhiye Memurları Mektebi, 1913'ten sonra vilayetlerde Amelî Ticaret Mektepleri, 1914'te Dârülbedayi (Tiyatro Mektebi), 1915'te Şimendifer Memurları Mektebi ve Orman Memurları Mektebi, 1916'da Dârülelhan ( Konservatuar ) faaliyete geçmiştir.

İttihat ve Terakki Cemiyeti'nin II. Abdülhamid rejimine karşı yürüttüğü mücadele boyunca ve iktidarı ele geçirerek denetim altına almasında ordunun rolü çok yüksekti. Bu nedenle II. Meşrutiyet döneminde askerî eğitim kurumlarına ve ordu mensuplarının eğitimine özel önem verilmişti. Özellikle, Balkan Savaşı yenilgisinin ardından ordudaki eski kadrolar görevden uzaklaştırılmış, bunların yerine yeni eğitim kurumlarında yetiştirilen elemanlar atanmaya başlanmıştı. Askerî eğitim kurumlarında yapılan yeni düzenlemelerle, eğitimin kalitesi artırılmaya çalışıldı.

1913 tarihinde yürürlüğe giren *Tedrisât-ı İbtidâiye* kararnamesinin uygulanmaya başlamasıyla sivil ve askerî rüşdiyeler birleştirilince, askerî rüşdiyeler tarihe karışmış oldu. Yani Askerî eğitim, idadi ve üstü okulları kapsayan bir sisteme kavuşmuş oldu. Yine bu dönemde, askerî eğitim sisteminin bağlı olduğu "*Mekâtib-i Askeriye Nezareti*" kaldırılmış ve yerine "*Tedrisât-ı Umûmiye Müfettişliği*" kurulmuştur.

Bu dönemde, ordu merkezlerinde yer alan Harbiye mektepleri kapatılarak, askerî öğrenciler İstanbul'daki Harbiye Mektebi'nde toplandı. Seçkin bir eğitim kadrosu oluşturularak, öğrenciler daha kaliteli bir eğitimle yetiştirilmeye başlandı. 1914'te I. Dünya Savaşı'nın patlak vermesiyle Harbiye kapatıldı ve subayların eğitimi talimgâhlarda kısa süreli eğitimle sınırlandırıldı.

Meşrutiyet döneminde, Erkân-ı Harbiye sınıfları yeniden ele alınarak, Harb Okullarından doğrudan doğruya öğrenci seçme yöntemi terkedilmiş, bunun yerine istekliler arasından yarışma sınavıyla öğrenci seçilmesi yöntemine geçilmiştir. 1909'da Yıldız Sarayı Şehzadeler dairesinde ve doğrudan Erkân-ı Harbiye-i Umûmiye Riyâseti'ne bağlı ayrı bir okul halinde eğitime başladı. Bu dönemde okulun programı, erkân-ı harb adaylarının meslek bilgileri dışında, siyasi tarih, coğrafya, ekonomi, devletler hukuku gibi derslerle takviye edilerek, öğrencilere geniş bir genel kültür vermeyi amaçlıyordu.

1909 tarihinde, orduda ilk defa bir *Levâzım Mektebi* açıldı. Yine aynı yıl jandarma mekteplerinin sayısı 20'ye çıkarıldı. Bunlardan Selânik, İstanbul, İzmir'deki üçü *Jandarma Zâbit Mektebi*



olmuştur. 1910'da '**İhtiyat Zâbiti Mektebi**' kurularak, Meşrutiyet döneminin eşitlikçi vatandaşı anlayışı doğrultusunda bu okula gayrimüslimler ve yükseköğrenim görmüş olanlar alınmaya başlandı.

1911 tarihinden itibaren *İngiliz Bahriye Mektebi* sistemine göre **Mekteb-i Bahriye**'de de yeni düzenlemeler yapılmıştır. 1913'de **Namzet Mektebi** adında bir okul açılarak, Bahriye'ye çeşitli kaynaklardan gelen öğrencilerin hazırlık eğitimleri eşitlenmeye çalışılmıştır. 1917'de Heybeliada 'da **Muzıka Mektebi** ile yeni bir **Çarkçı Mektebi** açılmıştır.

II. Meşrutiyet'in ilânından sonra diğer öğretim kurumlarının yanı sıra Tıbbiye'de de yeni düzenlemelere gidilir. 1 Ekim 1908'de *Tıbbiye-i Mülkiye*, **Tıp Fakültesi** unvanını alır. 1909'da da askerî ve sivil Tıbbiyeler birleştirilerek, öğrenime Haydarpaşa'daki binada devam edilir.

İttihat ve Terakki ile birlikte kurulan yeni rejimin ideolojik tutumları, özellikle yükseköğrenim kurumlarında etkisini göstermiştir. Yüksekokulların eğitim programlarının yanında yönetim kadroları da değiştirilmiş, bu okulların çoğunda öğrenci dernekleri kurularak, eğitim yaşamı ile siyasi yaşam arasında etkileşim kanalları oluşturulmuştur. Bu bağlamda, 1909 tarihinde askerî yöneticilerden alınarak, Nafia Nezâreti'ne bağlı **Mühendis Mekteb-i Âlisi** haline getirilen *Hendese-i Mülkiye*, aynı zamanda gayrimüslimlerden de öğrenci almaya başlamıştı. **Mühendis Mekteb-i Âlisi**'ne ilk müdür olarak atanan Refik Bey, Belçika'da mühendislik eğitimi almıştı ve liberal fikirlere açık bir yapısı vardı. Onun müdürlüğü sırasında kurulmuş olan ilk **Talebe Cemiyeti**, çok yönlü işlevlere sahipti. Yerine göre, yetersiz eğitim sistemi ve öğretim kadrosunu eleştiriyor, öte yandan öğrencilerin siyâsi anlamda toplumsallaşmasını sağlıyor, dans kursları vs. gibi etkinliklerle öğrencilerin daha görgülü yetişmelerine zemin hazırlıyordu.

1911 tarihinde Nafia Nezâreti'ne bağlı olarak kurulan **Kondüktör Mektebi**, orta kademe teknik personel olan Nafia Fen Memurları yetiştirmeyi amaçlıyordu.

II. Abdülhamid'in mutlakîyet rejimi sırasında sıkı kontrol altına alınan Mekteb-i Mülkiye, Meşrutiyet'in ilanı sonrasında büyük önem atfedilerek ıslah edilmiş, mutlakîyet döneminde kaldırılan siyasi tarih, anayasa hukuku, etnografya, ekonomik coğrafya dersleri yeniden konulmuş, öğrenciler için bir Batı dilini öğrenmek zorunlu tutulmuştur. 1915'te Dârülfünûn bünyesinde Hukuk fakültesi ile birleştirilmek istenen **Mekteb-i Mülkiye** 1918 tarihinde Dâhiliye Nezâreti'ne bağlı üç yıl süreli bir okul olarak yeniden kurulmuştur.

1909 yılında açılan **Dişçi Mektebi**, Tıp Fakültesi'ne bağlı olup, eğitim süresi üç yıl olacaktı. II. Meşrutiyet döneminde programı geliştirilen **Mülkiye Baytar Mektebi**'nin eğitim kadrosu da güçlendirildi. I. Dünya Savaşı sırasında kapatılan bu okul, Mütâreke Dönemi'nde **Ziraat Mektebi**'ne bağlı **Askerî Baytar Mektebi** ile birleştirilerek '**Baytar Mekteb-i Âlisi**' olarak yeniden eğitime başlamıştır.

1914'te '**İnas Sanayi-i Nefise Mektebi**' açılarak Resim ve Heykel branşlarında eğitime başladı. **Sanayi-i Nefise Mektebi** ise 1917 tarihinde Müze yönetiminden ayrılarak bağımsız okul haline getirildi. Mütâreke yıllarında eğitim verecek bina bulmakta güçlük çeken bu iki okul 1921'de **Sanayi-i Nefise Mekteb-i Âlisi** adı altında birleştirildi.

II. Meşrutiyet dönemi, çeşitli alanlarda iyi eğitilmiş memur ihtiyacını karşılamaya dönük okulların açıldığı ve geliştirildiği bir dönem olmuştur. Bu okullar arasında; 1909'da **Rüsûmat Memurları Mektebi**, 1909'da İstanbul'da açılan **Polis Mektebi**, İstanbul Şehremaneti (Belediye Başkanlığı) tarafından kimsesiz çocuklar için 1910'da kurulan **Muzıka Mektebi**, bilgili maliye memurları yetiştirmek üzere 1910'da açılan **Maliye Memurları Mektebi**, 1911'de eğitime başlayan **Evkaf Memurları Mektebi**, aynı yıl eğitime başlayıp kısa süre sonra kapanan **Belediye Memurları**

**Mektebi**, 1912’de Devlet Şûrası kararıyla **Kadastro Mekteb-i Âlisi** adını alan Kadastro Memurları Mektebi, 1912’de kurulan **Küçük Sıhhiye Memurları Mektebi**, demiryollarına personel yetiştirmek amacıyla 1915’te kurulan **Şimendifer Memurları Mektebi**’ni saymamız mümkündür. Adı geçen bu okullar çoğu zaman uzun ömürlü olmamış, kimi zaman kapatılmış kimi zaman da başka okullarla birleştirilmiştir.

Bu dönemde, çeşitli Avrupa ülkelerine eğitim amaçlı öğrenci gönderme konusuna da önem verilmiştir. Buradaki amaç, daha ziyade orta ve yüksek dereceli okullara öğretmen yetiştirmektir. Avrupa’daki eğitimleri sona eren bu öğrenciler geri döndüklerinde Sultanilerde öğretmenliğe veya Dârülfünûn ya da yüksekokullarda öğretmen yardımcılığına atanıyorlardı. Avrupa’ya gönderilen bu öğrencilerle ilgilenmek üzere 1912 tarihinde Maârif Nezâreti bünyesinde bir daire kurulmuş, 1913’te ise yurt dışına gönderilecek öğrenciler için bir yönetmelik hazırlanmıştır. I. Dünya Savaşı sırasında dönemin şartları nedeniyle, sadece Almanya, Avusturya ve Macaristan’a öğrenci gönderilebilmiştir.

Medrese eğitiminin ıslâhı konusunda ilk ciddi çabalar II. Meşrutiyet döneminde gündeme gelmiştir. Eğitim alanındaki Batılılaşma gayretleri, nihayet yüzyıl sonra, geleneksel eğitim kurumu olan Medreseyi de etkisi altına almaya başlamıştı. Bu konuda oldukça geç kalınmasının sebebi elbette yeniliklere karşı reaksiyoner tavır alan muhalif kesimlerin tepkisini en alt düzeyde tutma düşüncesi idi. 1910’da yürürlüğe konulan **Medâris-i İlmiye Nizamnâmesi** ile medrese eğitimi 12 yıl olarak düzenlendi. Bundan sonra medrese öğrencilerinin okuyacağı dersler arasında Osmanlı sarfı, nahvi ve belagati, Fârisî (Farsça), hesap, hendese, coğrafya, tarih, fizik, kimya ve tabiat bilimleri de yer alacaktı. Öte yandan **Dârülfünûn** bünyesinde bulunan **Ulûm-ı Âliye-i Dîniye** şubesinin giderek gelişme göstermesi üzerine, hem ona hazırlayıcı rol oynaması hem de bir anlamda rekabet için **Medresetü’l- Mütahassisîn** kurulması için faaliyete geçilmişti. 1914’te kabul edilen **Islâh-ı Medâris Nizamnâmesi** ile İstanbul’daki tüm medreseler **Dârü’l- Hilâfeti’l- Âliye Medresesi** haline getirildi. Vilâyetlerde bulunan medreseler ise bunun şubeleri olarak faaliyet gösterecekti. Bu düzenlemeyle medrese eğitimi her biri dört yıllık üç kademe halinde verilecekti. İlk iki kademesi ortaöğretim, son kademe ise yükseköğretime tekâbül edecekti. Yükseköğretim kademesinden mezun olanlar İstanbul rûsu (diploma) almaya hak kazanacaklardı. Böylece, müderrislik yapma yetkisine sahip bulunacaklardı. Bundan sonra ise iki yıllık **Medresetü’l- Mütahassisîn**’e devam edecekler, bir çeşit uzmanlık eğitimi görmüş olacaklardı.

1917 tarihinde Şeyhülislâm Musa Kâzım Efendi bir **Nizamnâme** çıkartarak, 1914 yılı ıslahatı temel olmak üzere medreselerde yeni düzenlemeler yapmış, **Dârü’l- Hilâfeti’l- Âliye Medresesi**’ni de kapsayacak şekilde **Medrese-i Süleymaniye** adında bir kurum oluşturmuştur. Millî Mücadele döneminde (1919-1922) TBMM Hükümeti’nce Mayıs 1921 tarihinde yeni bir **Medâris-i İlmiye Nizamnâmesi** yürürlüğe konulmuştur. Bunun gerekçesi, ülkenin her yerinden halkın imam, müezzin ihtiyacının karşılanması için başvuruda bulunulması gösterilmiştir. Bu **Nizamnâme**, TBMM’nin etkisi altındaki yerlerde eski medreseleri **Medâris-i İlmiye** adı altında teşkilâtlandırmıştır. Medreselerin programlarında dîni, hukukî derslerin yanında Maârif mekteplerinde yer alan bazı sosyal ve müspet bilim dersleri de görülmektedir. Öğrenim süresi 12 yılda tamamlanmaktadır.

Kısaca özetlenen bu yenileşme çabaları sonucunda medreselerin toplumun ve çağın ihtiyaçlarına cevap verecek duruma gelmiş olup olmadıklarını anlamaya fırsat kalmadı. Zira bilindiği üzere 1924 tarihinde kabul edilen yasayla medreselerin faaliyetine son verilmiş ve böylece, yüzlerce yıl geriye giden kurumsal varlıkları tarihe karışmış oldu.

II. Meşrutiyet dönemi, **Dârülfünûn** ile ilgili yeni düzenlemelerin yapılması konusunda yoğun çabalara sahne olmuştur. Programları yeniden gözden geçirilerek, Mutlakiyet döneminde siyasi şartlar nedeniyle okutulmayan tarih, edebiyat ve felsefe dersleri yeniden müfredata konulmuş ve



**Dârülfünûn-ı Şahane** teriminin yerine **Dârülfünûn-ı Osmânî** ifadesi kullanılmaya başlanmıştır. Ayrıca okul, Vezneciler semtindeki *Zeynep Hanım Konağı*'na taşınmıştır. 1911 tarihinde hazırlanan bir *tâlimatnâme*ye göre *Dârülfünûn*'un beş şubesinde birer *Muallimler Meclisi* kuruluyor ve her biri kendi aralarından şube reislerini seçiyorlardı.

Dönemin hemen başlarında, 1912'de ikinci kez Maârif Nâzırı olarak atanan Emrullah Efendi, *Dârülfünûn*'da köklü reformlar yapmak amacıyla bir *Nizamnâme* hazırladı. Buna göre *İstanbul Dârülfünûnu*; 1) *Ulûm-ı Şer'îye*, 2) *Ulûm-ı Hukûkiye*, 3) *Ulûm-ı Tıbbiye*, 4) *Fünûn*, 5) *Ulûm-ı Edebiye* olmak üzere beş şubeye ayrılıyordu. Emrullah Efendi, *Dârülfünûn*'a büyük önem veriyor ve bu kurumu; "*İlimlerin ve fenlerin hem yayılmasına, hem ilerlemesine hizmet eden yüksek ilim müessesesi*" şeklinde tanımlamış ve "*Dârülfünûnları mükemmel olan memleketlerin tâlî ve iptidâî mektepleri de o nispette mükemmel olur*" demek suretiyle, ilköğretim ve ortaöğretimde iyileşmenin ancak *Dârülfünûn*'daki iyileşme ile mümkün olacağını ifade etmiştir.

1912'de çıkarılan başka bir *Nizamnâme* ile *Dârülfünûn*'da disiplin işleri düzenlenmiş ve şübelere *Fakülte* adı verilmiştir. Ayrıca, *Dârülfünûn* hocalarına *Müderris* denilmesi ve *Dârülmesâî* denen *Enstitü*'lerin açılması da bu döneme rastlar.

Dönemin siyasî ve askerî gelişmeleri de eğitimde yeni anlayış ve düşüncelerin etkisini artırmıştır. 1912 tarihindeki Balkan Savaşı'nda toprak kayıplarıyla sonuçlanan yenilgiler, Osmanlı Devleti'nin ideolojisinde dönüşümlere yol açmış, bu durum *Dârülfünûn* içinde de yeni fikir ve ideolojilerin yayılmasını sağlamıştır. Devletin bir anlamda resmî ideolojisi olan Osmanlıcılık ve İslâmcılık akımlarına karşı giderek güç kazanan Türkçülük, Ziya Gökalp (1876-1924), Ahmet Ağaoğlu (1869-1939), Yusuf Akçura gibi temsilcileri vasıtasıyla yükseköğretim kurumlarında etkili olmaya başlamıştı. Bu etkiyi, 1919'da İsmail Hakkı Baltacıoğlu (1886-1978) şöyle ifade ediyordu: "*Eski Dârülfünûn böyle cansız bedensiz bir Dârülfünûn'du. Bütün sahteliği, bütün mukallitliğiyle 'Tanzimat Ruhunu' garplılaşmak yahut garplı görünmek ihtiyacını temsil ediyor, zevâhiri kurtarmak endişesiyle yaşıyordu. Meşrutiyet bunun üzerine geldi. Dârülfünûn'u böyle perişanlıklar içinde buldu. İlk senelerde Dârülfünûn'un hayatı muhitin neşelerine, kederlerine iştirakle geçti. Bu devirde Dârülfünûn daha ziyade şan ve şeref siyaseti takip etti; fakat bâtinî denilecek hiçbir istihâlâ geçirmedi. Balkan hezimetini, tahsil için Avrupa'ya gönderilen avdeti, yine asrileşmek ihtiyacı ve her sebebin fevkinde kuvvetli olarak milliyet intihabı, Dârülfünûn'un vücudunu mükerreren sarstı, bu köhne sermayeyi yenileştirmek, hastayı diriltmek istedi*".

*Dârülfünûn*'da öğretimin düzeyi de "*acınr*" durumdaydı. Ders kitapları ortaokul kitabından farksızdı. "*Araştırma ve bilim yöntemi*" ifadesi bolca kullanılmakla beraber, ortada bundan eser yoktu.

*Dârülfünûn*, kendi dışında da etkili olamamış, ülkenin gelişimine olumlu katkıda bulunamamıştır. Baltacıoğlu'nun ifadesiyle devam edersek; "*Bu zayıf bünyeden fikirler dışarı yayılamadı. Dışarıdaki akımlardan da kendisi habersiz kaldı. Genel eğitimin ıslah ve yayılmasında etkin olamadığı gibi, ticaret, ziraat ve zenaat müesseselerimizin gelişmesinde, memleketin fikrî, millî hayatında, siyasî buhran ve inkılâbında zerre kadar tesiri görülmedi; beş senelik savaş zamanında hep kendisiyle meşgul oldu, gözü dışarıyı göremedi*". *Dârülfünûn*'un başarısızlığında I. Dünya Savaşı'nın büyük payı olmuştur. Savaş ortamında askerlik çağındaki genç nüfusun silah altına alınması nedeniyle 1915'te bu kurumda eğitim dahi yapılamamıştır.

Dünya savaşının başlangıcında Maârif Nâzırı olan Ahmet Şükrü Bey ve Alman danışmanı Franz Schmidt tarafından, *Dârülfünûn* hocalarının görüşleri dikkate alınmadan, 1915'te 20 Alman profesör getirilerek görevlendirilmiştir. Bu duruma o dönemde tepki gösterilmiş olsa da, bu Alman öğretim üyelerinin de katkısıyla, *Dârülfünûn*'un araştırmacı bir üniversiteye dönüşmesi yolunda önemli çalışmalar yapıldığı anlaşıyor. Bu amaçla, *Dârülfünûn*'da kürsüler hâlinde teşkilatlanmaya

gidilmiş, *araştırma enstitüleri* (*Dârülmesai*) ve laboratuvarlar kurulmuştur. Yeni bir düzenleme de sınıf usulünün terkedilmesi ve sömestre usulünün uygulanmaya başlaması olmuştur. Dünya savaşının ortaya çıkardığı yeni şartlara rağmen, kurulmuş olan enstitüler için kütüphaneler ve çalışma ortamları oluşturulduğunu görmekteyiz. Bu gelişmeler neticesinde Dârülfünûn'da bilimsel yayınlar da başlamıştır.

Savaş döneminde yükseköğrenim alanında meydana gelen bir diğer gelişme ise 1915 yılında ***İnas Dârülfünûnu*** adını taşıyan, kızlara mahsus bir yükseköğretim kurumunun açılması olmuştur. Bu okulun ilk öğrencileri *kız idadîsi* mezunları ve *İstanbul Dârülmualлимâtı* mezunları idi. Bu kurumun her biri üç yıl süreli üç şubesi vardı: *Edebiyat*, *Riyaziyat*, *Tabiiyat*. 1917 tarihinde, 18 öğrenciden oluşan ilk mezunlarının 7'si Edebiyat, 3'ü Riyaziyat, 8'i Tabiiyat şubelerinden çıkmıştı. Bu okul, 1920'de kaldırılarak, Dârülfünûn'a bağlanmıştır. Mezunlardan bir kısmı İstanbul İnas Sultanileri muallimliklerine, diğerleri de taşra Dârülmuallimatları müdire ve muallimliklerine tayin edilmişlerdi.

Meşrutiyet dönemindeki iç ve dış siyasî gelişmeler, yükseköğrenim kurumlarındaki öğrenciler üzerinde de etki yapmış, bunun neticesi olarak zaman zaman öğrenci olayları meydana gelmiştir. Öğrenciler bazı konulardaki tepkilerini, Meşrutiyet döneminin göreceli hürriyet ortamında gösteriler (*nümâyiş*) yaparak ortaya koymuşlardır.

Meşrutiyet döneminin başlarında basın yayın hayatında ve örgütlenme özgürlüğündeki gelişmeler nedeniyle özel öğretim kurumları da önceki dönemlerle kıyaslanamayacak ölçüde hem sayı hem de nitelik açısından artış göstermiştir. Bu konuyla ilgili yapılan bir düzenleme, 1915 tarihinde ***Husûsî Mektepler Tâlimatnâmesi***'nin çıkarılmasıdır.

Yabancı özel okullardan Türk öğrencileri kurtarmak ve Türk özel öğretimini geliştirmek amacıyla çeşitli cemiyetlerin faaliyete geçtiğini görüyoruz. Bu amaçla 1909'da İstanbul Kadıköy'de ***Osmanlı İttihat Mektepleri Cemiyeti*** kurulmuştur. Yine İstanbul'da Türk özel okul kurucularını bir araya toplayan ***Osmanlı Mektepleri Tevhîd-i Mesaî Cemiyeti*** adında bir teşekkül faaliyete geçirilmiştir. Bu cemiyetin kurucuları tarafından, okullarından mezun olanlara İdadî öğretimini de özel olarak yaptırmak için ***Mekâtib-i Husûsiye İdadîsi*** adıyla bir okul kurulmuştur.

Meşrutiyet döneminin nisbî özgürlük havasından yararlanan Azınlıklar da eğitim kurumlarına yönelik her türlü denetim girişimine karşı çıkarak, bu yoldaki çabaları başarısızlığa uğratmışlardır. Balkan Savaşları sonucunda, Rumeli'deki Osmanlı toprakları elden çıkmıştır. 1914'te I. Dünya Savaşı'nın patlak vermesi ve Osmanlı Devleti'nin Almanya'nın yanında savaşa girmesine mukabil, Ermeni ve Rum azınlıklar, karşı cepheye yer alan devletlerle işbirliğine gitmişlerdir. Ermeniler, Doğu Anadolu'dan güneye doğru tehcir edilmiştir. Bu yeni gelişmeler sonucunda Osmanlı Devleti, ülkede kalan ve sayıları azalmış bulunan azınlıkların eğitim işlerini düzenlemek için harekete geçmiş ve 1915 tarihli *Tâlimatnâme* işte bu sırada çıkarılmıştır.

Azınlıkların eğitim işlerini düzenleyen 1915 tarihli *Tâlimatnâme*'ye göre, azınlıklar sadece kendi oturdukları mahalle veya köylerde okul açabileceklerdi. Eğitim dili olarak kendi dillerini kullanabilecekler, fakat okullarında Türkçe'nin yanı sıra Türkiye Tarihi ve Coğrafyası Türkçe olarak ve Türk öğretmenler tarafından okutulacaktı. Azınlık okulları, Osmanlı *Maârif Nezâreti* ve mülkiye âmirleri tarafından denetlenecekti.

II. Meşrutiyet dönemi gazetecilerinden Ahmet Şerif, o dönemde Anadolu'yu gezerken, Türk ve Ermeni Rüşdiye ve İptidâîlerini kıyaslamış ve bunun sonucunda şu fikirleri ifade etmiştir: “Türkiye’de yaşayan çeşitli unsurlar arasında fikir ve düşünce bakımından derin uçurum devam ettikçe ülkede birlik ve eşitlik nasıl kurulabilir?...İslamlar ve Türkler cahilliklerinde ne kadar ısrarlı iseler Hristiyan vatandaşlar çalışmakta, özellikle gelecek için çocuklarını hazırlamakta o kadar

*inatçı. Burada bir toplumsal tehlike başlıyor ( ... ) Bu gidişle halimiz ne olacak? Kendi kendimizi aldatmak, müthiş gerçekleri yaldızlı hayallerimizle karıştırmak hastalığından hâlâ kurtulamıyoruz''.*

Bu dönemde, özel eğitim alanında yabancıların okullarında sayısal bakımdan artış olduğunu ve bu durumun I. Dünya Savaşı'nda uğranılan yenilginin ardından ivme kazandığını görüyoruz. 1913-1914'te yabancılara ait 215 ilkokul ve 806 öğretmen, 80 orta dereceli okul ve buralarda görevli 1600 civarında öğretmenin mevcut olduğu bilinmektedir. Harput (Elazığ) Amerikan Koleji gibi yabancı okullar da mevcuttu. Bazı Amerikan misyonerleri, çoğu Osmanlı aydını ve yöneticisinin bu okulları yararlı ve çağdaş gördükleri için onlara destek verdiklerini belirtirler.

II. Meşrutiyet'in ilânından itibaren, halk eğitimi alanında da yoğun çabaların başlatıldığını görüyoruz. Halk eğitime yönelik çalışmalar, daha çok siyasî partiler, dernekler, okullar tarafından yürütülmüştür. Bu konuda basın ve matbuatın da teşvik edici rol oynadığı bilinmektedir. Halk eğitimi ile ilgili faaliyetler daha çok gece dersleri, konferanslar, kurslar şeklinde gerçekleştirilmiştir. O zamana dek okuma imkânı bulamamış yaşlılara, yoksul çocuklara, kızlara, tutuklulara okuma yazma ve bazı meslekî bilgiler verilmeye çaba gösterilmiştir. Bu kurslarda özellikle okuma yazma, Hesap, İktisat, Defter tutma, Ziraat, Elektrik, Yabancı Dil, Dikiş, Nakış, Hastabakıcılık gibi dersler öğretilmiştir.

Bu dönemde birçok kadın dernekleri de kurulmuştur. Bu kadın dernekleri özellikle Balkan savaşları sırasında düzenledikleri toplantılar ve konferanslarla dikkati çekmekteydiler. 1913 yılının Ocak ve Şubat aylarında yapılan toplantılarda, genellikle öğretmen kadınlar konuştular ve Balkan savaşlarında Bulgar, Sırp ve Yunanlıların Türklere karşı giriştikleri soykırımı ve vahşeti, İnsan Hakları savunuculuğu yapan Avrupa devletlerinin bu duruma seyirci kalıp, zulmü teşvik ettiklerini dile getirerek protesto ettiler.

1908'den sonra, bazı önemli derneklerin faaliyete geçirildiğini görüyoruz. Bunlar arasında, *Türk Derneği*, *Türk Yurdu* ve 1911'de *Türk Ocağı* dernekleri yer almaktadır. Bu dernekler, o dönemde giderek güçlenmekte olan Türkçülük akımı lehinde konferanslar düzenliyor, yayın faaliyetinde bulunuyorlardı.

## KAYNAKÇA

- Akşin, S. (2020). *Siyasal Tarih 1908-1923*. Yönetmen: Sina AKŞİN. *Türkiye Tarihi Cilt: 4 Çağdaş Türkiye 1908-1980 (14. Baskı)*. İstanbul: Cem Yayınevi.
- Akyüz, Y. (2012). *Türk Eğitim Tarihi M.Ö. 1000 - M.S. 2012 (Gözden Geçirilmiş 22. Baskı)*. Ankara: Pegem Akademi.
- Anduze, E. (2012). *Osmanlı Türkiye'si'nde Masonluk 1908-1924*. İstanbul: Omnia Yayınları.
- Berkes, N. (2012). *Türkiye'de Çağdaşlaşma*. (Yayına Hazırlayan: Ahmet KUYAŞ). İstanbul: Yapı Kredi Yayınları.
- Crystal, D. (1995). *The Cambridge Biographical Encyclopedia*. Cambridge: Cambridge University Press.
- Esenbel, S. (2012). *Japon Modernleşmesi ve Osmanlı*. İstanbul: İletişim Yayınları.
- Rufer, A. (1962). *Pestalozzi ve Devrim*. İstanbul: Ekin Yayınları.

- Tekeli, İ. ve İlkin, S. (2002). *Osmanlı İmparatorluğunda Eğitim ve Bilgi Üretimi Sisteminin Oluşumu ve Dönüşümü*. Ankara: Türk Tarih Kurumu Yayınları.
- Tonguç, İ. H. (2004). *İlköğretim Kavramı*. Ankara: Piramit Yayınları.
- Ünal, U. (2008). *Meclis-i Kebir-i Maarif (1869-1922)*. Ankara: Türk Tarih Kurumu Yayınları.

## ИСТОРИЧЕСКИЕ КОРНИ ПРОБЛЕМЫ ВОСПИТАНИЯ СОЦИУМА И ИНДИВИДА. HISTORIKAL ROOTS OF THE PROBLEM OF EDUCATION OF THE INDIVIDUAL AND SOCIETY

**Bagirova Tamilla Ali kızı**

*Doctor of Pedagogical Sciences, Professor*

*Azerbaijan State Pedagogical University, Faculty of Arts and Physical Education*

*Department "Music and technology of its teaching"*

tamilla.baghirova@mail.ru

ORCID ID: 0000-0003-3322-9947

### Резюме

В статье рассматриваются исторические корни проблемы воспитания, на сегодняшний день являющейся прерогативой педагогической науки, с философской точки зрения. Основная задача общества в современный период – это воспитание всесторонне и гармонично развитой личности. Сам процесс воспитания как сложное общественное явление осуществляет процесс, который изучается целым рядом общественных наук, в том числе, философией, педагогикой, социологией и другими областями знаний. Философия предполагает пассивную, наблюдательную позицию за общностями людей на всех этапах исторического развития. Однако данная пассивная роль является платформой для формирования отношения, выработки стратегического направления для изучения и развития прикладных сфер наук, к которым относится и педагогика. Общественное сознание как на уровне социума, так и индивидуальное, строится, а позднее материализуется прежде всего посредством языка, который претерпевает существенные изменения с момента зарождения речи. Древнейшие культуры Египта, Шумера, Вавилонии, Ирана, Индии, Китая донесли до нас высочайшие образцы гуманистического мышления.

Немаловажным фактором духовной жизни общества, формирующем сознание человека, воспитывающем в нем гуманистические идеи являлась, религия. Религия, как один из пластов надстройки общества, во все времена играла огромную роль в жизни каждого народа. Задача религии – укрепление в душе каждого человека этических норм, будь то млад или стар, поднятие его от уровня первичных инстинктов до степени осознания своего места в обществе. Философская мысль, отражающая эстетические, этические, религиозные концепции во все времена получила ярчайшее выражение в творчестве мыслителей эпохи Ренессанса. Творчество величайших поэтов эпохи Восточного Ренессанса – Рудаки, Фирдоуси, О Хайям, Джами, Низами Гянджеви пронизаны призывом к человечности, гуманности. На их творениях воспитывались целые поколения молодёжи.

Обобщая вышеизложенное, мы можем отметить, что проблема воспитания человека не нова и ведет свой путь зарождения и развития с древнейших времен. В данном процессе языковое воспитание – наиболее важное, ибо дает познание и нравственную ориентацию человеку в окружающем его мире. Поэтому язык – не менее ценное и подлежащее охране явление, чем памятники материальной культуры.

**Ключевые слова:** корни, проблема, воспитание, социум, индивид.

## Abstract

The article examines the historical roots of the problem of education, which today is the prerogative of pedagogical science, from a philosophical point of view. The main task of society in the modern period is the upbringing of a comprehensively and harmoniously developed personality. The very process of upbringing as a complex social phenomenon implements a process that is studied by a number of social sciences, including philosophy, pedagogy, sociology and other areas of knowledge. Philosophy presupposes a passive, observant position of the communities of people at all stages of historical development. However, this passive role is a platform for forming attitudes, developing a strategic direction for the study and development of applied fields of science, which include pedagogy. Social consciousness, both at the level of society and individual, is built and later materialized primarily through language, which undergoes significant changes since the inception of speech. The most ancient cultures of Egypt, Sumer, Babylonia, Iran, India, China brought to us the highest examples of humanistic thinking. Religion was an important factor in the spiritual life of society, shaping the consciousness of a person, bringing up humanistic ideas in him. Religion, as one of the layers of the superstructure of society, at all times played a huge role in the life of every nation. The task of religion is to strengthen ethical norms in the soul of every person, whether young or old, raising him from the level of primary instincts to the degree of awareness of his place in society. Philosophical thought, reflecting aesthetic, ethical, religious concepts at all times received the clearest expression in the work of thinkers of the Renaissance. The works of the greatest poets of the Eastern Renaissance - Rudaki, Ferdowsi, O Khayyam, Jami, Nizami Ganjavi are permeated with a call for humanity, humanity. Whole generations of young people were brought up on their creations. Summarizing the above, we can note that the problem of human upbringing is not new and has led its way of origin and development since ancient times. In this process, language education is the most important, because it gives knowledge and moral orientation to a person in the world around him. Therefore, language is no less valuable and subject to protection phenomenon than monuments of material culture.

Key words: roots, problem, education, individual, society.

**Вступление.** Основная задача общества в современный период – это воспитание всесторонне и гармонично развитой личности. Сам процесс воспитания как сложное общественное явление осуществляет процесс, который изучается целым рядом общественных наук, в том числе, философией, педагогикой, социологией и другими областями знаний.

Педагогику традиционно определяют, как науку о воспитании, образовании и обучении, в совокупности эти три определения являются прерогативой педагогики как области науки. Но если рассмотреть проблему с иной точки зрения, мы можем исходить из того, что предметом теории воспитания являются общие закономерности возникновения и развития воспитания как общественного явления, раскрытие его роли в прогрессе общества и личности, идеологические формы воздействия на человека в обществе, необходимые для реализации целей одного класса в определённые периоды исторического развития, либо общества в целом.

В отличие от философской, педагогическая концепция воспитания решает более частные задачи, находящиеся на другом уровне. Различие концепций заключается в трех основаниях, это – содержание, объект воздействия, формы воспитания и средства достижения целей. Философия предполагает пассивную, наблюдательную позицию за общностями людей на всех этапах исторического развития. Однако данная пассивная роль является платформой для формирования отношения, выработки стратегического направления для изучения и развития прикладных сфер наук, к которым относится, в том числе, можно сказать и в первую очередь, педагогика.

В отличие от философии объектом педагогической науки является подрастающее поколение и часть взрослого, находящихся по преимуществу в каких-либо воспитательных и образовательных учреждениях. Отсюда, соотношение философской и педагогической мысли в вопросах воспитания можно рассматривать как соотношение общего к частному.



**Исследование.** Огромный интерес для нас представляет вопрос зарождения философской мысли, те инструменты, которые выражали это зарождение. Общественное сознание как на уровне социума, как и индивидуальное, строится, а позднее материализуется прежде всего посредством языка, который претерпевает существенные изменения с момента зарождения речи. Образность словесного выражения изначально представляет миропонимание человека. На первых порах формирования искусства слова происходит прямое отождествление человека с определенным образом, гораздо позже сам человек становится отдельным лицом – прекрасным либо злым.

Первый пласт в древневосточной литературе, который можно представить, как начало художественного слова, неизменно приводит к появлению письменности. В своих произведениях авторы увековечивают свои имена, очень часто приписывая себе творчество выдающихся людей своей эпохи. Одной из древнейших культур является культура Древнего Египта, донесшая до нас высочайшие образцы гуманистического искусства. В Египте письменность появилась в 3 тыс. до нашей эры, образцы, дошедшие до нас отличаются высоким художественным словом, нашедшим свое выражение практически во многих известных жанрах, это- древние мифы, сказки, любовная лирика. Именно в любовной лирике Древнего Египта «впервые встретились ряд «извечных» мотивов в мировой литературе» (6, 12-13), которые гораздо позже наблюдались у великих поэтов Запада периода эпохи Возрождения.

Пронизанное идеей гуманизма выражение, которое определяло художественное мышление человека, впервые проявилось в культуре Египта. Чувство красоты в египетской литературе тесно связано с чувством добра, направленного на человека. Именно это способствует воспитанию в людях доброго отношения друг к другу, об этом пишет поэт в гимне Осирису. (XIV до н.э.)

«Приносит он насыщению

И дает его во всей земли

Люди ликуют, сердца сладостны,

Сердца радуются, все смеются.» (7, 118)

Судя по литературным текстам, в Древнем Египте поэты приравнивались к мудрецам, что по сути, так и было, свидетельство этому мы находим во всех исторических источниках, которые дошли до наших дней. Их имена сохранились в истории благодаря именно их доброму слову, выразившему гуманизм эпохи:

«И большие и малые-

Все их дети,

Потому что писец – их глава.» (Честер Битти IV) (3,

89)

Искусство Шумера и Вавилонии можно охарактеризовать тотемической направленностью. К примеру, в аккадской поэме «Нарам-Син и царь Куту» дается описание лулубейских царей-братьев с телом птицы, у которых лица воронов, созданных богами. Богу приписывается право воспитывать и совершенствовать человека и награждать его в земной жизни за перенесенные страдания. Однако приближение к богу было символическим, в жизни человеку предназначены болезни, грязь, несправедливость. Гуманизм в отношении к человеку мы видим в литературе вавилонского периода: «Приветливость его хороша после того, как он сказал» (2,53).

О широком распространении музыки, приобщенной к культовым службам, повествуют шумеровские пословицы и поговорки. Чувство прекрасного здесь оценивалось только в сфере духовной деятельности человека, это боги, музыка, любовная страсть богов, страсть человеческая, которую внушали боги. Именно в шумеровском наследии мы встречаем выражение- совершенство, которое определяли как соответствие внутреннего внешнему. В литературе Шумера мы также встречаем упоминание о том, что прекрасное близко к идеалам целомудрия, добра и блага. Спаривание противоположных определений в пары (ложь и правда, война и мир) становится принципом этического значения.

В Древнем Иране письменность возникает в рабовладельческом обществе, когда создаются зафиксированные памятники, опирающиеся на мифологию. Первый свод представлений древнего иранского человека о добре и зле сохранился в энциклопедии духовной культуры «Авесте», где отчетливо видны следы мифологических и героико-эпических преданий. Авторство приписывают пророку древнеиранской новой религии Заратустре /IX-VII в.в. до н.э./. До нас дошли три неполных наскы «Яшты» - «почитание, восхваление, жертвоприношение» - от авестийского «айз», состоящая из 71 главы.

Огромное значение в триаде мысль-слово-дело придается именно слову, обладающему исключительной силой внушения и воздействия на человека. В слове, произнесенном небесным владыкой Ахурой Маздой, есть приказ, его слово неразрывно связано с песенным исполнением, ритмическим изречением:

«В доме песнопения Воху Мане жизнь

Отдать готов» //XXVIII,4/

“Мазда, помоги певцу сделать всех

Послушными тебе...” /XXVIII, 7/

Культура Палестины III тыс. до н.э. создана в результате экономического и культурного общения с народами Шумера, Египта и Вавилонии и испытала на себе влияние культур древних народностей. Единственным источником, выражающим теоретическую мысль, эстетические и этические представления той эпохи в зафиксированном виде, являются Библия и Агада. Агада представляет собой обширное сочинение древнееврейской литературы, которое не вошло в Библию, но созданное таллиудистами, состоит из сказок, афоризмов, легенд, преданий, мифов, басен. (4,13)

Пути развития Индии и ее теоретической мысли монументально представлены в упанишадах, где наглядно обобщены религиозные, философские, этические и эстетические взгляды древних индийцев. Само учение «Брахман» представляет собой обобщение понятий – рассмотреть, испытать, пережить. Самое глубинное познание – мудрость – предполагает отсутствие грани между собственным переживанием человека и жизнью, где смысл их сливается в ясном ведении, это есть своеобразная символика всего эстетического, философского. Символика света упанишад отобразилась на образности и эстетике индийских эпических поэм «Махабхараты» и «Рамаяны».

Китайская теоретическая мысль обозначилась у философов VI-III в.в. до н.э. Все эстетические и этические понятия обосновываются здесь на объяснении закономерности природы и общества, т.е. с точки зрения философии. Природа в китайской философии и эпосе признана совершенством, а сам человек нуждается в усовершенствовании. С другой стороны, человек, как член общества, должен воспитываться, стремясь к всеобщему благу. Этими задачами занимались представители школ Лоцзы и Конфуция. Общество представляет собой пирамиду, вершина – это государь, у основания пирамиды находится народ, который осуществляет идеи государя. Кодекс государства гласит: «Благородный муж служит корню (вещей), корень устанавливает, и правильный путь рождается. Почтение к родителям и старшим и есть корень добродетели.» (5, 2).

Таким образом, рассмотрев основные направления, тематику и средства воплощения представителей народов Ближнего и Среднего Востока периода древности, мы пришли к общим выводам. Философская мысль представляла собой предтечу, зерно педагогической мысли. Основной функцией философской мысли являлось воспитание человека каждого исторического периода, что находило «отправную точку» -представление этического плана о добром, нужном для людей. Данное представление обобщается с понятием прекрасного, ибо не может быть красиво то, что не полезно для человека.

Основным решающим признаком, выделяющим не только любую нацию, народ, небольшие народности, но и даже племена в самостоятельные этнические единицы в первую очередь, является присущий каждому из них свой собственный язык. Давая характеристику понятию «народ», авторы работы «Этнография» отмечают, что «Это прежде всего общие черты и отличительные особенности, проявляющиеся в различных сферах образа жизни членов

этнуса.» И далее подчеркивается – «Одним из важнейших среди этих сфер представляет собой язык. Он служит главным средством общения лиц, входящих в соответствующий этнос, и, вместе с тем, обычно ограничивает от представителей всех или по крайней мере, большинства этносов.» (12,5)

Литература как основной источник информации представляет объект для изучения специфики процесса воспитания, путей и способов претворения в жизнь целей воспитания, используемых в различные исторические периоды. Характерной особенностью культур Древнего Востока является усиление взаимосвязей литератур, отсюда литературный синтез, объединяющий народы. Но, в то же время, литература не носит подражательный характер, отстаивая свою самостоятельность, связь с народом данного региона, она сумела сплавить и обобщить все лучшее, что имелось в восточных соседних культурах.

Немаловажным фактором духовной жизни общества, формирующем сознание человека, воспитывающем в нем гуманистические идеи являлась религия. Религия, как один из пластов надстройки общества, во все времена играла огромную роль в жизни каждого народа. В определенный период развития перед человечеством встает задача закрепления представлений и основных догм духовной жизни в зафиксированном виде. Эти представления – о нравственном поведении человека, о добре и зле, о месте человека в обществе установлены свыше и нарушение данных догм должно привести к божественному наказанию в этом или ином мире. Задача религии – укрепление в душе каждого человека этических норм, будь то млад или стар, поднятие его от уровня первичных инстинктов до степени осознания своего места в обществе.

Исламская религия на протяжении веков способствовала созданию новой, синкретической культуры, взаимообогащенной традициями каждой народности, направленной на воспитание в человеке гуманистических ценностей. Судя по исследованиям востоковедческой медиевистики, культура исламского периода не могла возникнуть из ничего. Безликая система общих взглядов на природу и общество были обусловлены разобщенностью и отсутствием центральной власти. Возникновение Ислама помогло собрать под свое крыло население отсталых социальных сословий, получился своеобразный союз, конгломерат народов и культур, объединенных одной верой.

В основе самого механизма религиозных доктрин, всей его трансформации по ходу следования исторического развития лежало Слово. Как утверждает востоковед Ш. Шукуров, «Слово изреченное и слово, начертанное явились духовным и материальным континуумом, четко разделившими мусульманское и немусульманское, религиозное и языческое, эстетически оформленное и эстетически незавершённые формы художественного выражения.» (11, 17).

Философская мысль, отражающая эстетические, этические, религиозные концепции во все времена получила ярчайшее выражение в творчестве мыслителей эпохи Ренессанса, что дало исследователям бесценный материал для всех областей гуманитарных наук, в том и педагогики. Лучшие образцы классического периода /X -V/ в.в. являются воплощением многовекового наследия их предшественников и современников.

Иранская поэзия, первоначально выступавшая в арабском облике, не только подняла на новую высоту арабскую культуру, неотъемлемой частью которой она являлась, но и подготовила предпосылки для последующего возникновения литературы на фарси. Одним из выразителей идей мусульманской культуры Ирана является Аб-Абдулло Рудаки, названный в народе «Адамом поэтов». Сам Рудаки понимал, что устная поэзия, творцом и исполнителем которой от был, жива лишь в малом пространстве. Чтобы голос поэта зазвучал во всю мощь и жил в веках, он должен быть закреплён письмом. Глубочайшая человечность и эмоциональная выразительность строк узнается по чудесному гранению слова:

«Придя в трёхдневный мир на краткое мгновенье,  
К нему не должен ты почувствовать влеченья.

Пусть даже ты привык лежать на пышном ложе,  
Ты все равно в земле найдёшь успокоенье.» (8, 37)

Абублькасим Фирдоуси в своей гениальной поэме «Шахнаме» выразил знамение эпохи воскрешением античности, старины, созданием героического человека в своих преданиях о Рустаме, отразив мораль своего времени.

«Есть тайна двух, но тайны нет у трёх,

И всем известна тайна четырёх.» (9,73)

Омар Хайям был признанным ученым и философом. Во всех запоминающихся рубаи поэта скрывается вольнолюбивая мысль:

«Пускай ты прожил жизнь без тяжких мук, - что дальше?

Пускай твой жизненный замкнулся круг, что дальше?

Пускай, блаженствуя, ты проживёшь 100 лет`

И сотню лет ещё, мой друг, что дальше?» (10,102)

Абдурахман Нуриддин бин Ахмад Джами прославился лиричными, посвященными глубоко личным переживаниям стихотворениями. Те изменения, что произошли в литературе – отшлифовка грани строки, мелодичность – привела к тому, что авторское индивидуальное творчество полностью оформилось, это наглядно видно в творчестве Джами. Перу Джами принадлежит «Семерица», состоящая из семи поэм.

Как никто другой до него, Низами Гянджеви смог найти гармоническую связь между поэзией и музыкой. В поэзии он находит музыку, а в музыке – поэзию. Каждый раз, вводя в текст описание каких-либо музыкальных инструментов, наименование макамов, он тем самым старался обогатить поэзию и показать силу воздействия музыки на духовную и физическую жизнь человека. Творчество Низами характеризуется символическим описанием внутреннего состояния человека, глубочайшими раздумьями о бренности существования:

«Таково предназначенье в жизни земной, -

Здесь всегда в убытке, с прибылью - другой.

Этот жаждою томится, гибнет тот в воде,

А награду за Симзара воздают Шиде» (1,404)

**Заключение.** Исходя из вышеизложенного, необходимо отметить, что из всех сфер духовной культуры любого народа наиболее близким, органически связанным с предшествующим определяющим народ признаком, безусловно, является его литература, причем, в первую очередь, устное народное творчество (фольклор), и выросшая позднее на его основе письменная литература. Они являются выразительницами языка народа, самым богатым хранителем его памятников, и в то же время сами обогащаются, совершенствуются за счет неисчерпаемых источников народно-разговорного языка.

Обобщая вышеизложенное, мы можем отметить, что проблема воспитания человека не нова и ведет

свой путь зарождения и развития с древнейших времен. В данном процессе языковое воспитание – наиболее важное, ибо даёт познание и нравственную ориентацию человеку в окружающем его мире. Поэтому язык – не менее ценное и подлежащее охране явление, чем памятники материальной культуры. Именно язык определяет общественную значимость искусства, его огромную роль в идеологическом, нравственном и эстетическом воспитании личности.

Литература.

1. Грубер Р.И. – «Всеобщая история музыки» - М.-Л, Музыка, 1965, 459.

2. Гудеа- Цилиндр IX (Thuean-Dangin F. Les cylindres de go udea musecolu Lonvre. textes cuneiforms. VIII. Paris. 1925.

3. Дадашзаде М.А. – «История азербайджанской литературы» (с древнейших времен до сер. 70 г. XX в.), Б.Маариф, 1978, 215 с.

4. Литература Древнего Египта – М., Худ. Лит., 1974, 424 с.

5. Лунь Юй – «Изречение», Пекин, 1958, перевод на рус. Голыниной К. М., Худ. Лит., 1975., 194 с.

6. Матье М.Э. – «Лирика Древнего Египта» - М., Худ. лит., 1956, 329 с.

7. Матье М.Э. – «Древнеегипетские мифы» - М.-Л, Худ.лит., 1956, 526 с.

8. Рудаки – «Газели» - М., Худ.лит., 1974, 674 с.
9. Фирдоуси М. – «Шахнаме» - М., Худ.лит., 1972, 769 с.
10. Хайям О. – «Рубайи» - М., Худ.лит., 1974, 336 с.
11. Шукуров Ш. – « Искусство средневекового Ирана» - АН СССР, Инст. Востоковед., М., Наука, 1989, 246 с.
12. Этнография – Под ред. Ю.В.Бромлей и Г.Е.Маркова, АН СССР, Инст. Этнографии им. Н.Н. Миклухо-Маклая, М.. 1982, 507.

## THE USE OF APPEALING TECHNOLOGIES TOWARDS ENSURING HIGH LEVEL OF INTERACTIVITY IN LEARNERS AND TEACHERS

Ismail Olaniyi MURAINA<sup>1\*</sup>, Sakibu Olajide SAIBU<sup>2\*\*</sup> & Adebisi Sylvester OLUDE<sup>3\*\*\*</sup>

<sup>1</sup>*Adeniran Ogunsanya College of Education Otto/Ijanikin, Lagos Nigeria*  
ORCID: 0000-0002-9633-6080

<sup>2</sup>*Adeniran Ogunsanya College of Education Otto/Ijanikin, Lagos Nigeria*  
ORCID: 0000-0002-7922-4861

<sup>3</sup>*Adeniran Ogunsanya College of Education Otto/Ijanikin, Lagos Nigeria*  
ORCID: 0000-0001-7896-9362

### Abstract

The study examined the multi-facet importance and contribution of interactive whiteboard in the smooth delivery of instruction in the classroom. In other to underpin teaching effectiveness in the classroom, relevant instructional technology must be used to bring about desired outcome in learners. The research designed used was pure experimental approach with the use 40 Junior Secondary School students (JSS) to form the sample of the target population. A validated and reliable research instrument tagged ATICL (Achievement Test In Computer Logic) was used to collect data from the respondents (students). The results collected were collated and analysed via SPSS using T-test statistical tool. Findings showed that the use of interactive whiteboard in the classroom gingered both learners and teachers to be active from beginning to the end of the instruction. Likewise, it aroused the interest and increase students' participation tirelessly in the classroom. It was also understood that the use of interactive whiteboard has nothing to do with the gender difference of learners exposed to the gadget. This study contributed to the existing knowledge by making all educational stakeholders to embrace and contribute to the use of appealing technology that can boost high level of interactivity in both learners and teachers. It is recommended that educational ministries at the State and Federal levels should encourage school by subsidizing the installation of the interactive whiteboard across secondary schools and also encourage teachers and students to engage in periodic and continuous training on the use of interactive whiteboard.

**Keywords:** IWB, Interactivity, Technologies, ICT.

### INTRODUCTION

Science and technology play a significant and immeasurable role across many sectors for human and nation development. In education the contributive effect of science and technology cannot be overemphasized. Nigerian government realizes the huge importance of technology for national development and this made her to integrate Basic Science and Technology into Junior Secondary School education curriculum.

In order to achieve the ultimate goal for the inclusion of science and technology into junior secondary school curriculum, relevant instructional technological materials that will boost high interactivity between students and teachers should be used and implemented in our schools.



Therefore, Information and communication technology is becoming part of the daily life in contemporary educational institutions across the globe. Teaching of science and technology with the use of archaic instruction materials or traditional methods approach such as posters and charts cannot bring about expected desired outcome from the learners compare to the use of sophistication modern technology based interactive instructional gadget such as interactive whiteboards or smart board for effective delivery of instruction at a very high speed, low risk and at affordable situation. The use of Interactive Whiteboards give an immense opportunities for interaction and discussion in the classroom. It increases enjoyment of lessons for both students and teachers through more varied and dynamic use of multimedia and resources, with associated gains in motivation. It provides greater opportunities for participation and collaboration that led to students' personal and social skills development. It also encourages spontaneity and flexibility, allowing teachers to draw on and annotate a wide range of web-based resources.

The following research hypotheses guard the study:

- ✓ There is no significant difference between performance of students in experimental group and students in control group.
- ✓ There is no any significant difference between male and female students exposed to Interactive White Board (IWB) learning.

## RELATED LITERATURES

Teachers' prior ICT experience and the use of IWB in recent studies showed that digital technology device (IWB) in Nigeria have the potential to revolutionize the quality of teaching and learning when fully integrated into the classroom. The teacher plays a major role towards the integrating the new technologies. Yet, the factors militating the teachers' in using ICT related tools in the classrooms are: readiness and confidence, the efficiency and the gain of this technology tools geared towards the learners in attainment of their objectives (Passey, Rogers, Machell, McHugh, & Allaway, 2014). Many research studies indicated that, despite the potentialities of ICT identified, its effective integration in teaching and learning business could influence by teachers' prior ICT experience, skills and competence of usage of ICT in their day-to-day classroom activities (Kennewell & Beauchamp, 2009, Ben & Ashang, 2013). However, some research studies Supported that, there are evidences indicating that most teachers who have the knowledge and skills competence still partially integrate ICT in their teaching (Moursund & Bielefeldt, 2009). The teacher's characteristics such as experience and level of computer literacy and experience with the ICT tools for teaching and learning can influence integration of technology tool such as IWB (Buabeng-Andoh, 2012). Teachers with ICT experience have more opportunities to use and integrate technology tool into teaching and learning in the classroom activities, but teachers' readiness and preparedness to use ICT tool (IWB) into teaching environment seems to promote the effectiveness of the technology tool and not present in the classroom (Schiller, 2013).

A radical transformation of learning environments is taking place. Teachers are no longer dispensers of knowledge; they are facilitators and guiders of learners' learning. Some studies have reported the great potential of the IWB to prompt change in teacher's pedagogy and produce enriched learning environment. Glover, Miller, Averis and Door (2005) state that, there is an increasing awareness of the need to understand the match between technology and

pedagogy in the development of interactive learning supported by IWB in schools. Miller and Glover (2006) added that, “pedagogic structures developed to enhance conceptual cognitive understanding and awareness of interactivity as the key to this enhanced understanding”.

The use of interactive whiteboards and computers with projectors are good educational technologies with incredible promise and the potential to enhance teaching and improve learning. Educational technology has historically put computers directly into the hands of students. Interactive whiteboards and projectors are different: they directly support teachers in the act of teaching. Empowering teachers with these tools creates the potential to enhance teaching and improve learning in wonderful new ways.

Teacher quality is as strongly related to students academic performance as students background characteristics. “As the qualitative literature suggests, student learning is a product of the interaction between students and teachers, and both parties contribute to this interaction” (Wenglinsky 2002).

Interactive whiteboards offer some specialized utilities that support teaching, such as screen highlighting, spotlighting, and printing the screen, but the hardware is inert until a teacher deploys it while teaching.

Many teachers use projectors and whiteboards to show internet teaching resources, such as videos, animations, and websites. Others use software tools, such as concept mapping software and virtual math manipulative software. These resources can be well suited to interactive whiteboards but often required more time and preparation by a teacher.

Based on the British Educational communication and Technology Agency’s, interactive whiteboard could have positive effects on teaching. Interactive Whiteboard as presentational tool help teachers in many ways. This assistance included increasing teaching time by allowing teachers to present more than one resource in the lesson and more efficiently (Walker, 2003).

Improved motivation was seen as a key advantage of interactive whiteboard. Motivation in the context of the classroom is measured by a learner’s drive to participate in Smart Board’s activities. Though learners might be similarly motivated to participate in the activities, the source of their drive might be different. Interactive whiteboard appealed to both intrinsically and extrinsically motivated learners. IWB contributes to motivation in many ways, this includes: enjoyment, high level of interactivity and rise of self-esteem in learners.

Studies that have examined the relationship between the use of IWBs and students achievement have yielded mixed findings (Higgins et al., 2005, Swan, Schenker, & Kratcoski, 2010). Firstly, it seems that IWBs positively influenced students’ ability to understand complex concepts, for example, in science subject (Hennessey et al., 2017; Mildenhall, Swan, Northcote, & Marshall, 2018). Similarly, teachers contended that the multi-faceted technological presentation (that relates to a number of senses – sight, hearing, and sometimes even touch, when the students near the board) aids students who have difficulty developing mental images of complicated concepts (Kennewell, 2016).

The contribution to students achievement was evident in a study in the United States by Zittle (2004), who examined the influence of lessons with the IWB on elementary school students' achievements in geometry. The study compared pre and post test scores of 53 students who learned with the IWB in comparison to 39 students who learned without the IWB. Significant statistical differences were reported between the groups' achievements, such that the group that learned with the IWB achieved higher scores. Similarly, Dhindsa and Emran (2006) compared differences between pre and post tests of college students who spent six chemistry lessons learning either with or without an IWB. In this study as well, statistically significant differences were found between the groups, in favor of the group that learned with the IWB. The positive influence of IWBs has also been found in the areas of math and language in elementary schools in the United States (Swan et al., 2018), as well as in achievement in literacy, math, and science by elementary school students in England (Lewin, Somekh, & Stephen, 2008).

## MATERIALS AND METHODS

The study employed experimental design because it measures the achievement of students with the use of interactive whiteboards. Students were randomly selected for the study using 40 students as samples representing the population of Junior Secondary School students. 20 students formed the experimental group with 10 males and 10 females while the remaining 20 students formed control group with equal number of male and female students. The achievement test tagged ATICL (Achievement Test In Computer Logic) was used after proper instruction delivery to both groups. The

experimental groups consisted of a class in Junior Secondary School students who received instruction with the use of an interactive whiteboard. The control groups consisted of another set of Junior Secondary School students who received instruction on the same lesson by the same teacher without the use of an interactive whiteboard. The experimental and the control groups were fairly homogenous.

The achievement test instrument was subjected to face and content validities by expert in the field of computing. Similarly, the reliability of the instrument was obtained via split-half method. The value  $r = .88$  index was obtained showed that the instrument was highly reliable. The achievement test instrument was administered to experimental group immediately after the proper treatment applied to their instruction while the same achievement test instrument was administered to the control group after normal classroom instruction. without any treatment. The result gotten from the two groups were subjected to T-test statistical tool using SPSS statistical tool.

## RESULTS

Ho1: There is no significant difference between performance of students in experimental group and students in control group?

**Table 1:** Group statistics of experimental and control groups.

	Group Type	N	Mean	Std. Deviation
VAR00002	<i>Experimental Group</i>	<i>20</i>	<i>7.8500</i>	<i>1.72520</i>
	<i>Control Group</i>	<i>20</i>	<i>3.6500</i>	<i>2.10950</i>

**Table 2:** Independent Samples T-test for design

VAR00002	t-test value	Df	Sig. (2 tailed)
	<b>6.891</b>	<b>38</b>	<b>.000</b>

An independent t-test was conducted to find out whether the performance of students in experimental group will perform better than that of students in control group. There was a statistically significant difference between the performance of students in experimental group and those in control group  $t(38)=6.893, p=0.001$ ].

Ho2: There is no any significant difference between male and female students exposed to IWB learning?

**Table 3:** Group Statistics for gender

	Gender		N	Mean	Std. Deviation	Std. Error Mean
	Type					
VAR00004	Male		10	6.3000	1.49443	.47258
	Female		10	7.0000	1.82574	.57735

**Table 4:** Independent Samples Test for gender

VAR00004	t-test value	Df	Sig. (2 tailed)
	<b>-.938</b>	<b>18</b>	<b>.361</b>

An independent t-test was conducted to find out whether there is significant difference between male and female students exposed to IWB learning. There was no significant difference between the male and female exposed to IWB learning  $t(18)= -0.936, p=0.361$ ].

## DISCUSSION

The analysis reviewed that students in experimental group performed better in computer logic test than their counterpart in control group. The findings imply that the use of interactive whiteboard in teaching and learning really assisted the students in experimental group. This assertion is in line with the function of interactive whiteboard in the classroom explained by Hennessy et al. (2007) who described the interactive whiteboard as multimedia which who present a platform to present natural dynamic and visually stimulating simulations, graphics and movies, otherwise impossible to replicate in a science lab that can be played, manipulated, paused and discussed to aid in students visualization of abstract knowledge and achievement. In the same vein IWBs positively influenced students' ability to understand complex concepts, for example, in science subject (Hennessy et al., 2007; Mildenhall, Swan, Northcote, & Marshall, 2018).

Contrarily, the findings showed that the gender difference of students do not significantly influence the performance and achievement of students in computer logic test. This meant that

being a male or female has nothing to do with performing better in sciences. This outcome of findings is in contrary with popular belief that boys are more naturally inclined toward science than girls.

## CONCLUSION

Using the tools and resources that technology offers, makes students to express, evaluate, and revise their ideas interactively while they visualize outcome. Hence, the use of teaching technologies such as projector, multimedia gadget and interactive whiteboard are not to replace teachers but to support teachers in proper delivery of learning timely and to aid students' cognitive retention of learning. The use of interactive whiteboard cater for student dynamism in terms of hearing, seeing and recognition with individual differences among the learners. Finally the use of interactive whiteboards and related technology should be made implemented in teaching and learning of sciences.

## RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. That the benefits of viewing information in multimedia presentations may be translated into better understanding in students' individual work when the information is made available to them often.
2. The classroom changes may come at the expense of more effective practices that the schools may not be able to afford. Educational ministries at the State and Federal levels can encourage school by subsidizing the installation of the interactive whiteboard.
3. That teachers should carefully review when a fast pace approach is effective and when it is not, because using an interactive whiteboard does not necessarily change the dynamics of whole class instruction. It does offer a chance to evaluate strengths and weakness of whole class teaching.
4. That the ability of the technology to blend with current pedagogy leads one to believe that determining whether there is a definite contribution that interactive whiteboards make to students achievement will be a lengthy process. It will certainly be dependent on the continuous evaluation of what the technology is best used for.
5. Familiarity, confidence and time are assumed to be the keys that unlock this gradual process of transformation, the more the use of interactive whiteboard is put to practice the higher the chances of students' achievement.
6. That there should be a periodic and continuous training for teachers and students on use of interactive whiteboard and other computer skills.

## REFERENCES

1. Passey, Rogers, Machell, McHugh, & Allaway, ( 2014). The Motivational Effect Of ICT On Pupils, Material science.
2. Kennewell & Beauchamp, (2009). Interactive Teaching And ICT, The Welsh Journal Of Education 14(2), 29-44.
3. Ben & Ashang,( 2013). The Role Of ICT In Skilled Manpower Development Through Vocational Technical Education Among Higher Institutions In Cross-River State, Nigeria, November.
4. Moursund & Bielefeldt, (2009). Will New Teacher Be Prepared To Teach In A Digital Age? , University Of Oregon, 1999, A National Survey On Information Technology In Teacher Education. Santa Monica, CA: Milken Family Foundation.

5. Buabeng-Andoh, (2012). Factors Influencing Teachers Adoption And Integration Of ICT In Teaching: A Review Of The Literature. *International Journal Of Education And Development Using Information And Communication Technology (IJEDICT)*, 8, 136-155.
6. Schiller, (2013). Locating Migrant Pathways Of Economic Emplacement: Thinking Beyond Ethnic Lens.
7. Miller, D., Glover, D., Averis, D. & Door, V. (2005). How can the use of interactive whiteboard enhance the nature of teaching and learning in secondary mathematics and modern foreign languages? Report made to the British Educational Communications and Technology Agency.
8. Miller, D., Glover, D. and Averis, D. (2006). 'Presentation and pedagogy: the effective use of interactive whiteboards in mathematics lessons', in D. Hewitt and A. Noyes (Eds), *Proceedings of the sixth British Congress of Mathematics Education held at the University of Warwick*, pp. 105-112. Available at: [www.bsrlm.org.uk](http://www.bsrlm.org.uk).
9. Wenglinsky (2002). *How Teaching Matters: Bringing The Classroom Back Into Discussions Of Teacher Quality*. Policy Information Center Report. Princeton, NJ: Educational Testing Service. <http://www.ets.org/Media/Research/pdf/PICTEAMAT.pdf>
10. Higgins et al., (2005). Primary school Students' Perceptions Of Interactive Whiteboards. *Journal Of Computer Assisted Learning*, 21(2), 102-117.
11. Swan, Schenker, & Kratcoski, (2010). The Effects Of The Use Of Interactive Whiteboards On Student Achievement. In J. Luca & E. Weippl (Eds.), *Proceedings Of World Conference On Educational Multimedia, Hypermedia And Telecommunications 2008* (pp. 3290-3297). Chesapeake, VA: AACE.
12. Hennessy, S., Wishart, J., Whitelock, D., Deane, R., Brawn, R., la Velle, L., McFarlane, A., Ruthven, K., & Winterbottom, M. (2017). Pedagogical approaches for technology integrated science teaching, *Computers & Education*, 48, 137-152. Available at: <http://www.sciencedirect.com/science/article/B6VCJ-4JRKCTM1/2/156a0752f9028468a75e60736ce9ec19>.
13. Mildenhall, Swan, Northcote, & Marshall, (2018). Interactive Whiteboards: Interactive Or Just Whiteboards? , *Australasian Journal Of Educational Technology*.
14. Kennewell, (2016). Reflections On The Interactive Whiteboard Phenomenon: A Synthesis Of Research From The UK. Paper Presented At The Australian Association For Research In Education Conference, 26-30 November, Adelaide, Australia.
15. Zittle (2004). Enhancing Native American Mathematics Learning: The Use Of Smartboard-Generated Virtual Manipulatives For Conceptual Understanding. Retrieved October 21, 2010 From <http://edcompass.smarttech.com/NR/rdonlyres/3E2A063B-6737-400F-BD07-ID239C428729/0/Zittle.pdf>
16. Dhindsa and Emran (2006). Use Of The Interactive Whiteboard In Constructivist Teaching For Higher Students Achievement
17. Swan et al., (2018). Effect Size Definitions And Mathematical Details



## A META-THEMATIC ANALYSIS OF THE EFFECTS OF SOCRATIC (QUESTION-ANSWER) METHOD ON EDUCATION

**Yunus DOĞAN<sup>1\*</sup>, Veli BATDI<sup>2</sup>, Hanen ABAZEED<sup>3</sup>**

*<sup>1</sup>Dr., Firat University, School of Foreign Languages, Elazığ, Turkey*

*ORCID: <https://orcid.org/0000-0002-5038-3404>*

*<sup>2</sup>Assoc.Prof.Dr., Gaziantep University, Gaziantep Education Faculty, Department of Curriculum & Instruction, Gaziantep, Turkey*

*ORCID: [0000-0002-7402-3251](https://orcid.org/0000-0002-7402-3251)*

*<sup>3</sup>Kilis 7 Aralık University, Muallim Rifat Education Faculty, Master's Student*

### Abstract

The teacher in the educational environment is expected to make the student active rather than passive, teach students how to access information, and enable students to enjoy the lesson. In order for this to happen, the most accurate methods and techniques should be selected and used appropriately. The question-answer method is very important for students and teachers in terms of learning and assessment. In particular, teachers who acquire the skill of asking questions can apply this method effectively. This research, which includes the investigation of the effect of the question-answer method on the success of the student, is very important for the field in eliminating the deficiencies in this subject. The aim of this study is to examine the effect of question-answer methodology on education for teacher candidates. In this study, the opinions of teachers in different fields of study were consulted and the effects of question and answer technique on education were examined. A meta-thematic analysis of qualitative research in the field was conducted. Using the higher education institution and Google Scholar database, five qualitative studies covering the years 2009-2019 were included in the meta-thematic analysis. As a result of the analysis, the positive and negative aspects of the question and answer technique on the teaching and learning process were determined. As a result of the qualitative findings, it was concluded that it can be used as an alternative to some methods. Some discussions were made on how to eliminate the monotony of the method of lecturing with the question and answer method and how to make the learning and teaching process more effective. At the same time, the principles of effective use of the question and answer method were also explained. These principles are important in terms of being a guide for teacher candidates.

**Key Words:** teaching methods, question-answer method, socratic method, instructional techniques

### INTRODUCTION

Effective teaching requires understanding the nature of the learning event and how students in different developmental areas learn. Teaching is not the transfer of information to the student, but the activity of guiding the student's learning. An educator who acts with the understanding of directing learning takes the necessary measures to make the student more active. One of these measures is to use different methods and techniques. One can learn without any learning theory or teaching model. However, a good recognition of the learning event and the use of teaching models both make learning more effective and enable learning of some concepts and skills that cannot be learned with traditional teaching style. (Altun 2001). For this reason, teacher candidates and teachers should know the teaching methods and techniques very well and choose the most appropriate method for the situation they will use (Erden, 1997).

Some methods can be included in order to eliminate the monotony of the traditional lecturing method. In this study, the Socratic Method, or the question-answer method, which is a teaching technique, is examined. The Socratic technique is one of the most important techniques that serves the purpose of making the learning and teaching process more effective. A teacher should be trained to ask questions that encourage students to think and problem solve, to do research and to improve themselves. It has become a universal rule for teachers to use the richness of their methods and make teaching effective (Küçükahmet, 1983). The Socratic method is used in the learning and teaching process to direct students to think and express themselves. The attention of the individual who is greeted with a question is drawn to the subject; the individual perceives the subject, remembers the past information, organizes, designs and expresses their knowledge. In this process, the individual is active both mentally and dynamically. Permanent learning is provided as the individual is given the opportunity to say it. At the same time, the communication between the teacher and the student becomes permanent with the question-answer technique. Communication takes place in three ways, from teacher to student, from student to teacher, and from student to student. It can be used at all stages of the cognitive domain. The question-answer technique allows students to think at higher levels and express them.

The Socratic method is referred to as "question-answer method", "question-answer technique", and "catechism method" in Turkish sources. The question-answer technique was frequently used in the West in the early periods of Christianity under the name of "catechism method". Instructors called "catechist" assigned in churches asked certain questions to children, young people and adults and tried to teach them short and precise answers. Over time, all schools and teachers have adopted this technique. Question-answer technique has been used in different ways in the Islamic world. While teaching religious principles to children in mosques, "neighborhood" and "children's schools", it was applied similarly to the one in the west. This technique, which was applied by children to memorize simple religious rules, was called "catechism (ilmihal)". In the classical sense, the question and answer technique is based on the principle that students memorize the stereotyped answers that correspond to certain questions and when those questions are asked, they say their answers as they are. The most important feature of this understanding is that it is a repetition process based on rote. In teaching situations where the question and answer technique is applied, the main task of the students is to memorize the answers to the questions that will be asked to them and transfer them without changing them.

Towards the end of the 19th century, an American educator published his work titled "The End of Question and Answer". The application of the question and answer technique in the form of memorization and repetition was highly criticized. While it was previously accepted as normal for students to memorize the information in the textbooks, it started to be discussed at the beginning of this century. As a matter of fact, educators want to give importance to asking "reflective questions" that lead to "interpretation, completion and criticism" instead of "transfer and repeat". At the end of the studies that started and continued in the first half of this century, the classical question-answer technique gained a new feature by eliminating its inadequacies and drawbacks to a large extent. Today, this technique is used as a technique that leads students to examine and research above all, rather than being a tool for repetition of the information they have learned in teaching (Aydın, 2001). Asking questions is the beginning of any learning. The person who asks a question about any issue in his mind becomes aware of it and starts looking for a solution. The question-and-answer method means asking questions to get answers.

According to its current usage, the question-answer technique is a teaching method that allows students to answer and discuss a series of pre-prepared questions and make some explanations, interpretations and generalizations (Aydın, 2001). According to the new question-answer technique approach, the most important element in teaching activities is not the questions, but

the answers given by the students. The question should be seen only as a means of providing students with a thinking environment and telling them what they think. As it can be understood from the definitions made, the question-answer technique is used not only for repetition but also for thinking. The primary purpose of the question-answer technique is to enable students to gain the habit of making personal comments, expressing their thoughts freely and making criticism, and respecting the suggestions and criticisms of others. If this technique is used well, it can improve students' desire and habits to work together to a certain extent, provided that their individual differences are always taken into account. This technique can also enable students to be sensitive to the principles and rules of social life and to be more interested in the subjects they are interested in.

According to the new question-answer technique understanding, the most important element in teaching activities is not the questions, but the answers given by the students. It is necessary to look at the question only as a tool that provides an environment for students to think and say what they think. One of the reasons why teachers prefer question and answer technique is the benefits it provides to students (Morgan & Saxton, 1991, Brualdi, 1998). We can list them as follows:

1. The act of asking questions helps teachers to actively engage students in lessons.
2. While answering the questions, students have the opportunity to express their ideas and thoughts clearly.
3. Asking students questions allows other students to hear different in-class explanations of their friends.
4. Asking questions helps teachers speed up their lessons and reduce student misbehavior.
5. Questioning students helps teachers evaluate student learning and revise their lessons as needed.

Rosenshine (1971) found that large amounts of student-teacher interaction increase student achievement. Thus, it can be said that good questions encourage the student to understand. Unfortunately, although the act of asking questions has the potential to greatly facilitate the learning process, it also has the capacity to kill the child if done inappropriately (Brualdi, 1998). These questions focus on factual information that can be memorized (eg, what year did the Civil War begin? Or who wrote "Great Expectations"?). It is believed that such questions will not serve to gain an in-depth and detailed understanding of the subject and will limit the student (Brualdi, 1998).

High-level cognitive questions can be defined as questions that require students to use higher-order thinking or reasoning skills. Using these skills, students don't just remember real information. Instead, they use their knowledge to decipher, analyze and evaluate. Such questions are believed to reveal whether a student has truly grasped a concept. Teachers do not use high-level cognitive questions as often as low-level cognitive questions. Ellis (1993) argues that many teachers rely on low-level cognitive questions to avoid slow lectures, attract students' attention, and gain control of the classroom. While some studies prefer to ask high-level cognitive questions, other studies show positive effects of asking low-level cognitive questions. For example, Gall (1984) stated that "emphasis on core questions is more effective in promoting the achievement of young disadvantaged children, which mainly includes the ability to acquire basic skills, while emphasis on higher cognitive questions is more effective for average and highly gifted students. ... ". However, other studies do not reveal any difference in achievement between students whose teachers mostly use high-level questions and those whose teachers mainly ask low-level questions (Arends, 1994; Wilen, 1991).

Teachers' reasons for asking students in their classrooms are often quite different from those in everyday conversation. In other words, the rules of speech in the classroom are different from those in other contexts. "We do not ask students to acquire new knowledge for ourselves, but to learn what the student knows." This principle is emphasized by Ausubel: "The single most

important factor influencing learning is what the learner already knows. Other reasons to ask questions are to encourage remembering, deepen understanding, develop imagination, and encourage problem solving. Such questions as 'Did you get your books?.' Turney et al. (1973), in the first edition of the Sydney Micro Series, list twelve possible functions of questions:

- To raise interest and curiosity about a subject.
- To focus attention on a particular subject or concept.
- Develop an active approach to learning.
- Encouraging students to ask questions for themselves and others.
- Configuring a task to maximize the task.
- To identify specific difficulties that hinder student learning.
- Communicating with the group where class participation is unexpected and open participation by all members of the group is valuable.
- Provide students with an opportunity to absorb and reflect on knowledge.
- Ensuring that students are involved in using a cognitive process based on the assumption that it will help develop their thinking skills.
- To develop comments and reflection on the responses of students, both students and teachers, other members of the group.
- To provide an opportunity for students to learn openly through discussion. (Turney et al., 1973; Wragg, 2001).

A clear goal of effective inquiry is to minimize the mistakes of teachers and students by focusing on a particular phenomenon, topic, skill, and belief. Activity 6 invites you to consider the extent to which you agree or disagree with the following list of 'errors' (Wragg 2001):

- Asking too many questions at once
- Asking a question and answering yourself
- Asking questions only from the smartest or most liked students •
- Asking a difficult question too early in the sequence of events •
- Asking irrelevant questions
- Always asking the same type of questions (eg closed questions)
- Asking questions in a threatening way.
- Not showing a change in question type.
- Not using questions to the problem.
- Not giving students time to think.
- Not correcting wrong answers.
- Ignoring students' answers.
- Not being able to see the effects of students' answers.
- Not being able to build on answers.

As a preliminary to preparing questions, it is helpful to consider these two questions:

1-What can I ask the lesson?

2-What should I ask the class?

For 'What can I ask the lesson?', a useful approach is to brainstorm questions. It's like teaching and then taking a blank slate and writing as many questions as you can on it in five minutes.

“Think about a topic and don't worry about the relevance or quality of the questions at this stage. Once you do that, you can start reviewing questions and reaching out to students to ask.”

It can be done in this way. Inevitably, this makes you think about what your goals are and what the class already knows. Most teachers use a set of key questions to organize and connect their lessons. For example, three of the key questions in a lesson on “bias” are been observed as “What do you understand by the word prejudice?”, “Which individuals or groups are likely to experience prejudice?”, and 'How does prejudice manifest itself in daily life?.

Question classification systems exist to aid the use of inquiry strategies. The most popular system of classifying questions is Bloom, Englehart, Furst, Hill, and Krathwohl's (1956)

taxonomy, known as Bloom's Taxonomy. This taxonomy has proven to be a valuable tool in designing, conducting and evaluating classroom instruction (Mansion, 1970). The teacher can use taxonomy to determine the accuracy of children's cognitive activities. There are six levels of cognitive processing in Bloom's Taxonomy. These are knowledge, understanding, application, analysis, synthesis and evaluation. It is best to examine issues of inquiry, dividing Bloom's Taxonomy into lower-order and higher-order inquiry (Marzano, 1993). Lower level questions arise from knowledge and understanding levels of Bloom's Taxonomy. Other levels of Bloom's Taxonomy belong to high level questions. (Filippone, 1998).

The other subject to be mentioned is about the closed and open-ended question groups. Closed questions are expected to provide a closed set of answers (for example, "Where were you born?" "Did you sell your house?"). In contrast, open-ended questions leave open the nature and duration of the response (for example, "What did you do on your trip?"). According to Barnes, the use of these two types of questions affects student engagement. When closed questions are asked, the learner is normally expected to generate knowledge or reasoning. It helps students grasp the topic and think loud open-ended questions are very helpful. Closed questions are the reason for passive participation; open-ended questions encourage active participation. Chaudron (1988) also describes the role of teachers' questions as an important means of attracting students' attention, encouraging verbal responses, and assessing progress, but states that questions alone cannot always encourage too much interaction (Godfrey, 2001).

### **THE PURPOSE AND SIGNIFICANCE OF THE STUDY**

The aim of this study is to examine the effect of question-answer methodology on education for teacher candidates. A meta-thematic analysis of qualitative research in the field was made. This study, which aims to make teacher candidates go through more qualified teaching processes, was deemed worthy of research and has been the subject of many studies. As a result of the analyzes and other sources examined, the historical basis of the question and answer technique was investigated. The development and change of this method in the historical process has been mentioned. The question and answer technique used today is emphasized. It was examined in which areas the question and answer method was used more. Thus, the areas that will benefit when used have been identified. The positive and negative aspects of the question and answer technique on the teaching and learning process were determined.

As a result of the qualitative findings, it was concluded that it can be used as an alternative to some methods. It is mentioned how to eliminate the monotony of the method of lecturing with the question and answer method and how to make the learning and teaching process more effective. At the same time, the principles of effective use of the question and answer method were mentioned. These principles are important in terms of being a guide for teacher candidates. At this point, it has been determined as the aim of this research to evaluate the question-answer technique practices and to improve the quality of the technique, taking into account the opinions of pre-service teachers in order to correct their mistakes.

### **METHOD**

In this study, the effects of question-answer technique on education are examined. A descriptive method, one of the qualitative research methods, was used. In the research conducted within the scope of meta-thematic analysis, the national database (Google Scholar and YÖK) was used. The studies carried out cover the period between 2008 and 2019. Content analysis was used in this study, in which document reviews were conducted. Content analysis is to present a more understandable product to the reader by combining similar data collected for research under themes and codes (Yıldırım and Şimşek, 2008: 227). As a result of this scanning, a total of ten theses and articles were selected.



In order to ensure the validity and reliability of the qualitative dimension of the study, it was ensured that the sub-themes and codes form a unity with each other for the consistency and meaningfulness of the findings. The data obtained for the reliability of the study are presented as they are without any interpretation. The codes obtained from the studies on the question-answer technique; analyzed under five themes. Before mentioning the themes, the theoretical meaning of the question-answer technique was evaluated in the historical process. These theme titles are: General Features of Question-Answer Technique, Purpose, Function (Table 1), Where Question-Answer Technique is Used (Table 2), Benefits of Question-Answer Technique (Table 3), Limitations of Question-Answer Technique (Table 4), Principles of Effective Use of the Question-Answer Technique (Table 5). Apart from the themes, the reasons why teachers prefer question and answer techniques are also mentioned.

## FINDINGS

In the research, question-answer technique practices were carried out to check whether there is a significant difference in the views and thoughts of teachers and prospective teachers about teaching in the classroom. In this study, in which document analysis was applied, it was aimed to present and interpret the data obtained in a meta-thematic way. The themes and codes obtained as a result of the analyses are presented as models. It is seen that the relevant codes are grouped under six themes and visualized in six models (Tables 1,2,3,4,5). These theme titles are presented below as General Features of Question-Answer Technique, Purpose, Function (Table 1), Where Question-Answer Technique is Used (Table 2), Benefits of Question-Answer Technique (Table 3), Limitations of Question-Answer Technique (Table 4), The Principles of Effective Use of the Answer Technique (Table 5).

**Table 1. General Characteristics, Purpose and Function of Question-Answer Technique**

1. To create an environment that encourages constructive and productive thinking,	12. To enable the student to express himself,
2. To motivate and involve others,	13. To enable students to evaluate themselves,
3. Systematizing information in the mind, encouraging analytical thoughts,	14. To enable students to develop in terms of aesthetics and taste,
4. To teach the basic rules of problem solving technique,	15. To give a special direction to thought (Oğuzkan 1989).
5. To develop objective evaluation skills,	16. The individual perceives the subject, remembers the past information,
6. To make students work on new studies and to guide them in studies,	17. The individual is active both mentally and dynamically,
7. Providing the opportunity to gather and express thoughts in an orderly manner,	18. Communication between teacher and student becomes permanent,
8. Developing useful social interests and habits,	19. Communication takes place in three ways, from teacher to student, from student to teacher, and from student to student,
9. To train students to learn how to work collaboratively,	20. Emphasizing that the student will follow the course and that it will be rewarded,
10. To give students the ability to think in groups	
11. Promote new values and attitudes,	

In Table 1, some of the codes regarding the general characteristics, purpose and function of the question-answer technique are “Creating an encouraging environment for constructive and productive thinking”, “Acquiring objective assessment skills”, “attracting students’ attention”, “The individual is also dynamically active”. In the context of Figure 1 theme these statements can be cited as a source: quoted from the study coded 229945-p.43, “At first, I use the question-answer method. At first, I ask the student questions so that I can get what the students know and don’t know. Then I do things according to the answers I get, for example, I determine what I will tell at what level.” The coded 32372-p.172, which is related to the function of “Ensuring



the students to express themselves”, states, “I use the question and answer method to learn how students express themselves, what they think and how they approach things.” By looking at the sentences used in the preparation of the codes, it is possible to interrupt the monotony of the lecturing method with the question-answer method. Again with this method, it is possible to create an encouraging environment for a constructive and productive thinking system. It provides the opportunity to collect and express thoughts in an orderly manner.

**Table 2. Where the Question-Answer Technique is Used**

1. To induce thought	12. Evaluating the teaching process
2. Self-expression	13. Determining the effectiveness of teaching
3. Reinforcement	14. Determining the efficiency of teaching
4. To draw attention to the subject	15. Recognizing learning difficulties
5. Cause-effect relationship	16. Identifying incomprehensible topics
6. To ensure participation in the lesson	17. Repeating the topic
7. Increasing communication	18. Distinguishing between known and unknown subjects
8. Revealing interests	19. Giving the student self-confidence
9. Providing motivation	20. Determining my readiness level
10. Receiving feedback	
11. Making corrections	

When Table 2 is examined, it is seen that the areas where the question-answer technique is used are mentioned. Determining the effectiveness of teaching, determining the efficiency of teaching, distinguishing known and unknown subjects, the 15163-p.30 coded “I used Question-answer technique. For example, I will explain the subject of punctuation marks. I would describe its features in order, and then I would ask, which punctuation mark do you think I described?” The views obtained in order to ensure participation in the lesson are representative of the example given. The study coded 32372-p.172, “I use it to enable students to participate actively in the lesson. Because otherwise I can't include them in the course. In a way, it would not be a lie if I say that I also use it to get rid of the boringness of the narration method.” The code 32372-p.172, which he used to encourage thinking, said, “I like and use this method because it encourages students to think and share their thoughts by asking questions. I also use it because it contributes to the questioning and correction of wrong and illogical thoughts.”

**Table 3. Benefits of the Question-Answer Technique**

1. Gaining the attention of the student	11. Determining the level of readiness
2. Enabling the student to be active	12. Feedback on the teaching process
3. Opportunity to get to know the student	13. Increasing attention
4. Increasing teacher-student communication	14. Gaining the discipline of listening attentively
5. Possibility of feedback and correction	15. Gaining the discipline of being prepared for the lesson
6. Providing repetition and reinforcement	16. Reminding information
7. Opportunity for students to get to know each other	17. Categorizing information
8. Opportunity for students to benefit from each other	18. Developing and increasing the ability to comment
9. Motivating the student	19. Gaining self-confidence
10. Provoking thinking	20. Effective speaking

In Table 3, the benefits of the question-answer technique are mentioned. Quoting from the study 1017755-p.1592 with the aim of “provoking thinking”, “It makes the child think. It encourages them to examine their own knowledge and think for themselves. It also allows you to understand where the classroom is for the teacher. It gives the child self-confidence in terms of raising fingers and expressing himself. “ such statements can be cited as a source for the creation of codes. Another of these is the theme of determining the level of readiness and this theme is 32372-p. 172 coded “The biggest reason for using this method is I use it at the beginning of the lesson and before a new topic to be taught to determine the readiness of the students.”

**Table 4. Limitations of Question-Answer Technique**

1. It creates fear, anxiety, and excitement	11. Inability of the student to express himself
2. Student bored	12. To create an unfavorable climate
3. Inability to understand the subject	13. Mislearning
4. Waste of time	14. The answer does not come to mind immediately
5. Substituting the oral exam	15. The answer is not clear
6. Negative emotions such as stress in the student	16. Scoring limitation
7. Loss of self-confidence	17. Inappropriate state of general arousal
8. Seeing education as inadequate	18. Physical symptoms (dizziness, nausea)
9. To disintegrate the subject	19. Difficult to apply in crowded classrooms
10. Inadequacy in providing information	20. The answers are subjective

In Table 4, the limitations created by the question-answer technique are mentioned. Regarding the codes of Loss of Time, Disturbance of the subject, and the student's inability to express himself, with the code 87550-p.197, "I made changes during the lesson in line with the reactions of the students, although I did not take it into my plan..." Although I made an effort to explain it, I think the students had difficulty in putting forward their thoughts because they were not used to it. In this situation (to reveal thoughts) I too had a hard time." These expressions were effective in determining the codes. Regarding the code of anxiety, fear and excitement, he considered the anxiety of giving wrong answers, coded 32372-p.173, as a problem, and this theme was "I observe that students have anxiety and fear of giving wrong answers even if they know the right answer."

**Table 5. Principles of Effective Use of Question and Answer Technique**

1. Good preparation and planning	13. Not to go beyond the subject when asking questions
2. Preparation of questions in advance	14. Effective use of time
3. The student's preparation of questions	15. Immediate feedback to the student who gave the wrong answer
4. Questions serve a specific purpose	16. Avoiding punishment of the student who gives wrong answers
5. being suitable for the level of the student	17. Giving the student enough time to answer
6. Not being used frequently as a measurement and evaluation tool	18. Giving a clue to the student who has difficulty in answering
7. Asking open-ended questions	19. Allowing students to ask questions to each other
8. Asking the questions to the whole class	20. Asking questions that gain insight and high-level target behaviors
9. Questions should be based on interpretation	
10. Answers should be listened patiently	
11. Asking the questions to the student by random selection	
12. Not asking above or below level	

When we examine Table 5, the question of how to use the question-answer technique effectively has been principled. Codes such as being appropriate for the level of the student, not being asked above or below the level, giving the student enough time to answer, and the questions serving a specific purpose were effective in the creation of this theme. Quoting from the study 1017755-p.1593, “The questions asked will not be very complex and difficult. The questions will be appropriate to the age, readiness and level of knowledge of the children. In other words, it should not be in a way that discourages students. It should be arranged from simple to complex. “and coded 1017755-p.1594 ” I do not make any applications. Like this; If I don't get an answer when I ask a question, I don't respond. These expressions can be cited as a source for the creation of codes. The statement coded 229945-p.44 regarding the code of being suitable for the student's level is “For example, some children have a late learning period, some are early, so I can develop my strategy, for example.” Examining the codes helped to envision what the principles of an effective question-answer technique should be.

## DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In this study, which was conducted on the effectiveness of the question-answer technique in education and training, it was determined that the candidates participating in the practices benefited from the question-answer technique. In the studies carried out on pre-service teachers, the fact that the method that pre-service teachers know most is the method of lecturing and that the method they think to use most frequently in the future is the supports the research finding (Özer, 2013). In addition to the benefits, they faced the limitations of this method from time to time. Although it was stated in the studies that the question and answer method was frequently used by teachers, it was emphasized that this method was not used in a qualified way in the learning and teaching process and most of the questions remained only at the level of knowledge (Safran, 1993, Kalaycı, 1994). This research, which will serve as a guide for dealing with these limitations, aims to provide an idea about how an effective question and answer technique should be. It provides the opportunity for pre-service teachers to learn actively and in this way to direct them to think, research and discover. Throughout this research, the contribution of the question-answer technique to the cognitive, affective and personal development of students and teacher candidates and the findings about the basic principles are included.

Another situation is that the question-answer technique applications serve as a bridge between practical and theoretical knowledge. However, it is still among the limitations of the question-answer technique to worry the students and to use it as a measurement tool. It was observed that the candidates experienced some difficulties during the question-answer technique applications. Items such as insufficient time, dispersion of the subject, excess number of students can be counted as disadvantages. The excess in the number of students and the insufficient number of classrooms can also be explained by economic reasons. It is thought that a more effective teaching environment will be offered when these reasons are removed. New and more comprehensive research is needed. The effectiveness of different methods can be tested by studies with students of different age groups. In addition, in teacher training institutions, students should be informed about education methods.

## REFERENCES

1. Altun, M. (1995). *İlkokul 3.,4. ve 5. Sınıf Öğrencilerinin Problem Çözme Davranışları Üzerine bir Çalışma*, Yayınlanmış Doktora Tezi, Hacettepe Üniversitesi, Ankara
2. Arends, R. (1994). *Learning to Teach*. NY: Mc Graw-Hill, Inc. New York.

3. Aydın, Z. (2001). Aktif Öğretim Yöntemlerinden Buldurma (Sokrates) Yöntemi, *C.Ü. İlahiyat Fakültesi Dergisi*, 5(1), 55-80.
4. Brown, G., & Wrag, E.C. (1993). *Questioning Classroom Skills Series*. Newyork.
5. Brualdi, C. (1998). *Classroom Questions*. ERIC Clearinghouse on Assessment and Evaluation Washington DC.
6. Ellis, K. (1993). *Teacher Question and Student Learning. What Research says to the Teacher*. Newyork.
7. Erden, M. (1997). *Sosyal Bilgiler Öğretimi*, Ankara: Alkım Yayınevi.
8. Filiz, S.B. (2009). Soru Cevap Yöntemi Eğitiminin Öğretmenlerin Soru Sorma Bilgisi Ve Soru Sorma Tekniklerine Etkisi. *Journal Of The Institute Of Social Sciences*, 3, 167-195.
9. Gall, M.D., Dunning, B. & Weathersby, R. (1971). *Higher Cognitive Questioning Teachers Handbook*. Beverly Hills, California: Macmillan Educational.
10. Journal of educational and instructional studies in the World May 2012, Volume: 2 Issue: 2 Article: 01 ISSN: 2146-7463
11. Küçükahmet, L. (1997). *Eğitim Programları ve Öğretim. Öğretim İlke ve Yöntemleri*. Gazi Kitabevi, Ankara.
12. Morgan, N., & Saxton, J. (1991). *Teaching Questioning anad Learning*. London.
13. Oğuzkan, F. (1989). *Orta Dereceli Okullarda Öğretim, Amaç, İlke, Yöntem ve Teknikler*, Ankara, S.85-86.
14. Özer, B. (2013). Eğitim fakültesi son sınıf öğrencilerinin öğretim kuram, strateji yöntem ve tekniklerinin farkında olma ve kullanma düzeyleri. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 10 (24), 197-211.
15. Safran, M. (1993). *Orta Öğretim Kurumlarında Tarih Öğretiminin yapı ve Sorunları*, Ankara.
16. Yeşilyurt, E. (2013). Öğretmenlerin Öğretim Yöntemlerini Kullanma Amaçları ve Karşılaştıkları Sorunlar. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 17 (1): 163-188.
17. Yıldırım, A., & Şimşek, H. (2003), *Sosyal bilimlerde nitel araştırma yöntemleri*, Ankara: Seçkin Yayıncılık.

## APPROPRIATE LEARNING MANAGEMENT SYSTEM: A SYSTEMATIC REVIEW ON FLEXIBLE TEACHING AND LEARNING

**Dr Adam Andani MOHAMMED<sup>1</sup>, Dr Mpawenimana Abdallah SAIDI<sup>2</sup>,  
Dr Bougangue BASSOUMAH<sup>3</sup>**

*<sup>1</sup>Social Work Studies, <sup>1,2</sup>Faculty of Social Sciences and Humanities, Universiti Malaysia Sarawak UNIMAS, Malaysia <sup>1</sup>maandani@unimas.my/ORCID 0000 0001 9715 4353*

*<sup>2</sup>International Studies*

*<sup>3</sup>Department of Population & Reproductive Health, School of Public Health, University for Development Studies (UDS), Tamale*

### Abstract

The current pandemic has created significant challenges on aspects of general life and for higher education across the globe. Owing to this situation, governments and education departments came up with various forms of transformative responses like social isolation in schools and on campuses, situational curriculum development and alignment with full online delivery of lectures. This situation calls for teaching and learning design that accommodates academic abilities of all students in order not to create a gap between high and low academic ability learners. In order to strengthen the collective response to innovative higher education, the delivery of knowledge should be flexible enough to overcome the existing challenges that confront students due to the current hybrid academic activities. This systematic review focused on understanding flexible learning with appropriate Learning Management System, dimensions of learning systems and application of online learning to cater for the learning needs of all. In order to source relevant data, Google Scholar is used as a tool to access the major databases provided by Taylor and Frances, Emerald, Elsevier, Springer, Sage and others. Empirical evidence used in this study is based on secondary data and qualitative analysis technique adopted to assess issues on transformative teaching and learning. The review revealed blended learning to be the most effective learning system. It also found that the benefit of online learning in terms of the use of technology in teaching and learning is proven to be enormous. This study may contribute critical information about new tools in knowledge delivery through the ICT infrastructure to facilitate flexible learning in higher institutions under the current and similar future situations.

**Keywords:** management system, global pandemic, infrastructure, blended learning

### INTRODUCTION

The efforts to improve high education results in institutions employing modern technologies to accelerate innovative and flexible teaching and learning. Prior to the pandemic, most countries and educational institution took it upon themselves to improve internet access and online learning environments to fully utilize the ICT infrastructure for quality learning experience. As such policies on e-learning in higher education is an initiative to provide quality online teaching and learning to derive national development (Kasim, & Khalid, 2016 Coates, James, & Baldwin, 2005; Adobe. 2009). Other studies revealed that blended learning has become the preferred mode of teaching in the twenty-first century through the utilization IT to enhance and transform teaching and learning activities of students and lecturers in higher educational institutions (Anthony, Kamaludin, Romli, Raffei, Abdullah, Ming, & Baba, 2019; Chang-Tik



2018). The integration of ICT in the delivery of lectures led to changes in the design of curriculums to match the way current students learn and communicate. The core element integrated with online learning include Learning Management System, Content Management Systems among others (see references for details Kasim, & Khalid, 2016; Coates et al., 2005; Adobe, 2009). The effectiveness of the internet enhanced teaching and learning in larger class environment. The use of digital technology via these Learning Management System LMS tools complement lessons and facilitated group learning outside the classroom. For example, eLEAP as a platform exposes students to several student-centered learning mechanisms like photo folio, e-poster presentations, role play and forums in an effort to provide them with a more holistic learning experience. (Rasiah, 2014) Several previous studies (Schroeder, Minocha & Schneider 2010; Collins & Halverson 2010; Wodzicki, Schwämmlein & Moskaliuk 2012) found that the use of software in higher education provides a collaborative landscape to learning and teaching, leading to peer interaction and interaction between instructors and students.

Learning Management System LMS allows students to interact with learning tools online through web browsers using any operating system, computer or smart phones. It is a web-based software application designed to handle learning content, student interaction, assessment tools and reports of learning progress and student activities (Adobe, 2009; Srichanyachon et al., 2014; Nasser et al., 2011; Kasim, & Khalid, 2016). According to Coates et al. (2005), LMS represent an evolution from the processes and systems like learning systems, course management systems, content management systems, portals, and instructional management systems. All these systems are developed to keep records of students' activities and courses registered by students. The use of technology in the educational field with the application of online learning through massive open online learning system, learning management system, learning Apps have received greater acceptance by all across the globe (Omar, Yunus, Ismail, Sharef, & Murad, 2019; Ahmad, & Chua, 2015). Electronic learning otherwise known as e-learning is a form of learning where the lecturer and learners are separated by space or time and the gap bridged through the use of learning management system tools by using technology (Omar et al., 2019). The target for successful implementation of e-learning should include the cognitive skills like computer competency, the environment like incentives and resources to foster e-learning as well as beliefs and behaviour such as self-efficacy and appropriate behavioural skills of the e-learners (Ahmad, & Chua, 2015).

The conventional lecture teaching style is gradually becoming ineffective in meeting the learning needs of current students. This style of delivery seems not flexible enough to develop an engaging and effective learning environment for the learners. As such, authorities of tertiary institutions and schools are expected to come up with best practices and future potentials of digitalisation initiatives on how to position teaching and learning in a more practical and flexible manner. The United Nations' Sustainable Development Goals emphasises the key potentials digital technology holds for achieving the goals for education by 2030 (Orr, Weller, & Farrow, 2018; UNESCO, 2017). Most of these institutions developed comprehensive strategies in which emphasis is put on the dimensions of flexibility like time and place, access to learning and the design of learning to benefit from integration of digital solutions. (Orr, Weller, & Farrow, 2018). The flexibility of teaching and learning relates to how technology is used to reduce the need for physical presence, limitations of access and to control the contents, delivery and assessment. For instance, the current situation calls for tertiary institutions to apply new technologies to all the units and departments considering the context, organisational structure and the needs of different learners. The tertiary institutions need to adopt new technologies with a range of pedagogies to meet specific needs like the current disruption due to Covid-19. There is the need to formulate and implement comprehensive strategies to integrate e-learning into the key teaching and learning processes



to encourage innovative delivery of lectures. With these strategies, educators are in a better position to use technologies effectively to cater for the learning needs of current and future students (Hudin, Osman, Shokory, & Ab Wahid, 2018). An innovative teaching and learning that adopts student-centered learning style may empower students. These institutions can therefore transform the conventional lecturer-centered to student-centered learning approach and supported by e-learning environment which motivate students to participate actively in the learning process. The innovation and flexibility of e-learning provides a new dimension to education through virtual learning tool which improve the quality of teaching and learning in both higher and lower institutions.

The flexibility in e-learning allows students and lecturers to choose when and where to conduct teaching and learning activities (Ahmad, & Chua, 2015; Chang & Chang, 2012; Rani & Kant, 2013). In addition, e-learning is a tool that supports collaborative learning through virtual methods use by lecturers to supervise students, gain new skills and use them in the teaching and learning processes together (Ahmad, & Chua, 2015; Kopp, Matteucci & Tomasetto, 2012).

## RESEARCH METHOD

Researchers adopted secondary data analysis approach and focused on articles available in English Language. The search for articles for this narrative literature review was done through Google scholar to examine the appropriate learning management system and flexible teaching and learning meet the needs of students during disruptive period like the current situation.

The qualitative data analysis technique is adopted to assess issues on choosing appropriate learning management system. Extensive and relevant literature was gathered from articles on the latest development in relation to teaching and learning in educational institutions. Therefore, the source of data for the current study is extracts from the secondary data that explains the current happenings in the delivery knowledge to students. The researcher engaged in extensive reading to identify reports that related to usage of ICT infrastructure, selection of appropriate learning management system and flexible teaching and learning in institutions. Representative themes on learning management systems and flexible teaching and learning were generated from sample of articles collected and refined.

All the authors consulted with one another throughout the analysis of the articles. The authors also discussed and reviewed each other's portion of the paper and what they found to support validity and reliability of the analysis. The researchers settled on descriptive themes as most appropriate to respond to the research questions. The data collected through multiple sources and varied interpretation which involved reading and re-reading articles to pick consistent information to support the objectives of the review was analyzed in line with the research objectives. The main themes were generated from the data after several readings and analysis. These themes were based on the appearance in the secondary data and information obtained from the literature.

The limitation of the study is that the analysis was based on thematic analysis, it is possible the work did not fully capture all the essential nuances within the available literature on complex concept like LMS and the ICT infrastructure. It is important to note that since it is based on online articles and not that of educators and students' voices or personal narratives or face-to-face presentation of testimonies for that matter it is not based on intense empirical techniques. Therefore, the basic features of the study are to offer a glimpse of the choose appropriate LMS rather than seek generalization.

## FINDINGS

The expansion and efforts to widen participation through the use of LMS is vital so that students from different background are not left behind in developments and in opportunities to

participate in teaching and learning under the current situation ((Orr, Weller, & Farrow, 2018; Salmi, 2017). Studies identified six services considered as university package to include teaching and learning described as “interaction services”, assessment and support services leading to credentialing services which are supported by technology services (Mackintosh, 2016; Miao, Mishra, & McGreal, 2016; (Orr, Weller, & Farrow, 2018).

### **BLENDED LEARNING**

Blended learning refers to the use of technology (computer, Internet, World Wide Web and currently smart phone) that makes a variety of resources in the physical classroom (lectures, books, lecturer’s note and slides, handouts) teaching and learning possible and contributes to enhance experience in learning. Combination of two kind of learning environment, physical classroom learning and online learning to enhance the learning outcomes (Azizan, 2010 Hudin, Osman, Shokory, & Ab Wahid, 2018; Kasim, & Khalid, 2016; Kudrick, Lahn and Morch, 2009). The blended learning provides a comprehensive learning delivery approaches where teaching and learning activities are carried out either synchronous (live classroom Learning or e-live classroom) or/and asynchronous (self-paced) formats. It provides quality learning experiences as students develop critical thinking abilities, social interaction, confidence and competence through the three criteria like social presence, cognitive presence and teaching presence in the learning environment. Blended learning combines offline in a more traditional classroom setting and online learning thus the use of Internet to provide flexibility and innovative learning activities. The students can choose to attend the teaching and learning session through video or teleconference via online either using smart phone and/or lap/desk top. All the study materials and resources are uploaded on the available learning platform. Studies revealed that BL enhances student lecturer communication and collaboration through social networking, ease of use of course materials, decrease physical class time, create a student-based learning environment, produce an encouraging learning environment, flexible learning time and location, promotes independent learning skills (Anthony, Kamaludin, Romli, Raffei, Abdullah, Ming, & Baba, 2019; Rahman et al. 2015; Siew-Eng and Muuk 2015; Wai and Seng 2015). Blended learning delivery consist of the qualities of place, pace and the content through physical and online teaching and learning events. (Azizan, 2010). The implementation has attracted great interest among provider of education across the globe. For instance, most institutions of higher learning adopted and implemented information and communication technology (ICT) in teaching and learning activity. Such electronic learning is considered as a source for flexible knowledge delivery process both in and outside the classroom. (Hudin, Osman, Shokory, & Ab Wahid, 2018; Azizan, 2010). The integration of ICT in delivery of lectures led to changes in the design of curriculums to match the way current students learn and communicate.

### **SERVICE-LEARNING (SL)**

In an effort towards flexible and innovative teaching and learning, Service-Learning (SL) be conducted especially in tertiary institutions to supplement student learning and to prepare them for the job market. (Rasiah, 2014 Hudin, Osman, Shokory, & Ab Wahid, 2018). The current situation demands that any knowledge or skills acquired should be based on real world experience and with lasting impact thus where knowledge is expected to flow from both directions in way of student active participation in discussions. SL can be considered as strategies to increase graduate employability through programmes that provide technical skills, work ethics and soft skills to meet the expectation (work from home, for instance) of the market. Such curriculums produce and equip graduates with relevant skills as expected of the industry. (Lee, 2014; Hudin, et al., 2018; Seetha, 2014). SL is also identified as a measure to produce graduates with certain soft skills to include critical thinking and problem solving skills,

communication skills, lifelong learning and information literacy, team-working skills, professional ethics and morality, entrepreneurship skills, and leadership and management skills (Adnan, Daud, Alias, & Razali, 2017; Hudin, et al., 2018). This approach reduces students' dependence on instructor for that matter eliminate excessive guidance and direction to enhance their skills through the learning process which eventually improve employability. According to Stelljes, A. D. (2008), SL is flexible and innovative in that it encourages community service, volunteerism, community-based learning, civic engagement and service-learning internship. Studies has shown that SL truly links theory and practice as well as improvement in learning experience in terms of knowledge, attitude and skills of students (Schoenherr 2015; Flannery, & Pragman, 2010; Ghee & Zakaria 2012; Hudin, et al., 2018). The advances in ICT have broadened the learning processes and enabled students to interact and make learning more meaningful to overcome the insufficiency in rote learning (Dembo & Seli, 2012; Hudin, et al., 2018). The advances in technology and growth of information should link the learners with the learning resources to support the independent and self-managed learning and delivery of knowledge in a more flexible manner. The Malaysian education system emphasized on creativity and innovation as the enablers to equip students to facilitate the attainment of high-income status (MOHE, 2011; Hudin, et al., 2018 Leow, & Neo, 2014).

### **MOBILE TECHNOLOGIES**

The advent of ICT necessitated educational institutions to design new paradigms to restructure curricula and classroom facilities to facilitate e-learning in higher education. The effective adoption of e-learning into the current situation may provide learners with appropriate knowledge and promote meaningful learning experience. (Ismail, Bokhare, Azizan, & Azman, 2013). The emerging mobile technologies or mobile learning (m-learning) is done through wireless technological devices that is easy to carry and use by learners with a device that has uninterrupted connection to the internet. With effective and efficient internet connection, m-learning allow students access to instant learning with exciting new experience in education and pedagogy. Prior to the pandemic, students were prohibited from using mobile phones to school but it turns out to be the best alternative in teaching and learning. The current situation brought the need of integrating m-learning into education system considering its flexibility. For effective m-learning, educational institutions need to restructure and implementation curriculum and pedagogy, institutional readiness, the teachers and students need ICT literacy and skills on the new educational technology to support the new teaching methodologies. With the usage of mobile technology allow teachers integrate technology into teaching and learning accessible, judicious use of time, and technical support. For successful ICT integration in teaching and learning the confidence and competence of teachers need to be boosted as well as accessibility of resources. The effective utilization and implementation of mobile technology into teaching and learning require ICT infrastructure in institutions, resources and technological know-how teachers. Teachers and institutions of higher in current situation has the option to adopt mobile technology in education considering the important role it plays in the successfully implementation of flexible education system (Ismail et al., 2013).

### **E-LEARNING TUTORIAL AS A PEDAGOGY**

Electronic learning, or e-learning is a situation where the teacher and learners are separated by space or time, and get across to each other through the use of online technologies. The e-learning tutorial is an alternative method that makes teaching and learning flexible leading to mastery of the content of learning, enhanced creative and critical thinking. Students found e-learning enjoyable and easier to follow the tutorials than the conventional tutorials since it is accessible anywhere and at any time and thus reduce learning costs. (Ahmad, & Chua, 2015). The use of eLearning tutorial as a pedagogy in teaching delivery may provide better

understanding during the teaching and learning process eLearning has become the household name in many higher education institutions considering its effectiveness as an alternative method of learning. The e-learning in higher education institutions involves provision of ICT infrastructure to students and the integration of ICT in delivery of lessons. The education institutions need strategic plans for efficient ICT infrastructure in place for more enduring and effective e-learning to take place. Ahmad, & Chua, 2015; Orr, Weller, & Farrow, 2018). The flexibility and accessibility of e-learning brings about a new paradigm and a superior virtual learning tool that improve quality of teaching and learning in educational institutions. The emergence of e-learning provides students and lecturers the flexibility to choose when and where to teach or learn. e-learning has become an important tool that support collaborative learning through virtual methods. because lecturers and Apart from supervising students' tasks, both students and lecturers gain new skills leading to flexible teaching and learning (Ahmad, & Chua, 2015; Kasim, & Khalid, 2016; Rasiah, 2014). The successful implementation of e-learning programmes should target the environment, cognitive skills, beliefs and behaviour of learners Both lecturers and learners ought to have self-efficacy and appropriate behavioural skills, motivation and computer competency in order to foster e-learning. Beliefs and behaviour refer to Apart from flexibility, e-learning hasten the teaching and learning process more effectively. e-learning is about converting traditional classrooms into online versions to bring about more flexible teaching and learning environment. E-learning makes students more curios with which they are able to fine new information and understanding of programme and learning outcomes. Both lecturers and students can engage in collaborative learning, online discussions, WhatsApp chat and Zoom or Webex discussion which makes learning more active and effective. Considering the forward looking nature of current leaners, e-learning in teaching and learning increase the preparedness and attention of students in learning as they already want to be on their smart phones all the time Ahmad, & Chua, 2015; Orr, Weller, & Farrow, 2018; Leow, & Neo, 2014).

## STUDENT-CENTRED LEARNING

Learners need to be linked with the learning resources for independent and self-managed study. Educators need to take advantage of the technological advancement and readily available information to make learning more flexible (Leow, & Neo, 2014; Rasiah, 2014 Ahmad, & Chua, 2015). The current circumstances demand that universities adopt innovative student-centered learning approach into the course design. That means capacity build of teachers/lecturers is essential to transform from the teacher-centered to student-centered learning approach with online learning to motivate students to participation in class discussions (Leow, & Neo, 2014). When the learning environment is adequately resourced, the equality of learning can be enhanced encourage students to demonstrate their understanding of what is taught and the learning alternative to adopt to enhance learning experience. Suh, (2011) this strengthen student's self-esteem and critical thinking skills in a learning community (Leow, & Neo, 2014; Rasiah, 2014 Omar et al., 2019.). The institutions of learning and educators need to upgrade teaching and learning facilities with multimedia and web technologies, high speed internet connections to facilitate student learning to enhance the competence (Leow, & Neo, 2014 Orr, Weller, & Farrow, 2018 Azizan, 2010). Adopting innovative and flexible approach may lead usage of effective teaching method that support self-paced learning and effective teacher learner interactions (Leow, & Neo, 2014). It is revealed learners can retain 5% of what is heard, 10% of what is read, 20% of what is obtained in audio-visual presentations and that retention rates can be increased to 70%. This shows that hands-on practical work in learning process leads to increase retention. (Leow, & Neo, 2014). The approach puts needs of students at the centre of the learning process as leaners gain knowledge through participation and interactions with the peer and instructors. The successful adoption of this approach calls for

computer-based programs designed with the needs of student at the centre of learning process to make students responsible in selecting activities and accountable (Leow, & Neo, 2014 Azizan, 2010).

## DISCUSSION

This online platform allows the lecturer to present, interact, discuss, demonstrate and communicate with students and students also interact and communicate with one another virtually. Learning online is a proven engagement with full opportunities for interaction between the lecturer and students via assignments, tutorials and exercises. For instance, eLeap platform addresses the difficulties and limitations posed by the pandemic making online learning a significant part of teaching and learning experience. Most of the institutions of higher learning across the globe, including Malaysia, resorted to online delivery (Anthony, Kamaludin, Romli, Raffei, Abdullah, Ming, & Baba, 2019; Azizan, 2010; Hudin, et al., 2018). long before the pandemic. Of late online teaching and learning has been viable due to the growth of ICT infrastructure and the massive usage of Internet. An innovative way of learning and teaching delivery have changed since the advances made in information and communication technology (ICT) leading to a paradigm shift, thus online learning. The teaching and learning at the tertiary level should be flexible enough to meet the learners aspirations since the population now covers single and married, employed and unemployed, residential and non-residential as well as fulltime and part time students.

Flexible teaching and learning depends on the acceptance of technology by teachers needs to be addressed by higher institutions of learning. Apart from the awareness and motivation to use technology, the question of willingness of teachers to employ technology in teaching and learning process comes to mind. The decision of teachers to employ technology has to do with awareness of pedagogical usage of technology to assess how user friendly it is in classroom situation. These factors will propel teachers to look and identify useful technological tools for specific teaching and learning outcome. The level of teachers and learners' motivation can be a recipe for successful implementation of flexible teaching learning through the availability of ICT infrastructure and technological tools within the educational institutions. Quite apart, career development of teachers come to play in ensuring a successful integration of technology into classroom instructions and delivery. There is therefore the need for capacity building thus providing technological training for successful integration of technology for effective classroom management and in imparting of knowledge. For flexible and effective teaching and learning, management of educational institutions need to involve technology in pedagogical activities. These will depend on the amount of training that prepare teachers to adopt and integrate mobile technology into their teaching and learning activities. As such, training might open up full understanding and the potentiality of mobile technology or m-learning in pedagogical activities. Besides, enough capacity building and knowledge in using this m-learning by teachers make effective use of technology in teaching and learning thus bring about flexibility (Ismail et al., 2013).

Omar et al., 2019 The emergence of technology and its use in the classroom is better students' leaning experience. The modern pedagogical methods may shape the understanding of the benefits of flexible and innovative usage of technology in classroom situation. The ICT infrastructure has made varieties of teaching approaches in demonstrating and application of knowledge possible thus translating into effective teaching and learning. The new approaches allow flexible teaching and learning as classroom techniques are modified to meet the needs of students in the current situation. The current situation could be carted for in a flexible and innovative manner if authorities carry out needs assessment to understand the abilities of both teachers and learners as well as the level of preparedness of learners. For Rahim et al, (2016) the needs of students may include motivation and ability where the schedule of learning,



subjects to be learned, books that will be used and methods of delivery. The curriculum should encourage students to participate co-curricular activities clubs, associations, sport, and games as that lead to students' sense of identity as that make them feel secure and enjoy being part of the school community (Orr, Weller, & Farrow, 2018; Omar et al., 2019; Hudin, et al., 2018). A flexible and innovative teaching and learning involves teacher-student communication in the process of interaction in the school environment. In this case, the need to prepare the social and physical environment is necessary to ensure successful interaction and to encourage teacher-student communication.

## CONCLUSION

Students have access to interactive learning environment through e-learning that is so valuable for shy students who find it difficult to communicate in class but feel at ease to interact in real time with others in the virtual world. For instance, learners prepare before responding or contributing in online discussion or in sharing thoughts without fear of criticism. Besides, sending direct messages give students more confident since only the two parties can read the message sent. The adoption of e-learning as alternative method is helpful especially when learners have personal questions or want to explain certain concepts via online. It is also possible for lecturers to correct learners' mistakes by forwarding direct those concern without the knowledge of other learners. E-learning is ideal and flexible for the current situation because of it is interactive and exciting with better learning experience as students are able to share their thoughts and ideas individually and in group. The mobile technology is gaining grounds due to students' active knowledge with digital technologies as they are able to monitor their learning progress. Teachers are able to guide students learning through classroom participation in groups, frequent interaction, feedback and connections to real-class contexts with ease.

## REFERENCES

- Abd Rahim, S. I., Yakob, M. A., Mohd Mansor, S. K., & Mohamad, R. (2016). Talaqqi method in teaching and learning Islamic education at Pondok institutions. *Global Journal of Business and Social Science Review*, 4(3), 68-73.
- Adnan, Y. M., Daud, M. N., Alias, A., & Razali, M. N. (2017). Importance of soft skills for graduates in the real estate programmes in Malaysia. *Journal of Surveying, Construction and Property*, 3(2).
- Adobe. (2009, April 04). Adobe Solutions for Learning Management Systems (LMS) [online]. Available: <https://www.adobe.com/content/dam/Adobe/en/education/pdfs/lms-primer-102909.pdf>.
- Ahmad, N. A., & Chua, L. N. (2015). Technology and higher education: Using an E-learning tutorial as a pedagogy for innovation and flexible learning. *Malaysian Journal of Distance Education*, 17(1), 21-31.
- Anthony, B., Kamaludin, A., Romli, A., Raffei, A. F. M., Abdullah, A., Ming, G. L., ... & Baba, S. (2019). Exploring the role of blended learning for teaching and learning effectiveness in institutions of higher learning: An empirical investigation. *Education and Information Technologies*, 24(6), 3433-3466.
- Azizan, F. Z. (2010). Blended learning in higher education institution in Malaysia. In *Proceedings of regional conference on knowledge integration in ICT* (Vol. 10, pp. 454-466).
- Coates, H., James, R., & Baldwin, G. (2005). A critical examination of the effects of learning management systems on university teaching and learning. *Tertiary education and management*, 11, 19-36.



- Flannery, B. L., & Pragman, C. H. (2010). Service-learning and integrated course redesign: Principles of management and the campus kitchen metaproject. *Journal of Management Education*, 34(1), 11-38.
- Ghee W, Y., & Zakaria F. (2012) Promoting civic engagement through a service learning experience. *International Journal of Humanities and Social Science*. 2(12):83-8.
- Hudin, N. S., Osman, J., Shokory, S. M., & Ab Wahid, H. (2018). Service learning in higher education: Evidence from Malaysia. *International Journal of Engineering & Technology*, 7(3.30), 474-479.
- Ismail, I., Bokhare, S., Azizan, S., & Azman, N. (2013). Teaching via mobile phone: A case study on Malaysian teachers' technology acceptance and readiness. *Journal of Educators Online*, 10(1), 1-38.
- Kasim, N. N. M., & Khalid, F. (2016). Choosing the right learning management system (LMS) for the higher education institution context: A systematic review. *International Journal of Emerging Technologies in Learning*, 11(6).
- Lee, M. N. (2014). Educational reforms in Malaysia: Towards equity, quality and efficiency. In *Routledge Handbook of Contemporary Malaysia* (pp. 302-311). Routledge.
- Leow, F. T., & Neo, M. (2014). Interactive multimedia learning: Innovating classroom education in a Malaysian university. *Turkish Online Journal of Educational Technology-TOJET*, 13(2), 99-110.
- Nasser, R., Cherif, M., & Romanowski, M. (2011). Factors that impact student usage of the learning management system in Qatari schools. *International Review of Research in Open and Distributed Learning*, 12(6), 39-62.
- Omar, A. S. M., Yunus, M. K., Ismail, I. A., Sharef, N. M., & Murad, M. A. A. (2019). What Constitutes Effective Learning? An Introduction to Talaqqi Framework. In *5th International Conference On Educational Research and Practice*.
- Orr, D., Weller, M., & Farrow, R. (2018). Models for online, open, flexible and technology enhanced higher education across the globe—a comparative analysis.
- Rasiah, R. R. V. (2014). Transformative higher education teaching and learning: Using social media in a team-based learning environment. *Procedia-Social and Behavioral Sciences*, 123, 369-379.
- Schoenherr T. (2015) Service-Learning in Supply Chain Management: Benefits, Challenges and Best Practices. *Decision Sciences Journal of Innovative Education*. 13(1):45-70.
- Seetha, N. (2014). Are soft skills important in the workplace? -A preliminary investigation in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 4(4), 44.
- Srichanyachon, N. (2014). EFL Learners' Perceptions of Using LMS. *Turkish Online Journal of Educational Technology-TOJET*, 13(4), 30-35.
- Stelljes, A. D. (2008). *Service-learning and community engagement: Cognitive developmental long-term social concern*. Cambria Press.
- Victoroff, K. Z., & Hogan, S. (2006). Students' perceptions of effective learning experiences in dental school: a qualitative study using a critical incident technique. *Journal of Dental Education*, 70(2), 124-132.

## ETHNO-CULTURAL ASPECTS OF LEARNING ATTITUDES

Marlena DANEVA <sup>1\*</sup>, Marina NIKOLOVA <sup>2\*\*</sup>

*\*1 Technical university of Sofia, Faculty of Engineering and Pedagogy of Sliven, Department of Pedagogy and Management, Sliven, Bulgaria, candidate Ph D, assistant*

*2 Technical university of Sofia, Faculty of Engineering and Pedagogy of Sliven, Department of Pedagogy and Management, Sliven, Bulgaria, doctor of pedagogical sciences, professor,*

### Abstract

The article discusses the issue of attitudes towards teaching children of different nationalities. The essence of the concept of ethnicity and its specificities are considered on the basis of the views of specialists working in this field. Attitude towards learning is associated with 'attitude' as a mental state of readiness for education-related activities. It is determined by past experience and has a decisive influence on behavioral acts. Helping to shape correct attitudes towards learning also influences learning motives but is more resilient and complex than them. The attitude towards learning in children and students is formed by cultural values and norms transmitted by their parents or guardians. The presence of ethnic or cultural stereotypes among parents affects the formation of appropriate attitudes in their children, including the importance of education as a value or its absence. Intercultural interaction in the educational environment will have a special weight in the direction of cognition of the ethno-aspects of personality values and the use of this knowledge for the formation of positive learning motivation. Studying the specifics of attitudes towards learning in a particular ethnic community leads to behavioral predictability of students in this group. Understanding the aspects of this attitude is a prerequisite for finding methods and means to formation a positive motivation for learning. Deciphering the multifaceted ethno-cultural attitudes to education improves the quality of education. This article introduces existing interventions that have proven to be ineffective to changing attitudes towards learning across a country that consists of diverse communities, identified by their ethnocentric characteristics. We propose that educational policies based on a vision of equal attitudes toward learning is not adequate in integrating and motivating students from diverse ethnocentric backgrounds.

**Key words:** ethnicity, attitude, ethnocentrism, motives, stereotypes.

### INTRODUCTION

The educational integration of ethnocentric communities as an educational process is characterized by transformation of the individual and the whole society. Through this process, children integrate into the community, perceive its values and models, and accordingly, form new behavioral approaches and attitudes. Integration processes are directed inwardly, towards the prevailing ethnic group, which has a predominant linguistic and cultural specificity. Simultaneously, education through the formation of new values brings value to various minorities common to both ethnic types. At the same time, the common cultural space is enriched for the nation, but also for minorities in particular. This happens dynamically and is based on the professionalism of teachers in the education system. Ethnocultural attitudes fuel this dynamic. The problem of incomprehensibility of various aspects of the ethnocultural attitude to education is the basis of the inequality of education.

The dynamics of intercultural interaction has different factors and therefore it is especially important that it is carried out by qualified personnel with a common goal and a clear vision, provided that the strategy of intercultural education is adhered to. Prioritizing equality in all school structures and processes is essential for the future realization of human capital for the prosperity of the nation.

**Ethnicity and its specificity.**

At the present stage of development of human society, it is generally accepted that ethnicity is a more important and fundamental condition for its stratification than social and status differences between people.

The term "ethnicity" is of Greek origin. Literally it means "a group of people with common cultural values." The use of this tonality has historically been used to refer to "others", but not "us" for "we". This is also observed in Homer, Plato, Aristotle, Herodotus (Kolev D., Krumova T., 2005).

We agree that the content of the term "ethnicity" should be seen as a group of people defined by cultural traditions that separate them from other communities / groups.

Two criteria are used to define each ethnic group. The first criterion relates to inclusion that defines the boundaries of an ethnic group. Ethnicity is determined by belonging to a cultural group. The second criterion is related to exclusion. This means that ethnicity is determined by belonging to other groups. The principle of differentiation also includes an evaluation point.

Ethnicity is a socially constructed category that completely depends on the self-awareness of the individual. Ethnicity is completely dependent on subjective self-esteem (Anderson B., 1983).

The constructive factors of ethnicity are language, religion and collective memory. An ethnic group is influenced by gravitational forces, which, through stereotypes and prejudices, create a sense of strength in unity (Ivanov I., 1999). (Fig.1)

In the literature, the term ethnicity is defined as a kind of phenomenon that contains a powerful manipulative potential that can serve a variety of interests and ideologies (Gillis, J., 1994).

The essence of a separate ethnic group, its characterological and psychological characteristics and attitudes largely determine the attitude and attitude of people from an ethnic group to one of the most important types of human activity - learning.

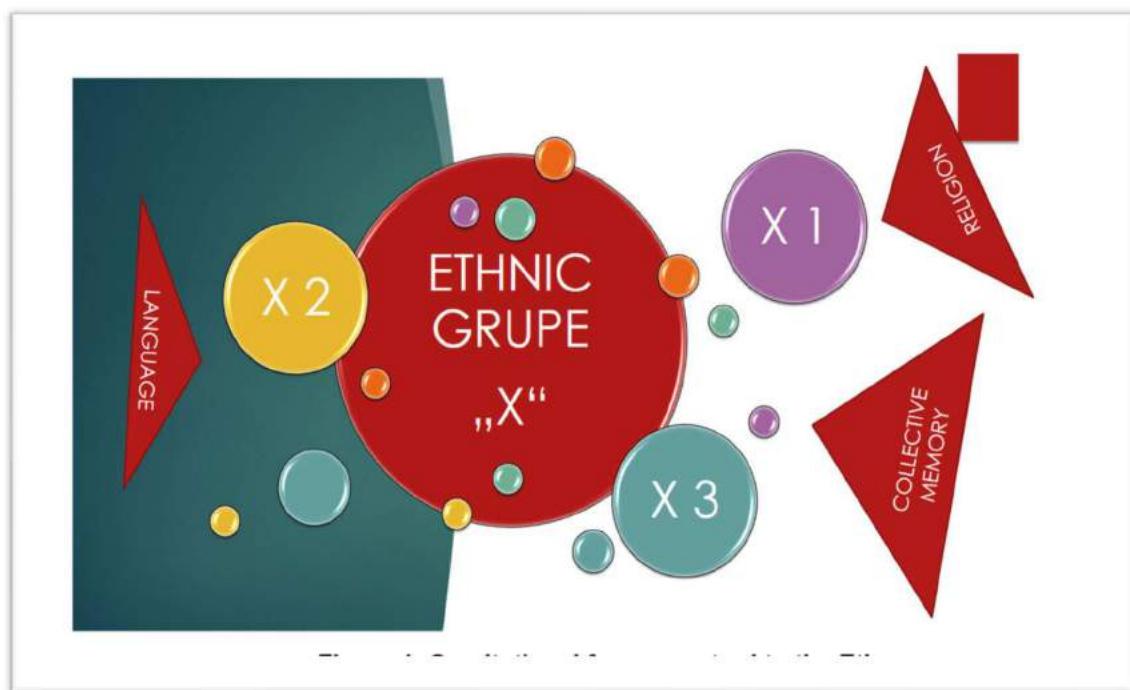


Figure 1. Gravitational forces centred to the Ethnos

### Predisposition and attitude

The term "attitude" was originally introduced into experimental psychology by the German psychologists G.E. Muller GE, Schumann, F. (1894) for the indication of conditionality of past experiences of a factor, defining the speed of reaction to perceiving a specific situation (Petrovsky A.; Yaroshevsky M.;1990). Attitude is viewed as a psychological state of readiness for a particular activity, the emergence of which depends on the presence of the following conditions: [1] need acting at a given moment in a given organism, and [2] objective situation to satisfy this need. Attitude is determined by a personal position, which expresses a certain attitude of a person to a certain line of

behavior, the goals and objectives facing him, as well as the state of selective mobilization and readiness for their implementation. It is viewed as an unconscious component of mental activity, expressed in the general dynamic state of the individual's readiness to react in a certain way to objects that meet his needs. It is characterized as "a stable latent state of a person's internal predisposition to a positive or negative assessment of an object or situation and is formed on the basis of individual life experience with its regulating, dynamically organizing influence on emotional and mental processes." Attitude is a connecting link between motivation and the target substructure of activity, on the one hand, and the operational one, on the other" (Pirev G., Desev L. 1998).

Attitude is a mental state of readiness based on past experience and has a decisive influence on a person's behavioral acts in relation to situations and objects with which he is associated. It affects the human psyche deeper than motives, and is more stable and complex than them. In each case, the installation is not carried out by the subject. The transition from the unconscious to the conscious occurs at the moments of its active manifestation, i.e. when it acquires the most pronounced regulatory significance for the course of activity. It is determined by past experience and a person's readiness for a certain activity (Pirev G., Desev L. 1998). Attitude is most often viewed as "an attitude as a mental state of readiness for a certain activity of the subject" (Desev L., 1990). It is "a defining tendency and predisposition, propensity or inclination on the part of a person, which makes a certain type of reaction more likely in a given situation" (R. Corsini. 1998).

D. Uznadze made a particularly great contribution to the development of the installation issue. He and his followers developed an original theory of installation. He describes attitude as a general psychological phenomenon. If there is a need and a situation necessary to satisfy it, the subject develops "a certain state that can be characterized as his readiness, attitude to certain activities aimed at satisfying his current need" (Uznadze DN 1968). Attitudes are not realized by a person, but they are manifested in consciously motivated behavior. Uznadze defines an attitude as "a complete modification of the subject, which focuses at each specific moment of its activity the system of character traits, absorbs it and ultimately determines the direction of specific activity."

A characteristic feature of attitude, according to I. Bzhalava, is that it: can manifest itself not only immediately, but also after some time; this is done unconsciously, but affects the content and course of consciousness; has the ability to irradiate, affect various systems of the body; has the ability to generalize (Bzhalava I. T. 1986).

From the meaning of what has been mentioned above, it becomes clear that the attitude, on the one hand, is a stable latent state of a person's internal predisposition to an object or situation and is formed on the basis of individual life experience. On the other hand, it is a temporary condition that predisposes a person to a certain reaction. This is the primary, elementary education of the human psyche. Compared to motives, it is deeper in the psyche of the individual, more stable and much more complex than them. In the mechanism of unfolding a volitional act, an attitude is formed after motivation and a decision made for the corresponding action. For the psychology of behavior, it is very important what the strength of the attitude is, whether it has any independent significance for behavior, and to what extent it determines the activity of a person. The stronger, more generalized and stable the attitude created as a result of motivation, the higher the activity of a person in the corresponding activity. There are two levels of information processing and behavior regulation: the impulsive level and the objectification level. In the first case, there is no moment of awareness. An instant attitude is formed that allows impulsive behavior. The objectification mechanism is inherent only in human consciousness. At this level, the subject consciously perceives the external situation as such. The settings are formed in the interaction of these two levels.

Attitude is the basis for the formation of a predisposition to activity. In this sense, it influences attitudes towards learning in general and, in particular, among students of different nationalities. Motives such as internal urges to action or refraining from certain types of activity are in close and organic interaction with attitudes. Strong and meaningful motives are more likely to shape the mood for action. Therefore, if it is necessary to accelerate the implementation of certain motives, they need to be made more significant for a person. Then their attitude to adequate behavior will be formed more quickly (Nikolova. M., 2003).

### Disposition to learning

Predisposition to learning in children and students is formed by cultural values and norms transmitted by their parents. *Consequently, the presence of an ethnic or cultural stereotype in parents will form a corresponding predisposition in children, including the value of education as a value or its absence.* In the scientific literature, there are various theories of motivating a child to learn, based on a change in his attitude. Among them is attribution theory. Considering the work of B. Weiner (1972), the author of the textbook "Child Psychology" R. Stamatov reflects on the main question of what motivates a child to learn. Stamatov believes that depending on the positive or negative assessment of the work done by the student, i.e. received a high or low mark, with his child's psyche, he identifies the reasons that ease his burden of responsibility. If he has a high score, the student finds his own explanation, i.e. transfers his success to the fact that he worked hard or had both work and luck, but he contributed to this appreciation. However, if the score is low, another contributed to this, the student shifts the responsibility for the result to the teacher, time, illness, or something else outside the Self. In both cases, we are talking about the process of attribution, through which consciousness creates a convenient basis for this. They are very important for subsequent similar cases, because they motivate the student's behavior in new cases.

Revealing the motivation for learning and the importance of predisposition and attitudes necessary for this in each specific case plays a decisive role in determining the measures for the formation of positive learning motivation (Stamatov R., Manchev B. (2003).

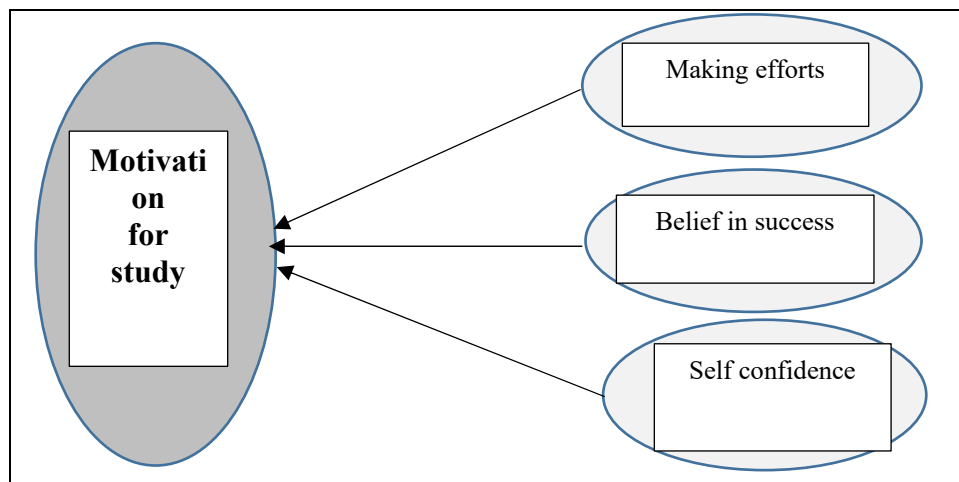
Entering the territory of ethnoculturalism, we must inevitably be guided by some important definitions for this area. For this purpose, an article by prof. Dr. I. Ivanova "Study of Ethnocentric Attitudes", in which the author defines ethnocentrism or ethnically centered personality as a person who strictly follows the principle of "cultural equality" and rejects the generally accepted ones. the paradigm of individual uniqueness. Ethnocentrism and prejudice are extremely close and difficult to distinguish. Ethnocentrism is a type of prejudice associated with a particular ethnic group, viewed in comparison with others. It is usually taken lightly or discarded. It is associated with societies of people, minorities. Ethnocentrism is considered in the context of group relations, discrimination, deterministic approach. Professor Ivanov notes that ethnocentrism, race, ethnic group are interchangeable in the socio-political dictionary of our culture (Ivanov I., 1999).

Let us dwell on the author's definition of ethnocentrism from the point of view of sociology, cultural anthropology and social psychology, namely, that the main factor in the creation of ethnocentrism in a person is social organization and the relationship between social structures and personality. It creates ethnic characteristics representative of the respective ethnic group and creates ethnic inheritance. The author deduces two main characteristics of the ideology of ethnocentrism.

- Revealing "others" in a negative point of view and counteraction.
- Rejection of others, known as social isolation, segregation.

Following Stamatov's idea (according to K. Dweck, 1976), there is a specific behavior of an unsuccessful student - a student with learned helplessness. This can be explained by the ethnocentric attitude towards the underestimation of the value of education among some ethnic groups in our country. Students from such groups quickly give up at the slightest obstacle to success and react with refusal. They believe in the insurmountability of external causes and do not seek solutions in themselves. This is a family experience. But motivation to learn is tantamount to striving for success, as evidenced by the formula of motivation to learn (Fig. 2).





**Figure 2. Formula of educational motivation.**

Motivating students with learned learning helplessness is not an impossible task. Teachers know that they do not evaluate the personality, so students must understand this (Stamatov R., 2000).

In his series of works "Educational Psychology" - Ethnos, prof. I. Ivanov explores the problems of ethnic issues in the school environment. School is a place where cultural differences and boundaries come together. Notes that an increase in the level of education is directly proportional to cultural and ethnic differentiation, i.e. at the earliest stage, the greatest cultural homogeneity. In the school environment, thanks to the unified approach of the educational system, all differences in norms and values, age, gender, ethnicity are highlighted.

The author shares the English experience of ethnic participation in school, which is a caste model - a closed elite circle with a predetermined bright future that has a lot of weight in the value of education. The American model of competitiveness, according to which success is the result of effort, hard work, and fair evaluation. Prof. Ivanov identifies a serious problem in the formation of ethnocentric communities. He believes that there is an inequality in the chances of education and social realization of children from dominant and non-working ethnic groups, such as Bulgarians and Roma (Ivanov I., 1998).

According to Professor Ivanov, the school is the territory of socialization of the prevailing ethnic group and the place of the threat of loss of their own identity for children who are defaulted. The main need for them is the absence of a model of adult behavior in another, mass ethnic group. This refers to solving the problem of segregation through the joint project work of a child from a privileged ethnic group with an adult from a privileged ethnic group. Unfortunately, according to the author, a scientific phenomenon is the difficulty of assimilating other people's values, because both the school and the teachers are from them. The dropping out of the education system of children of the default nationality becomes heroism - by this act they confirm their identity. The author calls this "self-selection."

Parents' ethnic or cultural stereotypes shape children's attitudes, including the value of education. As the level of education rises, the student's ethnic differentiation will increase. We believe that there is a disparity in the chances of education and social fulfillment. The school is the territory of socialization of the prevailing ethnic group and the place of the threat of loss of their own identity for children who have violated their rules. The main need of the latter is the absence of an "adult for others" model of behavior. There is a strong negative correlation between academic performance and positive attitudes in the dropout ethnic group.

According to Baron and Byrne (Baron, R. A. ; Byrne, D., 2000), predispositions and attitudes, including ethnocentric cognitive attitudes, determine their direction in accordance with our system of life values, our worldview. It is really very difficult to change them, because when they are already formed in our consciousness, they act as schemes of processes. If attitudes are definitely strongly influencing behavior, then knowing them will help us to anticipate a very wide range of aspects of this behavior. The attitudes and predisposition can also be formed by constantly comparing the Self



with the environment or the Self with other communities. It can also be formed on the basis of genetic factors - for example, ethnicity, race. In this sense, the student's ethnocentricity has already been formed, and changing views is a very difficult and slow process. But knowledge of these ethnocentric aspects can become the basis for finding methods and means of forming positive motivation for learning. The value of intercultural interaction in the educational environment will have a special weight in the direction of cognition of the ethno-aspects of personality values and the use of this knowledge to form positive motivation for learning. Students gaining good experience in implementing successful educational interactions is a sign that stimulates the expectation of similar success in other similar situations. The ethnocultural characteristics of attitudees and predisposition to learning in it can be changed based on this experience. Thus, a positive result for a student is the basis for a change in his ethnocentric attitude to learning.

In their study, Margaret Booth and College (Booth, M.Z. & All, 2014) interpret, according to Finney and Rosenthal (1992), ethnic identity as a sense of belonging and commitment to an ethnic group with shared behavior, language, and history. (Spencer and Markstrom-Adams, 1990) define the difference between ethnic identity and ethnic identity. The latter is limited by "the ability of a person to define himself as a member of a certain group" (Spencer MB; Markstrom-Adams S. 1990). According to the authors, ethnic identity is not the main characteristic of the dominant group of students (Phinney, 1992, 2008; Roberts et al., 1999), but for a disenfranchised group. Adolescents' sense of belonging to the educational environment and their perception of their relationships with others at school can affect their overall attitude towards school.

With regard to ethnic attitudes, Koender and Scheepers believe that there is a strong negative correlation between educational attainment and positive attitudes in the marginalized group. They found that education is closely associated with ethnic isolation, as well as chauvinism, but not patriotism. Moreover, the influence of education on the mechanism of ethnic isolation is less in newly established democracies (Coenders M., Scheepers, 2003).

We believe that intercultural exchange and the preservation and development of various cultural identities should take into account both specific ethnocultural characteristics and the educational process through various methods and forms of work with children, students and parents of all ethnic groups.

The dynamics of the ethnocultural attitude to learning has its own various factors. Prioritizing equality in all school structures and processes and analyzing student outcomes are steps towards ensuring equal opportunity for outcomes that are essential for the future realization of human capital for the prosperity of the nation.

In order to encourage teachers and leaders of the educational process, students and their families, to develop a "growth mindset, namely hard work and perseverance, which should be perceived as a factor of success" in ethnic groups, it is necessary to take action through educational policy reforms (Donnelly WJ; Kefalin A., 2017).

## RESULTS

The attitude of a person, in particular of students from ethnic minorities, influences the disposition to learn. The energy of motives for learning forms an attitude towards this action. Learning motivation in ethno-centered students can be catalyzed by focusing on the power of the importance of motives to an individual. Ethno-cultural stereotypes of parents are the mainstay of students' attitudes towards learning and not learning. A positive assessment of the work done changes the expectations of failure and leads to a change in the attitude towards learning, and therefore to a positive motivation for learning. Learning settings are process diagrams that define student behavior. One of the aspects of ethnocentrism in attitudes towards learning is inequality in the predisposition of education and, as a consequence, social realization. Another such aspect is the absence of a positive (in relation to education) pattern of behavior in the family and society. A similar aspect of ethnocentric identity is favoritism. A specific aspect is ethno-identity itself, established through a sense of belonging and influencing attitudes towards learning with a negative sign.

## DISCUSSION

The aspects listed above are not an exhaustive list, others can be defined in the context of a particular ethnic group. Prioritizing education equity in ethnic minority areas is fundamental to changing motivation to learn. Reorienting ethnocentric students towards other sources of strength and security for them, rather than their community, will counteract the gravitational forces that affect them, away from education and social fulfillment. The motivation of ethnocentric students is expressed in significant and valuable actions, phenomena, processes through which the educational process is carried out with them. Synergistic work with parents and students is the key to transforming learning motivation into positive. Promoting a successful model of social fulfillment will satisfy the ethnos' need for a vision of fulfillment and a prosperous life. The study of the specifics of attitudes towards learning in a particular ethnic community leads to predictability of the behavior of students in this group. In addition, knowledge of the aspects of such an attitude is a prerequisite for finding methods and means of forming positive motivation for learning. Knowledge of the multifaceted ethnocultural attitude to education improves the quality of education.

## CONCLUSION

Education as a process in the country is carried out in accordance with the philosophical views on education, educational policy and the educational system. The school is representative of ethnic groups within defined geographic boundaries. The quality of preparation of citizens of the state during the period of school education forms the available human capital in the state. It is adequate to the business processes in it if it carries out general social realization. The marginalization of students from ethnic groups in a society is the marginalization of citizens who are expected to create the welfare of the nation. An ethnocentric attitude towards the value of education as a factor of life well-being or against it can be transformed into a positive one with the help of appropriate motivational processes and actions. For their effective establishment, organization and implementation, it is necessary to fully study the aspects of educational attitudes in each specific ethnocentric group. Knowledge of the process of forming a positive attitude towards education is a prerequisite for the successful implementation of educational motivation for students with ethnocentric identity. Synergistic processes of establishing and intervening in attitudes towards learning in both parents and students are the path to successful transformation of attitudes towards learning. In this sense, the imposition of general interventions for the whole country, in which there are different communities with their ethnocentric characteristics, is an ineffective policy based on the vision of equality in the concrete relations of each particular community. If the philosophy of education changes to a real consideration of the diversity of ethnocentric communities, then education policies and measures will be adequate to reality and create adequate human capital for a prosperous nation.

## REFERENCES

1. Anderson B. (1983) *Imaginary Communities: Reflections on the Transition and Spread of Nationalism* (revised and expanded edition) Verso Publishing. London., ISBN 978-0-86091-546-1. p. 6-7.
2. Bzhalava, I.T. (1986) *Attitude and Behavior*, Moscow, Enlightenment, p. 22.
3. Desev, L. (1990) *Psychological Dictionary*. Sofia., Bulgarica. 626
4. European Agency for Special Education and Inclusive Education, 2017. *Improving the achievement of all students in inclusive education: Final monitoring reports*. (under the editorship of W. J. Donnelly and A. Kefalin). Odense, Denmark.
5. *Encyclopedia of Psychology*. ed. R. Corsini. (1998) Sofia., Science and Art. 1307
6. Ivanov, I. (1999) *Intercultural Education*, ISBN 954-8789-66-3, ed. Axios, Shumen.
7. Ivanov, IP, (1998) series "Educational Psychology" - Ethnos, ISBN 954-8789-44-2, 37-39). Axios, Shumen.
8. Ivanov, I. P., Research on the ethnocentrist naglasi, // Scientific conference on the occasion of the 50th anniversary of the VVUAP0 - Shumen '98, Part IV, Sh., 1999, 122-130./

9. Kolev D., Krumova T. (2005), *Between Scylla and Charybdis - about the identity of millet*, Astarta, V. Tarnovo, p. 40.
10. Nikolova. M., (2003) Dissertation - The dynamics of motives in the training of engineers with the professional qualification "teacher").
11. Pirev G., Desev L. (1998) *A Brief Psychological Dictionary*. Sofia., Partizdat. page 261
12. Psychology. Dictionary under the general editorship of A. Petrovsky and M. Yaroshevsky. (1990) Moscow., Politizdat. page 419
13. Stamatov R., (2000) *Child psychology, textbook*, ISBN 954-459-729-8, Hermes, Plovdiv, p. 193.
14. Stamatov R., Manchev B. (2003) *Human Psychology*, Hermes, Plovdiv, p. 340-349.
15. Uznadze D.N. (1968) *Experimental foundations of attitudinal psychology*. Tbilisi. 89
16. Baron, R. A., Byrne, D., *Social psychology*, (2000) A person Education Company, Needham, Massachusetts, c. 118.
17. Booth, M. Z. and all, (2014) *Ethnic Identity, Gender, and Adolescent Attitude toward School*: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4392378/>, article, *Midwest Educ Res (Akron)*. 2014 Jun; 26(2):, 3–27.
18. Coenders M., (2003) Scheepers, II. *The Effect of Education on Nationalism and Ethnic Exclusionism: An International Comparison*, *Political Psychology*, Volume 24, Issue 2, First published: 03 June 2003,
19. Gillis, J. 1994. *Memory and Identity: The History of a Relationship*. In: Gillis, J. (ed.). *Commemorations. The Politics of National Identity*. Princeton, New Jersey: Princeton University Press, 3 - 24.
20. Spencer MB, Markstrom-Adams S. *Identity Processes Among Children of Racial and Ethnic Minorities in America*. *Child development*. 1990; 61 (2), 290-310

## COVID19, FRAGILITY, AND HIGHER EDUCATION: HOW INTER-CORRELATED THEY ARE?

Ali BAYKAL\*

Bahçeşehir University, Faculty of Educational Sciences, İstanbul, Turkey.  
<https://orcid.org/0000-0001-7705-4064>

### Abstract

The mutual interdependence between countries in the world is increasing day by day with communication, transportation and therefore commerce. The indicators of fragility and methods established within the framework of relevant social sciences constitute an early warning system. On the other hand, within the last two years Covid19 came into the global society. Systems thinking postulates that any input to any system reconfigures the whole system and its components. So did Covid19 and its mutants. There is a need for approaches that fuse rather than separate qualitative and quantitative approaches in order to prevent and reduce vulnerability. The components that constitute individual and social development indicators are ultimately the causes or the results of education. Therefore, it is possible that education is expected of being one of the main factors that constitute or repair fragility. Because it is only possible to see the problems before they surface with valid data, correct methods and objective procedures. It is imperative that decision-makers have access to such information in order to implement effective policies. The purpose of this study is to draw some inferences from the meshwork of relationships between Covid19 data, fragility indicators of states, Human Development Indicators (HDI) and finally university rankings. The data compiled from open international sources (WHO, UNDP, OECD, FFP, THE) will be used to extract comparative and correlational inferences. Hopefully the bits and pieces of information derived will converge upon a set of knowledge that is essential for wisdom.

**Keywords:** Covid19; Fragility of States, Human Development Indicators; University rankings

### Özet

Dünyada ülkeler arasındaki karşılıklı bağımlılık, iletişim, ulaşım ve dolayısıyla ticaret ile her geçen gün artmaktadır. Kırılganlık göstergeleri ve ilgili sosyal bilimler çerçevesinde oluşturulan yöntemler bir erken uyarı sistemi oluşturmaktadır. Öte yandan, son iki yıl içinde Covid19 küresel topluma girdi. Sistem düşüncesi, herhangi bir sisteme yapılan herhangi bir girdinin tüm sistemi ve bileşenlerini yeniden yapılandırıldığını varsayar. Covid19 ve mutantları da öyle. Kırılganlığı önlemek ve azaltmak için nitel ve nicel yaklaşımları birbirinden ayırmak yerine kaynaştıran yaklaşımlara ihtiyaç vardır. Bireysel ve toplumsal gelişme göstergelerini oluşturan bileşenler, nihayetinde eğitimin nedenleri ya da sonuçlarıdır. Dolayısıyla eğitimin kırılganlığı oluşturan veya onaran temel faktörlerden biri olması beklenebilir. Çünkü sorunları ortaya çıkmadan görmek ancak geçerli veriler, doğru yöntemler ve objektif prosedürler ile mümkündür. Etkili politikaların uygulanabilmesi için karar vericilerin bu tür bilgilere erişiminin olması zorunludur. Bu çalışmanın amacı, Covid19 verileri, İnsani Gelişme Göstergeleri, kırılganlık göstergeleri ve son olarak üniversite sıralamaları arasındaki ilişkiler açısından bazı çıkarımlar yapmaktır. Açık uluslararası kaynaklardan (WHO, UNDP, OECD, FFP, THE) derlenen veriler, karşılaştırmalı ve korelasyonel çıkarımlar yapmak için kullanılacaktır. Umarım elde edilen bilgi parçaları, bilgelik için gerekli olan bir dizi bilgi üzerinde birleşir.

**Anahtar Kelimeler:** Covid19; Devletlerin Kırılganlık Göstergeleri, İnsani Gelişme Göstergeleri; Üniversite sıralaması

## INTRODUCTION

There are two kinds of oversophistication in educational sciences. First one is the careful philosophical inquiry of the foundations of behavioral research, and second one is the equally diligent explanation of complex details in the practice. No matter how admirable these efforts are, the former easily stops with the emergent problems of immediate daily school practice. And the latter may lead to technical details based on assumptions rarely or never met with in actual educational research. Nevertheless, these refinements are to be appreciated to simply because they exist in the vernacular of educational research. The present work is an effort to stay somewhere in between. On one hand the properties of available data will be exploited with a view to weaknesses and strengths of various approaches. On the other hand no attempts will be made to go deeply into foundations or technicalities. The attempt is rather to present the reader who is already acquainted with the elements of general methodology of educational research in particular, with an analytical outline. Thus, the present work will serve as an introduction or not as a conclusion. The hope is that it may be useful as an integration of widely scattered approaches in data collection, data-processing, data analysis, and theory formation. Just a few words about the plan of the presentation to start with: It is divided into two parts, data collection and correlational analysis.

The aim of this presentation is to describe and to explain the effects of current global problems on education based on data as much as possible. One of the current global problems that determine this aim is already evident as Covid 2019. Corona virus is a new threat. There are of course other pitfalls in every country weakening the states. The other determining factor is human development indicators. Many of the human development indicators are either the aims or the means of education directly or indirectly. In the study; regardless of its nature, any kind of education is perceived as a system composed of physical settings, social settings, instructional media, instructional methods and the teacher as the manager of all the other constituents. The plain meaning of this major tenet is that everything in education is related to everything. Therefore, the method was determined within the framework of this paradigm (Moore&Kearsley; 2012).

The integration of componential parts and processes is the most vital and at the same time the most vulnerable problem in instructional systems. The difficulty is because of the lack of usable factual information, and also of the inadequacy of our conceptual skills. Such a difficulty is felt not only in the study of instruction, but in the study of wholes in general. Our scientific thinking consists prevalently in the logical manipulation of structural elements. We point out that the structure of wholes should be described in terms of relationships. After accepting the premise that holistic connections can be resolved into relationships, the structure of whole might lend itself to conceptual treatment. Shortly the structure of wholes is amenable to conceptual treatment in terms of relations. Here the attempt will be made to demonstrate that there is a logical genus suitable to the treatment of wholes. That is the reason why the *system* has been brought into conceptual framework.

The ideal would be to develop a system metaphor with such a degree of precision that it might offer the exact mathematical foundations to describe, explain and predict the performance of organized complexities. Angyal (1941) reminds that Meyer had stated, “*The mathematics which would be needed for the mathematical formulation of biological laws does not exist today. It has to be created by the new biology*” (Meyer, 1934, p. 35).



## DATA AND METHODS

There are four groups of variables in the study. The first one is the COVID19 figure released by worldometer.org. These are as follows: Total Cases, New Cases, Total Deaths, New Deaths, Total Recovered, New Recovered, Active Cases, Serious Critical, ***Total Cases per 1 Million in population***, ***Deaths per 1 Million in population***, Total Tests, ***Tests per 1 Million in population***, and Total Population of the country... Only the high lighted (bold italics) variables will be included in the computations to maintain robustness of data (<https://www.worldometers.info/coronavirus/>).

The second set of data are the fragility indicators of states. Interdependence between countries in the world is increasing day by day with communication, transportation and therefore trade. Each of the rings must be strong so that the chain does not break. In a world where countries are interdependent, a fragile state poses a danger not only to its own people, but also to its neighbors and other states. In every period of history, many states have tried to suppress internal conflicts with mass violence. Internal conflicts, sectarian differences, ethnic tensions, civil wars arising from the sharing of assets; military coups, revolutions, etc. occurs in forms. Even if the reasons are different, the results of all of them are problematic human situations. Fracture lines often appear between identity groups such as nationality and language, religion and sect, class and party. In almost all of them, a tension arises with illegal competition over resources and assets. Unresolved disputes with law and democracy may turn into conflicts for one reason or another. The reasons for the fragility of states are complex but easily predictable. Institutions established by the international community should monitor and understand the conditions of fragile societies, and take precautions before the problems reach their breaking point.

Expert domain knowledge, case studies, and gossip evidence are essential, but not sufficient, to identify, comprehend, and evaluate common social trends. It is imperative to have sensitive early warning systems and effective political skills in order to predict vulnerability, take measures and succeed in preventing it. There is a need for approaches that combine qualitative and quantitative approaches, not separate them, in order to create approaches and trends to prevent and eliminate vulnerabilities. Because it is only possible to see the problems before they come to the surface with valid data, correct methods and objective procedures. It is imperative that decision makers have access to such information in order to implement effective policies.

The Country Vulnerability Indicators (FSI), created by the same institution and data compiled by the International Peace Fund (FPF), do not simply reflect the usual pressures experienced by all states. It is also a tool that can be used to anticipate situations where a state will not be able to manage these pressures. It also reveals the security vulnerabilities that create and feed the state's vulnerability risk. The fragility of states, indicators of fragility and data analysis methods established within the framework of relevant social sciences are an early warning system. This system is within the reach of decision makers and researchers.

Fragility Indicators of States are listed below:

Security Apparatus, Factionalized Elites, Group Grievance, Economy, Economic Inequality, Human Flight and Brain Drain, State Legitimacy, Public Services, Human Rights, Demographic Pressures, Refugees and IDPs, External Intervention.. These are too many if taken separately...Only the Total FSI (Composite index for fragility of states) will be used to introduce the fragility factor into the study (<https://fundforpeace.org/2020/05/11/fragile-states-index-2020/>).

The third group of variables are Education Index, Income Index, Health Expenditure as percentage of Gross Domestic Product (GDP), and Life Expectancy (<http://hdr.undp.org/en/content/human-development-report-2020>).



THE2020 and QS2021 are two university rankings taken as the fourth group of variables. (<https://www.timeshighereducation.com/content/world-university-rankings>).

THE and QS rank universities not countries. There may be different number of universities from different universities and their ranks are at different levels. In obtaining country rankings for tertiary education the sum of ranks of universities from each country have been taken as the key to sort. For example, in THE20 ranking there are 181 universities from USA, and their rankings are also pretty high. Interestingly, however Japan collected larger amount of scores by only 116 universities. On the other hand, there are 11 universities from Austria, South Africa, and Switzerland in THE20 Ranking list. The sums of the ranks of these universities are not equal. While Austria's universities rankings sums up to 4701. South Africa collects 6812, and Switzerland collects just 2236 points.

Quite a number of variables are at ratio scale, but since some of the variables are measured at the ordinal level Spearman's rho correlation coefficients were calculated in order to avoid error of isomorphism (McCall; 1975). Correlations and their significances were given in Table 1. Minus logarithms of particular significance levels are given to make the lives of the readers easier. Otherwise, they would have to count tens of decimal digits after the comma.

## RESULTS

**Table 1. Rank Order Correlations between the Selected Indicators and Their Significances**

Variable X	Variable Y	Rho	N	p	-	Judgement
Income Index 2019	HDI (Rank)	-	186	.000	104.7	XH
Education Index 2019	HDI (Rank)	-	186	.000	95.5	XH
Life Expectancy 2019	HDI (Rank)	-	185	.000	72.6	XH
TotalDeathsPerMill	TotalCasesPerMill	.895	176	.000	62.3	XH
HDI (Rank)	FragilityState2020	-	168	.000	58.7	XH
Income Index 2019	Education Index	.861	186	.000	55.3	XH
Life Expectancy 2019	Income Index 2019	.859	185	.000	54.3	XH
HDI (Rank)	TotalTestsPerMill	-	174	.000	52.6	XH
Income Index 2019	FragilityState2020	-	168	.000	51.7	XH
Education Index 2019	FragilityState2020	-	168	.000	49.0	XH
Income Index 2019	TotalTestsPerMill	.849	174	.000	48.7	XH
Life Expectancy 2019	Education Index	.815	185	.000	44.5	XH
Education Index 2019	TotalTestsPerMill	.826	174	.000	44.0	XH
Life Expectancy 2019	FragilityState2020	-	167	.000	40.1	XH
FragilityState2020	TotalTestsPerMill	-	162	.000	35.6	XH
Life Expectancy 2019	TotalTestsPerMill	.776	173	.000	35.4	XH
TotalTestsPerMill	TotalCasesPerMill	.769	174	.000	34.5	XH
HDI (Rank)	TotalCasesPerMill	-	181	.000	25.3	XH
Income Index 2019	TotalCasesPerMill	.673	181	.000	24.5	XH
Education Index 2019	TotalCasesPerMill	.641	181	.000	21.6	XH
Life Expectancy 2019	TotalCasesPerMill	.618	180	.000	19.6	XH
FragilityState2020	TotalCasesPerMill	-	168	.000	17.7	XH
TotalTestsPerMill	TotalDeathsPerMill	.577	172	.000	15.9	XH
HDI (Rank)	TotalDeathsPerMill	-	176	.000	15.8	XH
Education Index 2019	TotalDeathsPerMill	.567	176	.000	15.7	XH
Income Index 2019	TotalDeathsPerMill	.526	176	.000	13.2	XH
Life Expectancy 2019	TotalDeathsPerMill	.527	175	.000	13.1	XH
FragilityState2020	TotalDeathsPerMill	-	165	.000	11.5	XH
THE20 RankSum	OS 2021 Ranksum	.654	81	.000	10.4	XH
Health Expenditure 2017	Education Index	.438	181	.000	9.2	VH
Health Expenditure 2017	TotalDeathsPerMill	.433	171	.000	8.5	VH
HDI (Rank)	OS 2021 Ranksum	-	94	.000	8.3	VH
Health Expenditure 2017	Life Expectancy	.410	181	.000	8.0	VH
Income Index 2019	OS 2021 Ranksum	.537	94	.000	7.6	VH
Health Expenditure 2017	FragilityState2020	-	166	.000	7.3	VH
Health Expenditure 2017	HDI (Rank)	-	181	.000	7.1	VH

Education Index 2019	OS 2021 Ranksum	.520	94	.000	7.1	VH
Health Expenditure 2017	TotalTestsPerMill	.369	169	.000	6.1	VH
Life Expectancy 2019	OS 2021 Ranksum	.468	94	.000	5.7	VH
Health Expenditure 2017	TotalCasesPerMill	.346	176	.000	5.6	VH
FragilityState2020	OS 2021 Ranksum	-	92	.000	4.7	VH
Health Expenditure 2017	Income Index 2019	.278	181	.000	3.8	H
TotalTestsPerMill	OS 2021 Ranksum	.351	94	.001	3.3	H
EXP%GDP2017	OS 2021 Ranksum	.336	92	.001	3.0	H
Health Expenditure 2017	THE 2020 Rank	.170	87	.116	0.9	NS
TotalCasesPerMill	OS 2021 Ranksum	.088	94	.397	0.4	NS
TotalDeathsPerMill	OS 2021 Ranksum	.076	94	.469	0.3	NS
FragilityState2020	THE 2020 Rank	.077	88	.478	0.3	NS
Education Index 2019	THE 2020 Rank	.056	89	.603	0.2	NS
Life Expectancy 2019	THE 2020 Rank	.053	88	.623	0.2	NS
Income Index 2019	THE 2020 Rank	-	89	.765	0.1	NS
HDI (Rank)	THE 2020 Rank	-	89	.910	0.0	NS

XH: Extraordinarily high significance; VH: Very High significance; H: High Significance; J: Just significant; NS: Not significant

## DISCUSSION

First of all it is necessary to remind that correlations are ranked according to the minus logarithm of their significance levels in descending order not according to their magnitudes and/or directions. Correlations between the pairs of variables were found to have been significant quite high. The most significant correlations are between HDI Rank and Income Index 2019, Education Index 2019 and Life Expectancy 2019. These are almost auto-correlations because HDI Rank is a kind of compound variable of economic, educational and health factors in a country. In the meantime, one should note that HDI (Rank) is high when the rank number is small. The smaller the HDI (Rank) is the better the country is in Human Development. This is the reason why the correlations are high but minus. It doesn't mean that there is an inverse relationship between economic, educational, and medical development with the overall Human Development. Also FSI 2020 (Fragility of State Index) is a negative, adverse factor by definition. It is more unfavorable when it has a large value. This implies that it is more likely to observe inverse relationships between FSI 2020 and other favorable factors such as HDI, Education Index, Income Index, and health indicators.

The fourth most significant correlation is between the Total Deaths Per Million in Population and the Total Cases Per Million in population. This is so natural because there is almost a causal relationship between these two variables. They are variables inseparable.

Fifth extraordinarily high correlation ( $\rho = -0.893$ ,  $N=168$ ,  $p=0.000$ ,  $-\log(p)=58.7$ ) between HDI (Rank) and FSI 2020 implies that the more developed the human resources of a country the less likely she will suffer fragility.

Income Index 2019 and Education Index 2019 yields ( $\rho=0.861$  for  $N=186$ , at  $p=0.000$  with a minus  $\log(p)$  of 55.3) an extraordinarily high (XH) correlation. Income and Education are spiraling factors. Each one reinforces the other one: The richer are better educated and the better educated ones get richer.

Income is also essential for health as it is for education. Life Expectancy 2019 and Income Index 2019 are at the seventh line from the top ( $\rho=0.859$ ;  $N=185$ ;  $p=0.000$ ;  $-\log(p)=54.3$ ).

The more developed the human resources the more they demand for the public service of any kind: The higher the HDI (Rank) is the larger the proportion of population tested for Covid19: HDI (Rank) and Total Tests Per Million of population yields  $\rho = -0.865$ ;  $N=174$ ;  $-\log(p)=52.6$ . Minus sign is due to the fact that the numerical values of HDI (Rank) increases as the value to Human Resources decreases.

Fragility of States Index 2020 is inversely correlated with Income Index 2019 and Education Index 2019 along the 9th and 10th lines on Table 1. These are extraordinarily significant correlations.

The classification criterion has been arbitrarily set by the author: If the minus  $\log(p)$  is 10 or above the significance level has been labeled as XH (Extraordinarily High significance). There are 29 pairs of variables which are correlated at that level. It means that it is even more than miracle to obtain such significant correlations by chance. These relationships cannot be attributed to chance or random coincidences. Total Deaths per Million Population for instance cannot be attributed to fate alone. It is evident that if the developmental, educational and welfare level is higher then the proportion of deaths per million population tends to be smaller. Similarly the variable Total Cases per Million Population yields significantly high correlations with traditional variables such as income, education, health and also with total fragility. The magnitudes and direction of correlations are consistent with conventional expectations. There are no surprising and paradoxical cases.

Surprising findings are matched with the university rankings namely THE2020 and QS2021. The variable THE20 Rank yields non-significant correlations with Education Index 2019, FSI 2020, HDI (Rank). Health Expenditure 2017 %GDP, Income Index 2019, and Life Expectancy 2019.

QS 2021 Rank-sum values are significantly correlated with HDI (Rank), Income Index 2019, EduIndex 2019, LifeExpectancy 2019, FSI 2020, TotalTestsPerMill and EXP%GDP2017, but not with TotalCasesPerMill, TotalDeathsPerMill. The correlation between THE2020 and QS2021 ( $\rho=0,654$ ;  $N=81$ ;  $p=0,000$ ;  $-\log(p)=10,4$ ) is also quite significant which implies consistency between the country rankings in terms of tertiary education performance. If they were perfectly correlated they would't appeal to different expectations.

Almost all of the intellectuals are against the "horse race" among the universities. They scorn the ranking criteria for being narrow and irrelevant with respect to the social and intellectual values of academia. "University Olympics" perpetuates the advantageous positions of leading universities. Universities are not as competitive as political parties to earn prestige at the expense of others. Egalitarian values still prevail in higher education. This is not to deny the existence of stratification of higher institutions. There are inter-institutional differences among the universities in every country. There are also differences among students and researchers. These unequal competencies ends up with hierarchical structure and challenge whether we like it or not. These are the main reasons why the ranking culture sustains. It is impossible to avoid it but it is possible and desirable to obtain comparative information for the common concern may be just for curiosity (Rizvi&Lingards; 2010).

## CONCLUSION

All variables and intercorrelations between these variables are clear and straightforward in this study. They have been chosen in such a way that no one can be left out by anyone working in the area. They all appeal to every single stakeholder in the field of education. Correlational hypotheses are also of common interest. Results could have been anticipated almost by every layman. All favorable variables yielded positive and significant correlations with other favorable variables. Almost all favorable variables yielded positive and significant correlations with other favorable variables. Almost all favorable variables yielded inverse and significant correlations with unfavorable variables. Almost all unfavorable variables tend to correlate significantly with other unfavorable variables. Interestingly enough only the quantifiers of tertiary education seems to be alien to the actual phenomena around them. There is not enough legitimate evidence but some symptoms to conclude as follows: Apparently universities are really enjoying their ivory towers!

## REFERENCES

1. Angyal, A. (1941). Foundations for a Science of Personality, Harvard University Press. pp. 243-261. (In Emery; 1974); pp. 17-29).
2. Emery, F.E. Ed. (1974). Systems Thinking. Middlesex, Penguin books.
3. <https://fundforpeace.org/2020/05/11/fragile-states-index-2020/>
4. <http://hdr.undp.org/en/content/human-development-report-2020>
5. <https://www.worldometers.info/coronavirus/> (July 27<sup>th</sup>, 2021)
6. <https://www.timeshighereducation.com/content/world-university-rankings>
7. <https://www.topuniversities.com/university-rankings/world-university-rankings/2021>
8. McCall, R.B. Fundamental statistics for psychology. (2nd Edition). New York: Harcourt Brace Jovanovich, Inc., 1975.
9. Meyer, A. (1935). Ideen und Ideale der biologischen Erkenntnis, Barth. (In Angyal; 1941).
10. Moore, M. G., Kearsley, G. (2012). Distance Education: A Systems View of Online Learning. Belmont, CA.
11. Rizvi, F. & Lingard, B. (2010). Globalizing Education Policy, London and New York, Routledge.

## STUDENTS' PERSPECTIVES ON REAL AND IDEAL USES OF INSTRUCTOR'S TIME

Tami Meredith<sup>1\*</sup>, Maryanne Fisher<sup>2†</sup>

<sup>1</sup>*Dalhousie University, Faculty of Computer Science, Halifax, Canada.*

<sup>2</sup>*Saint Mary's University, Faculty of Science, Department of Psychology, Halifax, Canada.*

### Abstract

The reality of academia is that most instructors divide their time between teaching tasks, doing research, supervising students, and performing other administrative duties. After accounting for all other activities within a 40-hour workweek, we determined that instructors at a typical Canadian university have approximately 7 hours for teaching related tasks outside of the classroom such as creating and preparing lectures, making handouts, marking, grading, holding office hours, managing teaching assistants, or answering course related e-mail. We asked 99 current students to allocate an instructor's time, within the 'real' 7-hour constraint. We also asked them how they would 'ideally' allocate an instructor's time if there was no time constraint. Office hours were considered the most important use of time, with grading and exam/assignment preparation being listed next, while administrative activities were viewed as the least important. We identified sex differences, between male and female students, in their thoughts about how instructors should allocate their time with respect to office hours, grading, and preparation of examinations. In addition, all students believed that the 7-hour limit is unrealistic and does not provide an instructor with adequate time to support students effectively. We found that when instructors attempt to balance their time across their numerous responsibilities within a work week, there is insufficient time to satisfy student expectations. This conflict between student expectations and the limitations on an instructor's time creates a challenging and stressful situation that needs to be addressed so that instructors can effectively and satisfactorily fulfil their many responsibilities.

**Keywords:** Science Instruction, Time Use, Student Expectations, Teaching, Stress

### INTRODUCTION

The reality of academia is that most instructors divide their time between teaching tasks, doing research, supervising students, and performing other administrative duties. It is known that long workdays, greater than 9 hours in length, are linked to both poor physical health and poor mental functioning (Sekine, Chandola, Martikainen, Marmot, & Kagamimori, 2009). In Canada, where both authors are employed, it is traditional for the workday to be 8 hours in length, leading to a 40-hour workweek. Indeed, the Government of Canada imposes sanctions in accordance with guidelines around the 40 hour workweek format (see <https://www.canada.ca/en/employment-social-development/programs/employment-standards/work-hours.html> for additional details). Consequently, given university employees fall under the government, teaching, research, and administration must be distributed to fit within these 40 hours.

Based on the 40-hour workweek and using a rough guideline of allocating time such that one's workload is 40% teaching, 40% research and 20% administration, then one's available teaching time is approximately 16 hours per week for all courses. Some may argue that this teaching time should include student supervision, any emails from the university about allowing students into courses, and so on. However, for our purposes we restrict teaching duties to being course-related preparation, lecturing, or interacting with students enrolled in the course.

Furthermore, faculty members are required to teach more than one course per term and generally have a teaching load of 2 or 3 courses per term. At our universities, each course requires 3 hours of



lecture time each week, not including labs, tutorials, seminars, and student contact, such as office hours or communications.

When teaching a modest load of 2 or 3 courses per term, an instructor has an average time allocation of 5.3 to 8 hours per course, per week. If an instructor has 3 courses, on a weekly basis they will need 9 total lecture hours that are spent in the classroom, which only leaves 7 hours remaining for any other teaching related tasks – a time allotment that is then shared across 3 courses. Instructors might use that time to create and prepare lectures, make handouts, perform grading, hold office hours, manage teaching assistants, or answer course related e-mail, among other tasks. Accomplishing all the administrative activities for 3 courses within a 7 hour time span leaves very little time for each activity.

Of course, instructors teaching 3 courses will put more than 16 hours into teaching and will shift some of their research work to other terms when they have a lower teaching load, or alternatively, simply reduce the amount of research and administration that they are performing. However, given that research output is critical to achieving tenure and promotion, doing so is a risk that many instructors cannot take. Junior faculty are especially at risk, given that they need to demonstrate to their universities that they can achieve strongly positive teaching evaluations from students, maintain an impressive research record, and contribute to the university and academic community via service. The result is long workweeks, which have been connected with decreased health.

Indeed, occupational burnout is a serious concern that universities must consider among their faculty. The World Health Organization (2019) defines burnout as “a syndrome conceptualized as resulting from chronic workplace stress that has not been successfully managed. It is characterized by three dimensions: feelings of energy depletion or exhaustion; increased mental distance from one’s job, or feelings of negativism or cynicism related to one’s job; and reduced professional efficacy. Burnout refers specifically to phenomena in the occupational context and should not be applied to describe experiences in other areas of life.” Alves and colleagues (2019) review how more than a third of university faculty are suffering from burnout, and that it is connected with a decreased quality of life. Interestingly, their findings show that this pattern is apparent across all disciplines and is almost entirely unaddressed by universities.

Adding to the feelings of stress that underpin burnout is the need to provide excellent pedagogical experiences to students. While all faculty must achieve a satisfactory publication record, instructors are also required, in Canadian universities, to achieve acceptable ‘Student Ratings of Instruction’ (SRIs). That is, each term, the university administers a survey to determine the student’s perceptions of the instructor. These ratings are primarily numeric in nature and are typically used by academic administrators to evaluate the ‘quality’ of an instructor. Many of these surveys are about the actual instructor’s competencies, organization, and the quality of content delivery. However, at least one item is comparative, such that instructors are compared with each other (e.g., “Compared with other instructors I have had at this university, this instructor is very poor, poor, average, good, very good”; for a current example of the survey used by the second author’s university, see <https://www.smu.ca/about/academic-senate-instructor-course-evaluation.html>).

Further, departments typically evaluate instructors based on how they compare against the average score of other instructors, which creates an arbitrary ‘cut off’ of being above or below average. In our experiences as department members, those who are close or below average often are met with feedback that they need to improve, seek help, or take measures to perform better on student evaluations or risk reprimand and job loss. While there are many issues regarding the use of SRIs (for a review see Benton & Cashin, 2014), the reality is that instructors need to meet student expectations in order to remain employed. In this paper, we explore students’ expectations of instructor’s time use so that science instructors can be better informed as to students’ needs, priorities, and values.



Regardless of career considerations, in our experiences it appears that most instructors strive to deliver high quality courses. Here we examine one potential area that causes tension between instructors and students: the use of instructor's time in a course. Our examination of student views regarding instructors' time management promotes the development of high-quality learning environments, in that students perceive instructors as available. Dyer (2002) considers the teacher, not teaching resources, to be the most influential factor for student achievement. If so, then how students perceive an instructor's availability and time management will affect student learning outcomes. However, a slightly different position from Shaunessy and McHatton (2009) considers the student-teacher relationship to be the most important facet of an optimal learning experience and that considering student values and individual needs provides a nurturing learning environment, within which students can successfully progress. Although the focus is not entirely on the instructor, this model again indicates the importance of instructor availability and dedicated time toward a singular course, and students within that course.

Here, in the current study, we examine a small part of perceived instructor availability: the use of time by an instructor. Recalling the boundary of a 40-hour workweek, with 16 hours dedicated to teaching, an instructor with 3 courses has 5.3 hours per week per course, of which 3 hours is spent lecturing. The remaining 2.3 hours per course could be spent organizing lab activities, creating handouts or examinations, holding an office hour, answering e-mails, grading work, or engaging in lecture preparation. If the courses are new to the instructor, they will likely exceed the 2.3 hours on lecture preparation alone. If the instructor has only 2 courses assigned to them, then they have 8 hours per week per course available, of which 3 is reserved for lecturing. This leaves them with slightly more time outside the classroom for activities. We hypothesize that students are wholly unaware about the time demands placed on instructors, and do not consider it important, yet seek instructor's availability. We examine two scenarios to explore student expectations about availability: how students would assign instructor's tasks related to their 16 hour time allotment, and how they would assign tasks as if there was no time restriction.

## METHOD

In our study, we explored students' allocation of an instructor's time within two contexts. We initially described the duties that instructors perform (similarly to above) in addition to those that are teaching related, and stipulated that instructors have 7 hours per week in which to perform teaching-oriented tasks. (Using the 7 hour guideline assumed a given instructor was teaching 3 courses during a 40 hour workweek, with 40% dedicated toward teaching and resulting in 16 hours, with 9 of those dedicated toward lecturing at 3 hours per course, leaving 7 hours for all other activity for 3 courses combined.)

Students were then asked to allocate the instructor's time, within the 'real' 7 hour constraint. We subsequently asked them how they would 'ideally desire' to allocate an instructor's time if there was no time constraint. These tasks are listed in Figure 1 and, notably, do not include the very time intensive activity of lecture preparation, which can take up to 3 hours for a 1 hour class (Wankat, 2000). It should be noted that all students were in traditional face-to-face classes with online tools used only to supplement in-person course delivery.

We did not account for any 'additional' time provided by teaching assistants. That is, we did not permit tasks to be delegated to a teaching assistant instead of being performed by the instructor. In part, we did not consider teaching assistants because of the large number of factors that can influence their use. For example, teaching assistants may lack the skill to perform some tasks, may be constrained by union, visa, and employment restrictions with regard to permitted activities, or may not even be available for higher-level courses. The activity of 'Meet with teaching assistants' therefore describes meetings between the instructor and the assistants and does not consider any other meeting of the teaching assistants with students.

‘Blackboard’ was the online learning management system (LMS) in use at the time of the study. This activity refers to posting material, grades, and announcements as well as any other administrative tasks with respect to the LMS. ‘IM’ refers to instant messaging and is the use of SMS (i.e., texting on a mobile phone) as well as other messaging software (e.g., Discord, Zoom, Slack, Microsoft Teams).

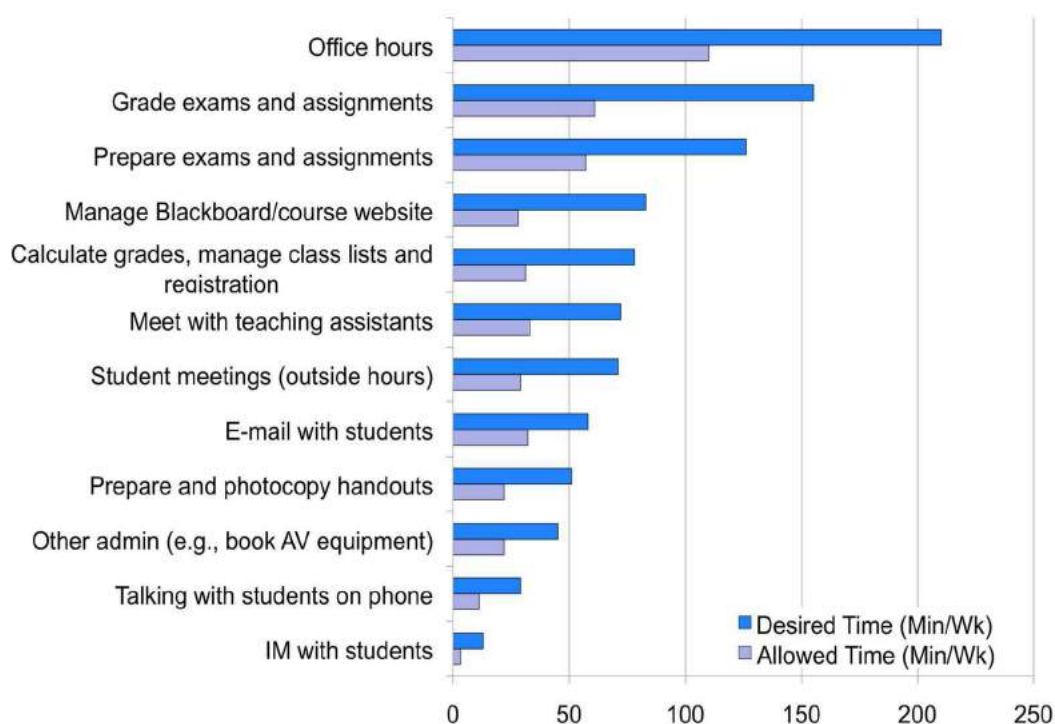
‘Other admin’ was an open-ended item that students could clarify. They included re-examining grades, placing items on hold at the library, ordering textbooks, installing software for lab assignments, meeting with other instructors, setting up demonstrations, locating movies, and arranging guest-lectures, for example.

Participants individually performed the time allocation tasks using a pencil-and-paper survey in a private room and were given a small course credit for their time. Time was to be allocated using minutes, with all results being normalized (e.g., 1 hour being converted to 60 minutes). The use of a calculator was permitted so that participants could ensure their time allocation equaled the 7 hour (420 minute) limit for the constrained task.

A total of 46 women and 53 men completed the study. All were undergraduate students at the same institution as the second author. With regard to their program, 4% were in their 1<sup>st</sup> year of study, 21% in 2<sup>nd</sup> year, 32% in 3<sup>rd</sup> year, 33% in 4<sup>th</sup> year, 6% in 5<sup>th</sup> year, and 1 person was in her 6<sup>th</sup> year. All were currently enrolled in a psychology course but represented a variety of discipline majors.

## RESULTS

Descriptively, students expressed that more time be spent on all activities than permitted by the 7 hour constraint (see Figure 1). We calculated difference scores for allowed time versus ideal time and then performed *t*-tests to determine the significant differences. Time spent on instant messaging (IM) and Blackboard significantly increased. However, there was large variation between students, which might obscure other significant increases – this variation was not accounted for by year of study or satisfaction at the university.



**FIGURE 1. Time allocation: Allowed by Time Constraints vs. Desired if No Time Constraints, in Minutes**

To explore whether participant sex impacted on their time allocation (partly to investigate the above finding with respect to variation), a Multivariate Analysis of Variance model was created. The difference scores (allowed versus ideal) for each task served as the repeated dependent variable, with sex as the independent variable. As seen in Table 1, women prefer more time be spent on grading, preparing exams and assignments, and calculating grades. Men prefer more time for office hours.

Unsurprisingly, students increased the time for all the tasks we listed for instructors, such that the time an instructor should devote to a course was approximately tripled. That is, students believed that the ideal amount of time that should be spent on each course, no including lecture preparation and delivery, is approximately 16 and a half hours. Given 9 hours of lecturing, and a very conservative 9 hours of lecture preparation, students believed that an instructor teaching 3 courses should work 67.5 hours a week on teaching alone.

**Table 1. Sex Differences in Time Allocation, in Minutes**

Task	All		Men		Women		Sex Difference Allow-Ideal <i>p</i> value
	Allowed	Desired	Allowed	Desired	Allowed	Desired	
<b>Office hours</b>	<b>110</b>	<b>208 (+108)</b>	<b>110</b>	<b>230 (+120)</b>	<b>111</b>	<b>185 (+74)</b>	<b>.031</b>
<b>Grading</b>	<b>61</b>	<b>157 (+98)</b>	<b>58</b>	<b>126 (+68)</b>	<b>64</b>	<b>188 (+124)</b>	<b>.001</b>
<b>Preparing exams</b>	<b>56</b>	<b>127 (+71)</b>	<b>56</b>	<b>109 (+53)</b>	<b>57</b>	<b>146 (+89)</b>	<b>.016</b>
Blackboard	27	84 (+57)	27	74 (+47)	28	94 (+66)	n.s.
<b>Calculate grades</b>	<b>30</b>	<b>78 (+48)</b>	<b>29</b>	<b>63 (+34)</b>	<b>32</b>	<b>94 (+62)</b>	<b>.011</b>
Meet TAs	34	72 (+38)	34	71 (+37)	33	73 (+40)	n.s.
Meet students	29	71 (+42)	28	64 (+36)	31	79 (+48)	n.s.
E-mail	32	58 (+26)	32	58 (+26)	32	59 (+26)	n.s.
Handouts	22	51 (+29)	21	49 (+28)	23	53 (+30)	n.s.
<b>Other admin</b>	<b>21</b>	<b>46 (+25)</b>	<b>28</b>	<b>39 (+11)</b>	<b>14</b>	<b>53 (+39)</b>	<b>.021</b>
Phone	10	28 (+18)	8	26 (+18)	13	31 (+18)	n.s.
IM	3	13 (+10)	3	14 (+11)	4	11 (+7)	n.s.

Table note: The dependent variable was the difference value of allowed versus ideal, such that the number in parentheses represents the increase in desired time over what was stated under the allowed time constraints. For brevity, the average minutes per task is provided, along with the outcome of the MANOVA model.

## DISCUSSION

Some of student's time allocations are far from realistic. Overall, students believed that instructors will talk to students on the phone for approximately 28 minutes a week. In reality, we find that students rarely telephone, preferring to use email, IM, and other text-based communication. As this study was performed prior to the COVID19 pandemic, it remains to be determined whether students have different ways they would assign tasks to instructors, given time constraints. With many universities transitioning online during

the pandemic, perhaps students perceive instructor availability as being receptive to phone calls, but also calls from other online tools.

While students allocated considerable amounts of time to preparing exams and calculating grades, these tasks are not performed weekly. Exams are only prepared a few times during the term (e.g., twice for a course with a midterm and a final exam). Considering a standard 13 week term, students allocated over 27 hours for exam preparation, 34 hours for grading, and 16 hours for calculating grades in the ideal (i.e., desired) condition. In general, we ourselves as instructors tend to spend less time than suggested on exam preparation, far more on grading, as this includes grading of both assignments and exams, and less time on calculating grades. While the student time allocations may not be accurate, likely because students have never had to prepare exams or grade submitted work, their relative weights provide a strong indication of students' level of concern with respect to these tasks.

Time spent on e-mail and IM showed the largest relative increase. Thus, efforts should be made to improve the efficient use of communication technology, perhaps through integrative social environments (e.g., FaceBook, Learning Management Systems), and to encourage students to interact and have meaningful and co-operative dialogues with each other, consequently reducing their need to solely rely on the instructor for information. However, such dialogues need to be carefully monitored by the instructor. Anecdotal reports of students setting up 'secret' online communication networks can explain how student misconceptions seeming propagate across the class and become 'common knowledge.' While instructors cannot influence these 'secret' networks, they can reduce the spread of misconceptions and erroneous information through careful monitoring of the communications mechanisms for which they do have access. Instructors may also attempt to maintain all communication within a tool that everyone can access by assigning a portion of a grade toward communication with peers or a group, for example.

All students were undergraduates at a predominately teaching focused university. Thus, they may be more concerned with teaching than with research, perhaps influencing their views on instructor's time use. Students may believe that research should be performed solely during non-teaching terms and may consequently consider the 7 hour limit as unreasonable, which could explain the time increases. It is also possible that students simply do not see research being performed; they are removed from the laboratories and offices of faculty, and do not comprehend the time commitment that goes into research. Further, the idea of administrative service toward one's university and academic community is not one that readily comes to mind for students. Instead, they see instructors as teachers in the front of the classroom (or on their computer screen) who assigns a grade, not as faculty with multiple demands outside of teaching.

Women's focus on grading may indicate a strong desire for feedback about their performance, possibly as a risk minimisation strategy (Fisher & Cox, 2002). That is, rather than wait to submit a large assignment, women may seek feedback for smaller components to ensure that they are moving along the right lines and will achieve a high grade. Men's desire for more office hours is potentially to maximise convenience as they typically have less regular class attendance than women (Dayioğlu & Türit-Aşik, 2004). Further research is needed to determine why these sex differences exist, as well as to see whether they translate to virtual teaching environments.

We close by noting that there has been increasing discussion about the need to reduce the 40-hour workweek, given that it reduces physical and mental health, decreases opportunities for family and personal interaction, and increases unemployment (e.g., Ibrahim, 2021). Reducing the workweek may also increase overall productivity through increased focus. For example, in Japan, Microsoft performed an experiment where they decreased the workweek to four days a week, with the same pay as a traditional five day workweek, for a one month trial. The reduced workweek resulted in an overall increased 40% productivity (<https://news.microsoft.com/ja-jp/2019/10/31/191031-published-the-results-of-measuring-the-effectiveness-of-our-work-life-choice-challenge-summer-2019/>). Faculty are at a high risk of burnout, and universities have taken minimal efforts to address this issue. Students, meanwhile, have expectations about how instructors will use their time that are not openly discussed. Instructors feel torn between needing to attend to many tasks outside of teaching, and yet need to maintain strong teaching evaluations from students to keep their position. Burnout from working excessive hours to meet student expectations while also fulfilling non-teaching commitments is a very real outcome for many instructors. Universities must work with instructors to help manage student expectations, in light of the other tasks expected from instructors such as research and administrative work. For example, decreasing the number of assigned courses, or decreasing expected administrative service would help free-up time for attending to student needs. Increasing outside support,

such as the use of trained, high-quality teaching assistants, secretarial staff for handout preparation, or the use of test-banks with automated grading, may also be worthwhile improvements.

## CONCLUSION

All students believe that 7 hours a week outside of lecturing is unrealistically low for performing teaching related tasks for multiple courses. Students more than triple the time they think instructors should take for tasks, which highlights their expectations for instructors. Although it is impossible to satisfy their suggestion of a 67.5 hour teaching week, we know of many colleagues, ourselves included, who have spent 15 hour days in our offices trying to get everything done on time. It is a simple reality that the activities associated with teaching often need more time than our hypothetical 40%, making research difficult or impossible to perform (McClain, 2003), and administrative service tasks go unfinished. While many instructors potentially compensate with longer workweeks, there are still never enough hours in the day to satisfy students' expectations. Universities absolutely must become aware of the real possibility for faculty burnout, and work toward managing student expectations.

## REFERENCES

- Castro Alves, P., Oliveira, A. d. F., & Paro, H. B. M. d. S. (2019). Quality of life and burnout among faculty members: How much does the field of knowledge matter? *PloS ONE*. <https://doi.org/10.1371/journal.pone.0214217>
- Benton, S. & Cashin, E. (2014). Student ratings of instruction in college and university courses. *Higher Education: Handbook of Theory and Research*, 279-326, Springer, Dordrecht.
- Dayioğlu, M. & TÜRÜT-AŞIK, S. (2004). *Gender differences in academic performance in a large public university in Turkey*. METU ERC Working Papers in Economics 04/17, Ankara.
- Dyer, J. (2002). Characteristics and behaviours of effective social education teachers: A discussion with primary social education students at Deakin University. *Ethos P-6*, 10(3), 8–9.
- Fisher, M. & Cox, A. (2006). Gender and programming contests: mitigating exclusionary practices. *Informatics in Education*, 5(1), 47-62.
- Ibrahim, N. (2021). *Fact or fiction: Is it time to shorten the 40-hour workweek?* Retrieved July 26 2021 from <https://globalnews.ca/news/7687131/fact-or-fiction-4-day-workweek/>
- McClain, L. (2003). Lessons in time management, *The Chronicle of Higher Education*. Retrieved from <http://chronicle.com/article/Lessons-in-Time-Management/45291>.
- Sekine M., Chandola T., Martikainen P., Marmot M., & Kagamimori S. (2009). Socioeconomic inequalities in physical and mental functioning of British, Finnish, and Japanese civil servants: Role of job demand, control, and work hours. *Social Science & Medicine*, 69, 1417–1425.
- Shaunessy, E. & McHatton, P. (2009). Urban students' perceptions of teachers: Views of students in general, special, and honors education. *The Urban Review*, 41. <https://doi.org/10.1007/s11256-008-0112-z>.
- Wankat, P. (2002). *The Effective, Efficient Professor: Teaching Scholarship, and Service*. Allyn & Bacon, Boston.
- World Health Organization (2021). *Burn-out an "occupational phenomenon": International Classification of Diseases*. Retrieved July 26 2021 from <https://www.who.int/news/item/28-05-2019-burn-out-an-occupational-phenomenon-international-classification-of-diseases>



## GUT-BRAIN AXIS IN PARKINSON'S DISEASE

**Busra AKTAS**

*Department of Molecular Biology and Genetics, Faculty of Arts and Sciences, Burdur  
Mehmet Akif Ersoy University, Burdur, Turkey  
<https://orcid.org/0000-0001-9863-683X>*

### Abstract

Parkinson's Disease is one of the most common neurodegenerative disorders. Parkinson's Disease is characterized by loss of dopaminergic neurons involved in maintaining motor functions, however; cause of dopaminergic neuron loss is unknown in most of the cases. Several factors are associated with neuronal degeneration in Parkinson's Disease including increase in free radicals, oxidative stress, mitochondrial dysfunction, and inflammatory cytokines. It has been reported that non-motor symptoms such as constipation and leaky gut syndrome precede the onset of the motor symptoms such as bradykinesia, resting tremor, postural instability. Growing evidence indicates that gut microbiota communicates with brain, which is called gut-brain axis maintaining homeostasis of the gastrointestinal and the nervous system with the association of immune system. Gut-brain axis is linked to various tissues and organs including immune cells, autonomic nervous systems, glands, brain, intestine with its microbial composition and communicate each other to preserve homeostasis. Current Parkinson's Disease treatment, based on replacement of dopamine to treat motor symptoms, provides only symptomatic relief and wanes in efficacy. That brings drug resistant-motor symptoms as well as drug side effects, which leads to emergence of alternative therapeutic strategies. Improvement of gut permeability and inflammation by modulating gut microbiota could be a good strategy in improvement of Parkinson's Disease. Considering the studies on the role of gut microbiota in neural development and pathogenesis of neural disorders to date, this review will highlight the role of the gut microbiota on Parkinson's Disease with the recent evidences. Additionally, alternative therapeutic interventions based on gut microbiota modulation to improve Parkinson's Disease pathogenesis will be discussed.

**Keywords:** gut microbiota, Parkinson's Disease, gut-brain axis

### PARKINSON DISEASE

Neurological disorders are the most common cause of disability in the world (Dorsey and Bloem, 2018). Parkinson's Disease (PD) is the fastest growing among these neurological disorders, which growing faster than the Alzheimer disease. Previously, 6M PD cases was reported in 2016 and 9.4M PD global population in 2020 was estimated (Maserejian et al., 2020). However, based on the Parkinson's foundation Parkinson's prevalence project, more than 10 M individuals worldwide are living with PD (Foundation, 2021). Incidence of Parkinson's Disease increases with age and people are diagnosed with Parkinson's at 60 as an average but around 4% of patients with PD has been diagnosed as young as before age 50 (Foundation, 2021; Medicine, 2021).

PD, one of the most common neurodegenerative disorders, is characterized by loss of dopaminergic neurons involved in maintaining motor functions and in most of the cases cause of dopaminergic neuron loss is unknown (Dorsey and Bloem, 2018; Taylor et al., 2013). Several factors are associated with neuronal degeneration in PD including increase in free radicals, aggregation of  $\alpha$ -synuclein ( $\alpha$ -syn) in neurons, oxidative stress, mitochondrial dysfunction, and inflammatory cytokines (Li et al., 2017; Taylor et al., 2013).

In both human and animal studies, immune system has shown to be involved in dopaminergic



neuron death and Parkinson pathogenicity but the mechanism of action is mostly unknown (Brochard et al., 2009). The leukocytes infiltrate was tested in the brain of postmortem human PD and the density of CD8<sup>+</sup> and CD4<sup>+</sup> T cells was found to be higher at the site of neuronal injury in PD patients compared to the age matched control group (Brochard et al., 2009). In the same study, they worked with immunodeficient mouse strains and showed that MPTP-induced dopaminergic cell death was significantly lessened in the absence of mature T lymphocytes. Moreover, infiltration of CD8<sup>+</sup> and CD4<sup>+</sup> was demonstrated in the MPTP-induced PD mouse model during the neuronal degeneration.

Additionally, microglia cells are primary immune cells maintaining the homeostasis of the brain via producing various neurotrophic and anti-inflammatory factors such as Interleukin-10 (IL-10), Brain-Derived Neurotrophic Factor (BDNF), and Insulin-like Growth Factor-1 (IGF-1) (Taylor et al., 2013). Under stress such as pathogen invasion and injury, activated microglia triggers immune response and eliminate the stress factor. However, persistence of the inflammatory stimuli causes neurotoxic factors such as cytokines and prostaglandins to be overproduced (Brochard et al., 2009; Calabrese et al., 2018; Taylor et al., 2013). This increased inflammatory response could reinforce the cell damage in neuronal system by inducing formation of reactive oxygen and nitrogen species (ROS/RNS), which causes death in dopaminergic cells (Taylor et al., 2013). Studies demonstrated that inflammatory cytokines such as TNF- $\alpha$  and IL-6 are high in PD patients relative to healthy individuals (Calabrese et al., 2018; Koziorowski et al., 2012). It has been proposed that a principal mechanism underlying PD is age related chronic inflammatory process referred as inflammaging (Calabrese et al., 2018).

### **GUT-BRAIN AXIS AND PARKINSON DISEASE**

Although PD is defined by motor impairments including resting tremor, rigidity, postural instability, and bradykinesia, non-motor symptoms such as sleep disorders, anxiety, cognitive impairment, defecation dysfunction, and constipation have been observed in PD patients and deeply impact the quality of life (Lindqvist et al., 2012; Schapira et al., 2017). Especially constipation is consistently associated with an elevated risk of PD and one of the most frequent non-motor manifestations (Hopfner et al., 2017; Houser et al., 2018). Approximately 50 to 80 % of the PD patients suffer from constipation and develop constipation several years before onset of motor symptoms (Houser et al., 2018). For the diagnosis of PD, clinical features of motor impairments are required, however; motor symptoms appear when dopaminergic neurons have been lost as much as 50–60% (Schapira et al., 2017). Researchers suggest an early involvement of gastrointestinal dysfunction could be a possible presymptomatic phase of PD.

It has been shown that gastrointestinal system take a role in spreading the disease pathology to

the brain (Holmqvist et al., 2014). Aggregation of  $\alpha$ -syn in neurons is one of the factors associated with neuronal degeneration in PD (Taylor et al., 2013). In a study,  $\alpha$ -syn has been detected in colon tissues collected from patients before onset of PD via immunostaining while colon samples from healthy control cases did not have  $\alpha$ -syn staining (Shannon et al., 2012). In another study, brain lysate from PD patients containing  $\alpha$ -syn was injected into the intestinal wall of wild type rats and evaluated the presence of  $\alpha$ -syn in other tissues by immunohistochemical analysis (Holmqvist et al., 2014). They detected human  $\alpha$ -syn in the vagal nerve segments ranging from the brainstem to the diaphragm of the rats and suggest that  $\alpha$ -syn is taken up from the intestine and transported via vagal nerve to the brain. It has been thought that gut-brain axis could be involved in PD pathogenesis.

Based on human microbiome project, the humans are reservoir for thousands of microbial species and 29% of the bacterial species are associated with the gastrointestinal system (The

NIH HMP Working Group, 2009). The microbial population in human body with trillion cells contributes to the health especially immune system and metabolism (Ostaff et al., 2013). It is well established that gut microbiota has a bidirectional relationship with immune system (Hviid et al., 2011; Shaw et al., 2010). Gut microbiota supports the immune system development while the immune system impacts the microbial composition and their functions in the organism. Dysbiosis, an unbalanced microbiota, could disrupt this balanced relationship and leads to various disorders characterized by chronic inflammation with increased gut permeability including asthma, obesity, inflammatory bowel disease, diabetes, and, mental illnesses (Aleman and Valenzano, 2019; Hufnagl et al., 2020; Johnsen et al., 2020; Tai et al., 2015)

Gut microbiota exchange information with brain via gut-brain axis and preserve homeostasis in the gastrointestinal and the nervous system with the association of immunomodulation (Rhee et al., 2009). Studies on relationship between the brain and the intestinal microbiota indicate that the resulting products from the interaction between the microbiota and the intestinal immune system could impact the brain functions (Mayer et al., 2014; Shanahan and Quigley, 2014). Mice that were not exposed to microorganisms (germfree) have found to increase the hypothalamic–pituitary–adrenal axis (HPA) activation in response to stress, suggesting the role of commensal microbiota on the HPA stress response in mice (Sudo et al., 2004).

Dysbiosis of the intestinal microbiota with inflammation and damaged intestinal barrier involve in dysregulation of gut-brain interaction and is linked to several mental illnesses including anxiety, depression, and schizophrenia (Black et al., 2020; Morais et al., 2021; Shen et al., 2018). Changes in the gut microbiota modulates the expression of the tight junction proteins and consequently modulates the intestinal permeability (Cani et al., 2008; Leclercq et al., 2014). Altered gut microbiota resulting increased inflammation in the gut decrease the gut permeability and cause translocation of bacterial antigens and toxins to the systemic circulation (Cani et al., 2009; Doig et al., 1998; Leclercq et al., 2014; Thevaranjan et al., 2017). Impaired gut barrier associated with increased systemic inflammation, then, effect distant organs (Burcelin et al., 2012; Doig et al., 1998; Wang and Ma, 2008). Studies analyzing fecal samples collected from PD patients compared the microbial populations in the gut with the healthy individuals and reported that gut microbial composition has been altered in PD patients (Hill-Burns et al., 2017; Sun et al., 2018; Unger et al., 2016). Moreover, studies demonstrated that increased level of proinflammatory cytokines in PD. Colon biopsies from both PD patients and healthy controls have been compared for pro-inflammatory cytokines such as IL-6, IL-1 $\beta$ , TNF- $\alpha$ , and IFN- $\gamma$  and glial markers such as Sox-10, S100-beta, and GFAP (Devos et al., 2013). The results show that levels of both proinflammatory cytokines and glial markers were increased in samples from PD patients relative to the control samples, suggesting an enteric inflammation in PD patients. Furthermore, studies have shown that intestinal permeability increased in PD patients (Hasegawa et al., 2015; Schwiertz et al., 2018). Sun et al. explored the function of gut microbiota in PD with MPTP-induced mouse model via fecal microbiota transplantation (FMT) (Sun et al., 2018). FMT from healthy mice has found to reduce gut dysbiosis in MPTP-mice and modulate short-chain fatty acids. Moreover, it has been demonstrated that FMT suppressed neuroinflammation and alleviated physical impairment in MPTP-induced mice.

Current PD treatment is mostly based on dopamine replacement to treat motor symptoms which efficacy diminishes over the time and provides only symptomatic relief (Biju et al., 2018). That leads to developing drug resistant-motor symptoms in addition to increase in drug side effects. Discovery and development of alternative therapeutic strategies are needed. Considering the role of gut microbiota in gut-brain axis with the association of

immunomodulation in neural development and pathogenesis of neural disorders to date, maintaining gut permeability and inflammation by altering gut microbiota could be a good strategy to improve PD. Alternative therapeutic interventions based on targeted gut microbiota modulation such as probiotics to improve Parkinson's Disease pathogenesis should be further studied.

## REFERENCES

- Aleman, F.D.D., Valenzano, D.R., 2019. Microbiome evolution during host aging. *PLoS Pathog.* 15, 21–24.
- Biju, K.C., Evans, R.C., Shrestha, K., Carlisle, D.C.B., Gelfond, J., Clark, R.A., 2018. Methylene Blue Ameliorates Olfactory Dysfunction and Motor Deficits in a Chronic MPTP/Probenecid Mouse Model of Parkinson's Disease. *Neuroscience* 380, 111–122.
- Black, C.J., Drossman, D.A., Talley, N.J., Ruddy, J., Ford, A.C., 2020. Functional gastrointestinal disorders: advances in understanding and management. *Lancet* 396, 1664–1674.
- Brochard, V., Combadière, B., Prigent, A., Laouar, Y., Perrin, A., Beray-Berthet, V., Bonduelle, O., Alvarez-Fischer, D., Callebert, J., Launay, J.-M., Duyckaerts, C., Flavell, R.A., Hirsch, E.C., Hunot, S., 2009. Infiltration of CD4<sup>+</sup> lymphocytes into the brain contributes to neurodegeneration in a mouse model of Parkinson disease. *J. Clin. Invest.* 119, 182–192.
- Burcelin, R., Garidou, L., Pomié, C., 2012. Immuno-microbiota cross and talk: The new paradigm of metabolic diseases. *Semin. Immunol.* 24, 67–74.
- Calabrese, V., Santoro, A., Monti, D., Crupi, R., Di Paola, R., Latteri, S., Cuzzocrea, S., Zappia, M., Giordano, J., Calabrese, E.J., Franceschi, C., 2018. Aging and Parkinson's Disease: Inflammaging, neuroinflammation and biological remodeling as key factors in pathogenesis. *Free Radic. Biol. Med.* 115, 80–91.
- Cani, P.D., Bibiloni, R., Knauf, C., Waget, A., Neyrinck, A.M., Delzenne, N.M., Burcelin, R., 2008. Changes in Gut Microbiota Control Metabolic Endotoxemia-Induced Inflammation in High-Fat Diet-Induced Obesity and Diabetes in Mice. *Diabetes* 57, 1470–1481.
- Cani, P.D., Possemiers, S., Van De Wiele, T., Guiot, Y., Everard, A., Rottier, O., Geurts, L., Naslain, D., Neyrinck, A., Lambert, D.M., Muccioli, G.G., Delzenne, N.M., 2009. Changes in gut microbiota control inflammation in obese mice through a mechanism involving GLP-2- driven improvement of gut permeability. *Gut* 58, 1091–1103.
- Devos, D., Lebouvier, T., Lardeux, B., Biraud, M., Rouaud, T., Pouclet, H., Coron, E., Bruley des Varannes, S., Naveilhan, P., Nguyen, J.M., Neunlist, M., Derkinderen, P., 2013. Colonic inflammation in Parkinson's disease. *Neurobiol. Dis.* 50, 42–48.
- Doig, C.J., Sutherland, L.R., Sandham, J.D., Fick, G.H., Verhoef, M., Meddings, J.B., 1998. Increased intestinal permeability is associated with the development of multiple organ dysfunction syndrome in critically ill ICU patients. *AM J RESPIR CRIT CARE MED* 52, 641.
- Dorsey, E.R., Bloem, B.R., 2018. The Parkinson pandemic - A call to action. *JAMA Neurol.* 75, 9–10.
- Foundation, P., 2021. Understanding Parkinson's [WWW Document]. *Park. Found. Park. Preval. Proj.* URL <https://www.parkinson.org/Understanding-Parkinsons/Statistics>
- Hasegawa, S., Goto, S., Tsuji, H., Okuno, T., Asahara, T., Nomoto, K., Shibata, A., Fujisawa, Y., Minato, T., Okamoto, A., Ohno, K., Hirayama, M., 2015. Intestinal dysbiosis and lowered serum lipopolysaccharide-binding protein in Parkinson's disease. *PLoS One* 10, 1–15.

- Hill-Burns, E.M., Debelius, J.W., Morton, J.T., Wissemann, W.T., Lewis, M.R., Wallen, Z.D., Peddada, S.D., Factor, S.A., Molho, E., Zabetian, C.P., Knight, R., Payami, H., 2017. Parkinson's disease and Parkinson's disease medications have distinct signatures of the gut microbiome. *Mov. Disord.* 32, 739–749.
- Holmqvist, S., Chutna, O., Bousset, L., Aldrin-Kirk, P., Li, W., Björklund, T., Wang, Z.Y., Roybon, L., Melki, R., Li, J.Y., 2014. Direct evidence of Parkinson pathology spread from the gastrointestinal tract to the brain in rats. *Acta Neuropathol.* 128, 805–820.
- Hopfner, F., Künstner, A., Müller, S.H., Künzel, S., Zeuner, K.E., Margraf, N.G., Deuschl, G., Baines, J.F., Kuhlenbäumer, G., 2017. Gut microbiota in Parkinson disease in a northern German cohort. *Brain Res.* 1667, 41–45.
- Houser, M.C., Chang, J., Factor, S.A., Molho, E.S., Zabetian, C.P., 2018. Stool Immune Profiles Evince Gastrointestinal Inflammation in Parkinson's Disease. *Mov. Disord.* 33, 793–804.
- Hufnagl, K., Pali-Schöll, I., Roth-Walter, F., Jensen-Jarolim, E., 2020. Dysbiosis of the gut and lung microbiome has a role in asthma. *Semin. Immunopathol.* 42, 75–93.
- Hviid, A., Svanström, H., Frisch, M., 2011. Antibiotic use and inflammatory bowel diseases in childhood. *Gut* 60, 49–54.
- Johnsen, P.H., Hilpüsch, F., Valle, P.C., Goll, R., 2020. The effect of fecal microbiota transplantation on IBS related quality of life and fatigue in moderate to severe non-constipated irritable bowel: Secondary endpoints of a double blind, randomized, placebo-controlled trial. *EBioMedicine* 51, 102562.
- Koziorowski, D., Tomasiuk, R., Szlufik, S., Friedman, A., 2012. Inflammatory cytokines and NT-proCNP in Parkinson's disease patients. *Cytokine* 60, 762–766.
- Leclercq, S., Matamoros, S., Cani, P.D., Neyrinck, A.M., Jamar, F., Stärkel, P., Windey, K., Tremaroli, V., Bäckhed, F., Verbeke, K., De Timary, P., Delzenne, N.M., 2014. Intestinal permeability, gut-bacterial dysbiosis, and behavioral markers of alcohol-dependence severity. *Proc. Natl. Acad. Sci. U. S. A.* 111, E4485–E4493.
- Li, Y., Liu, W.Z., Li, L., Hölscher, C., 2017. D-Ala2-GIP-glu-PAL is neuroprotective in a chronic Parkinson's disease mouse model and increases BDNF expression while reducing neuroinflammation and lipid peroxidation. *Eur. J. Pharmacol.* 797, 162–172.
- Lindqvist, D., Kaufman, E., Brundin, L., Hall, S., Surova, Y., Hansson, O., 2012. Non-Motor Symptoms in Patients with Parkinson's Disease - Correlations with Inflammatory Cytokines in Serum. *PLoS One* 7.
- Maserejian, N., Vinikoor-Imler, L., Dilley, A., 2020. Estimation of the 2020 Global Population of Parkinson's Disease (PD). In: *MDS Virtual Congress 2020*. p. 35 (suppl 1).
- Mayer, E.A., Savidge, T., Shulman, R.J., 2014. Brain-gut microbiome interactions and functional bowel disorders. *Gastroenterology* 146, 1500–12.
- Medicine, J.H., 2021. Young-Onset Parkinson's Disease [WWW Document]. *Med. Johns Hopkins*. URL <https://www.hopkinsmedicine.org/health/conditions-and-diseases/parkinsons-disease/youngonset-parkinsons-disease>
- Morais, L.H., Schreiber, H.L., Mazmanian, S.K., 2021. The gut microbiota–brain axis in behaviour and brain disorders. *Nat. Rev. Microbiol.* 19, 241–255.
- Ostaff, M.J., Stange, E.F., Wehkamp, J., 2013. Antimicrobial peptides and gut microbiota in homeostasis and pathology. *EMBO Mol. Med.* 5, 1–19.
- Rhee, S.H., Pothoulakis, C., Mayer, E.A., 2009. Principles and clinical implications of the brain-gut-enteric microbiota axis. *Nat. Rev. Gastroenterol. Hepatol.* 6, 306–314.
- Schapira, A.H.V., Chaudhuri, K.R., Jenner, P., 2017. Non-motor features of Parkinson disease. *Nat. Rev. Neurosci.* 18, 435–450.
- Schwartz, A., Spiegel, J., Dillmann, U., Grundmann, D., Bürmann, J., Faßbender, K.,

- Schäfer, K.H., Unger, M.M., 2018. Fecal markers of intestinal inflammation and intestinal permeability are elevated in Parkinson's disease. *Park. Relat. Disord.* 50, 104–107.
- Shanahan, F., Quigley, E.M.M., 2014. Manipulation of the microbiota for treatment of IBS and IBD-challenges and controversies. *Gastroenterology* 146, 1554–63.
- Shannon, K.M., Keshavarzian, A., Dodiya, H.B., Jakate, S., Kordower, J.H., 2012. Is alpha-synuclein in the colon a biomarker for premotor Parkinson's Disease? Evidence from 3 cases. *Mov. Disord.* 27, 716–719.
- Shaw, S.Y., Blanchard, J.F., Bernstein, C.N., 2010. Association between the use of antibiotics in the first year of life and pediatric inflammatory bowel disease. *Am. J. Gastroenterol.* 105, 2687–2692.
- Shen, Y., Xu, J., Li, Z., Huang, Y., Yuan, Y., Wang, J., Zhang, M., Hu, S., Liang, Y., 2018. Analysis of gut microbiota diversity and auxiliary diagnosis as a biomarker in patients with schizophrenia: A cross-sectional study. *Schizophr. Res.* 197, 470–477.
- Sudo, N., Chida, Y., Aiba, Y., Sonoda, J., Oyama, N., Yu, X.-N., Kubo, C., Koga, Y., 2004. Postnatal microbial colonization programs the hypothalamic-pituitary-adrenal system for stress response in mice. *J. Physiol.* 558, 263–75.
- Sun, M.F., Zhu, Y.L., Zhou, Z.L., Jia, X.B., Xu, Y. Da, Yang, Q., Cui, C., Shen, Y.Q., 2018. Neuroprotective effects of fecal microbiota transplantation on MPTP-induced Parkinson's disease mice: Gut microbiota, glial reaction and TLR4/TNF- $\alpha$  signaling pathway. *Brain. Behav. Immun.* 70, 48–60.
- Tai, N., Wong, F.S., Wen, L., 2015. The role of gut microbiota in the development of type 1, type 2 diabetes mellitus and obesity. *Rev. Endocr. Metab. Disord.* 16, 55–65.
- Taylor, J.M., Main, B.S., Crack, P.J., 2013. Neuroinflammation and oxidative stress: Co-conspirators in the pathology of Parkinson's disease. *Neurochem. Int.* 62, 803–819.
- The NIH HMP Working Group, 2009. The NIH Human Microbiome Project. *Genome Res.* 19, 2317–2323.
- Thevaranjan, N., Puchta, A., Schulz, C., Naidoo, A., Szamosi, J.C., Verschoor, C.P., Loukov, D., Schenck, L.P., Jury, J., Foley, K.P., Schertzer, J.D., Larché, M.J., Davidson, D.J., Verdú, E.F., Surette, M.G., Bowdish, D.M.E., 2017. Age-Associated Microbial Dysbiosis Promotes Intestinal Permeability, Systemic Inflammation, and Macrophage Dysfunction. *Cell Host Microbe* 21, 455-466.e4.
- Unger, M.M., Spiegel, J., Dillmann, K.U., Grundmann, D., Philippeit, H., Bürmann, J., Faßbender, K., Schwiertz, A., Schäfer, K.H., 2016. Short chain fatty acids and gut microbiota differ between patients with Parkinson's disease and age-matched controls. *Park. Relat. Disord.* 32, 66–72.
- Wang, H., Ma, S., 2008. The cytokine storm and factors determining the sequence and severity of organ dysfunction in multiple organ dysfunction syndrome. *Am. J. Emerg. Med.* 26, 711–715.



# EFFECTS OF TOXIC EMOTIONAL EXPERIENCES AND PERCEIVED ORGANIZATIONAL SUPPORT ON POSITIVE WORK BEHAVIORS, WITHDRAWAL BEHAVIORS, AND ANTAGONISTIC WORK BEHAVIORS<sup>1</sup>

Orou Issiaka SOUNON<sup>1\*</sup>, Hande ÖZGEN<sup>2\*\*</sup>

<sup>1</sup> *Ankara Yıldırım Beyazıt University, Social Science Institute, Department of Management, Ankara, Turkey,*

*ORCID ID: 0000-0001-9609-0570,*

<sup>2</sup> *Ankara Yıldırım Beyazıt University, Business School, Department of Management, Ankara, Turkey,*

*ORCID ID: 0000-0002-6939-6723*

## Abstract

This study aimed to determine the effects of positive and negative affectivity, toxic emotional experiences sub-dimensions (psychologically recurring, disconnecting, draining) and perceived organizational support on on-the-job behaviors (positive work behaviors, psychological and physical withdrawal behaviors, and antagonistic work behaviors). In addition, it was tested whether toxic emotional experiences differ according to demographical factors such as gender and age. A quantitative research was carried out targeting people of public and private organizations in Benin Republic. Watson, Clark, and Tellegen's (1988) The PANAs Scale, Kiefer and Barclay's (2012) Toxic Emotional Experiences Scale, Eisenberger, Huntington, Hutchinson, and Sowa's (1986) Perceived Organizational Support Scale, and Lehman and Simpson's (1992) On-the-Job Behaviors Scale were used for gathering data. A total of 306 employees (132 females, 174 males) participated in the survey. According to results female employees experience more toxic emotions. The results also showed that there was a low level of significant correlation between toxic emotional experience and perceived organizational support, psychological withdrawal behavior, and antagonistic work behavior. The hierarchical regression results revealed that only psychologically recurring sub-dimension predicts psychological withdrawal behaviors. In addition to this, positive affect, psychologically recurring sub-dimension together with diminished perceived organizational support predict positive work behaviors, and physical withdrawal behaviors. The remarkable finding is that employees who experience toxic emotions and perceive less support from their organization may exhibit antagonistic work behaviors.

**Keywords:** positive affect, negative affect, toxic emotional experiences, perceived organizational support, positive work behaviors, withdrawal behaviors, antagonistic work behaviors, Benin Republic

## INTRODUCTION

The effect of employees' emotions, particularly "toxic emotions" on organizations outcomes has long time been a perpetual topic of discussion within both business organizations and academic scholars (Goldman, 2008). This trend has led to the increasing studies in toxicity shown in different workplaces as a distress and pain that strips individuals of their self-esteem and very often disconnects them from their work (Stein, 2007). Organizations and researchers

<sup>1</sup> This study is derived from the first author's master's thesis conducted under the supervision of the second author.



are now looking ways to understand the influences of toxic emotional experiences within workplaces. Similarly, experiencing emotions such as stress, exhaustion, fear, sadness, anger, and frustration in workplaces have received remarkable attention in literature (Lawrence, 2008).

Toxic emotional experiences of employees represent an important factor when mentioning positive work behaviors, physical and psychological withdrawal behaviors, and antagonistic work behavior. According to Frost (2003), toxic emotions originated from negative emotions (anger, anxiety, fear, frustration, etc.) may have significant effects on employees, specifically when they believe the treatment in their regard is deprived by supervisors, they tend to change their behaviors and adopt other several actions such as spreading rumors or sharing the organization's secrets, and start being antagonistic.

In general, great support from organizations toward their employees is essential in a workplace. A lack of this support may undermine not only the performance of employees, but also their emotions. That is why Mayes et al. (2017) stated that organizations that lack support, especially for workers' wellness, is the source of their emotional and psychological distresses in the long run. This emphasizes the importance of considering the organizational support for maintaining employees' toxic emotional experiences as low as possible.

Therefore, exploring effects of positive and negative affectivity, toxic emotional experiences and perceived organizational support on positive work and withdrawal behaviors is an ultimate and inspiring goal. This research intends primary to provide better and more comprehensive framework regarding the effects of positive and negative affectivity, toxic emotional experiences and perceived organizational support on individuals' positive work behaviors, withdrawal behaviors, and antagonistic work behaviors. The contribution of this study lays on the fact that it addresses many questions regarding workers toxic emotions in a multi-ethnic and culturally diverse environment like Benin Republic and such a study has not been embraced yet in Benin even though various Western researchers have studied toxic emotions and work behaviors elsewhere. Therefore, filling this gap throughout this study will be a great achievement in management and organizational behaviors field.

## LITERATURE REVIEW

Positive affect and/or positive affectivity (Jurist, 2005) are being employed more widely in the self-report attitude, mood, and emotions literatures (Iverson et al., 1998). According to Diener et al. (1985), in recent research, these two prominent factors have consistently emerged in affective structure exploration in a variety of cultures as they appear to be the first two dimensions in the analysis of self-rated mood and emotions. More often, the positive affect (PA) indicates the degree to which an individual intuitively encounters positive moods (Cropanzano et al., 2003). In this circumstance, the person tends to feel active, enthusiastic, alert, relax, and even passionate (Watson et al., 1988). In this logic Watson et al. (1988) also claimed that high PA engenders high-level of energy on people with complete concentration and delightful engagement on their different activities and apathy, lethargy, laziness, and sadness are the characteristics of low PA.

Negative affect and/or negative affectivity shortened NA is used more broadly in the self-report attitude, mood, and emotions literatures along with positive affect (Sears et al., 2016). Judge and Larsen (2001) extended their explanation by referring negative affectivity as the tendency to experience and feel strongly unpleasant and undesirable feelings. Such emotions and feelings like anger, fear, and anxiety tend to predominate at the high pole. These negative emotions and feelings appear to be absent at the low pole, but positive affect does not necessarily exist (Armstrong, 1988). In addition, the negative affect dimension subjectively represents unpleasurable actions which involve various aversive states of mood such as nervousness,

displeasure, anger, disgust, fear, contempt, and that individuals' calmness, serenity, and tranquility derived from their low state of NA experienced by individuals (Suls, 2018).

It is thought that people's positive and negative affectivity will be effective in their perception of toxic emotional experiences. Therefore, positive and negative affect were considered as control variables in this study.

According to Kiefer and Barclay (2012), toxic emotional experiences have three sub-dimensions which are called psychologically recurring, disconnecting, and draining. Psychologically recurring sub-dimension invokes experiences that weigh on people, feels psychologically unresolved, and/or the individuals fear or negatively anticipate a reoccurrence (Kiefer & Barclay, 2012). Although destructive, negative, and/or unpleasant emotions are closely related to very specific actions and events, toxic emotional experiences are psychologically or emotionally recurrent. Cropanzano and Wright (1999) stressed that because of the emotional and psychological burden or weight psychologically recurring places on individuals, it can be qualified as poisonous or toxic.

Referring to employees' detachment from their colleagues and coworkers, disconnecting dimension indicates the disengagement and disconnection of individuals from their social and common network (Chu, 2014). Furthermore, the draining dimension denotes the psychological and physical energy diminution related to these experiences. Unlike adverse or negative emotions that attract attention and contribute to increased concentration on the situation or social network, experienced toxic emotions often describe one's social network disconnection either caused by others or by him/herself such as feeling of isolation (Shepherd & Cardon, 2009). Consequently, disconnection may arise as one's negative attitudes have not yet been appropriately attended to.

As people continue to constantly experience unpleasant feelings and emotions, they disrupt their behavioral and cognitive processes and turn their focus and intentions to an underlying issue (Bartunek & Frost, 2004). This therefore shows that negative emotions are directly associated with events and thus are described as short-lived occasions (Adler & Hershfield, 2012). As far as draining is involved, while negative emotions prepare individuals for practices and actions, emotionally toxic experiences may leave individuals and people believing that their strength is drained or absorbed by the experiences. Pennebaker (1997) argued that negative attitudes and emotions are consistently connected with draining component of toxic emotional experiences, therefore, negative emotions are undesirable experiences that people, and individuals tend to avoid.

Another independent variable considered in this study is perceived organizational support. It illustrates the recognition and acknowledgement of employees that the company they are working for recognizes and perceives their efforts, contributions, participation, and therefore cares for their comfort, happiness, and welfare or well-being (Zhang et al., 2016). POS does install a sense of duty and positive attitude for workers who, by their efforts and hard work support and repay what their employing organization has given them in terms of merit and reward (Panaccio & Vandenberghe, 2009). The notion of POS has longtime been presented as an assurance appraisal that care and assistance will be readily accessible for workers from the entire organization whenever deemed necessary to smoothly undertake employees' work and therefore to cope better with workplace stressors (Sulaiman et al., 2019). Employees' perceptions of organizational support when faced with negative situations lead to positive work outcomes. Rhoades and Eisenberger (2002) have reported that during the period of crisis for instance, POS might become essential and productive in terms of sustaining and increasing employee attitudes and behaviors as well as work performance. A list of literature reviews has identified a clear negative association between POS and the decisions of employees to leave or stay (turnover behavior) and continue working for the same organization (Li, 2020). Previous academic studies have also highlighted POS as an antecedent to employees' engagement within

an organization (Dai & Qin, 2016). For instance, when organization members feel they are being considered and treated with admiration and regard, they are ready to make more effort, invest themselves, and perform better than usual (Tan et al., 2019). In addition to this, when employees and staffs feel care, protection, approvals, and support from their organizations, they eventually fulfill and help the company accomplish its goals through the organization membership incorporation (Luo, 2020).

In this study, it was aimed to test the effects of toxic emotional experiences and perceived organizational support on on-the-job behaviors after controlling for positive and negative affect. On-the-job behaviors were handled in four dependent categories in line with Lehman and Simpson's (1992) model. These categories are positive work behaviors, psychological and physical withdrawal behaviors, and antagonistic work behaviors. Positive work behaviors involve good manners and conducts of an individual and/or employee in his/her workplace (Lehman & Simpson, 1992). Positive behaviors are usually about volunteering and undertaking for additional work, kindness, courtesy, generosity, and timeliness. A positive workplace behavior well describes employees who are motivated, engaged, committed, and efficient (Bindl & Parker, 2010). Psychological behaviors of withdrawal refer to the acts taken by individuals or employees when they are psychologically, mentally, or emotionally disconnected, disengaged, and detached from a group, team, or organization (Sagie et al., 2002). When the organizational climate (working environment) becomes unpleasant and uncomfortable, organizations members mainly employees will often attempt to disengage, disassociate, and withdraw mentally or psychologically (Moore et al., 2012). These people may be present in place physically with all their minds somewhere else. Hulin and Hanisch (1991) defended that psychological withdrawal patterns could be sometimes daydreaming, contemplating, or discussing with co-employees about subjects and topics that are unrelated to work. Physical withdrawal conducts and behaviors describe the acts taken by individuals or employees when they are physically disconnected, disengaged, and detached from a group or organization (Cropanzano et al., 1997). Generally, absenteeism, turnover, and tardiness or lateness mentioned in Johns's (2002) study frequently cited by academics when discussing physical behaviors of withdrawal. Physical withdrawal behaviors are widely identified as physical removal from a particular workplace for either part of a day, whole day, week, or permanently (Sege & Harper Browne, 2017). And finally, antagonistic conducts denote any forms of aggression through tone of voice including disputing with colleagues, disobeying managers, and superiors, spreading rumors, speculations, or gossips deliberately (Lehman & Simpson, 1992).

Based on the relevant literature, we expect that employees who experience toxic emotions in the workplace may exhibit negative behaviors such as psychological and physical withdrawals, and antagonistic work behaviors. However, it is thought that employees who have toxic emotional experiences may turn to positive work behaviors when they perceive support from their organizations. In addition, we wanted to test whether toxic emotional experiences differ according to demographical factors such as gender and age. Based on what have been highlighted our research questions are as follows:

*RQ1:* Do demographic traits (gender and age) of employees make any difference in terms of toxic emotional experience?

*RQ2:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict positive work behaviors?

*RQ3:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict psychological withdrawal behaviors?

*RQ4:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict physical withdrawal behaviors?

*RQ5:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict antagonistic work behaviors?

## **MATERIALS AND METHOD**

### **Participants and Procedure**

This study targeted people who are working in both public and private organizations in Benin Republic. A total of 306 participants (132 female, 174 male) took part in the study. An online based survey was prepared and shared with volunteers willing to contribute. The questionnaire was developed based on the previous studies and aimed to analyze and explore the effect of positive and negative affectivity, toxic emotional experiences and perceived organizational support on positive work behaviors, psychological and physical withdrawal behaviors, and antagonistic behaviors within different workplaces (in the Republic of Benin). The mean age of the participants was 29.86 (SD=5.79).

### **Measurements**

#### ***The PANAS Scale***

The PANAS scale developed by Watson, Clark, and Tellegen in 1988 was used to measure individuals' felt in recent times or their feelings at the moment (Watson et al., 1988). While applying this scale, Watson, Clark, and Tellegen (1988) used 20-items (1-10 items used to measure PA; and 11-20 items for measuring NA) and these items are measured on a 5-point scale ranging from 1 (not at all) to 5 (very much) by asking how participants generally feel in their workplaces. Sample items for PA and NA are "attentive" and "distressed", respectively. In our study the Cronbach alpha values were 0.83 and 0.77 for PA and NA respectively.

#### ***Toxic Emotional Experiences Scale***

The toxic emotional experiences scale was used to measure individuals' toxic emotional experiences (Kiefer & Barclay, 2012). It is a scale of 15-items divided into 5-items per sub-dimension (psychologically recurring, disconnecting, and draining). The items are measured on a 5-point scale ranging from 1 to 5 (very rarely) to 5 (very often), in which participants are invited to indicate their level of agreement on how they reflect over the last 6 months in their workplaces. Sample items for psychologically recurring, disconnecting and draining are "My negative emotional experiences are ongoing.", "I tend to isolate myself.", "I feel drained.", respectively. In our study, the Cronbach's alpha values were 0.87, 0.81, 0.73, 0.79 for the composite scale, psychologically recurring subscale, disconnecting subscale, and draining subscale, respectively.

#### ***Perceived Organizational Support Scale***

The perceived organizational support scale was established by Eisenberger, Huntington, Hutchison, and Sowa (1986) and its original survey stands one dimensional. In this study, the shortened 9-items version of the POS measurement scale is used. These items are measured on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree) to measure the extent and degree to which employees feel supported by their organizations. Items 5 and 7 were reverse coded. A sample item includes "The organization strongly considers my goals and values." In our study the Cronbach alpha value was 0.80.

### ***On-The-Job Behaviors Scale***

Lehman and Simpson's (1992) on-the-job behaviors scale were applied to measure positive work behaviors (1-5 items), psychological withdrawal behaviors (6-13 items), physical withdrawal behaviors (14-17 items), and antagonistic work behaviors (18-22 items). Items are measured on a 7-point scale ranging from 1 (never) to 7 (always), where participants are asked to report how often they have experienced the situations in the past twelve months. Sample items include "Did more work than required," for positive work behaviors, "Thoughts of being absent." for psychological withdrawal behaviors, "Left work early without permission." for physical withdrawal behaviors, and "Argued with co-workers." for antagonistic work behaviors. In our study the Cronbach alpha values were 0.77, 0.70, 0.76, and 0.72 for positive work behaviors, psychological withdrawal behaviors, physical withdrawal behaviors, and antagonistic work behaviors, respectively.

## **RESULTS**

*RQ1:* Do demographic traits (gender and age) of employees make any difference in terms of toxic emotional experience?

Table 1 presents the t-test results between sub-dimensions of toxic emotional experiences and gender. Looking at the  $p$  values, it is seen that there is a significant difference among psychologically recurring and disconnecting sub-dimensions regarding gender [respectively, ( $t_{(304)}=2.58, p=0.01$ ); ( $t_{(251.408)}=3.30, p=0.00$ )]. Women have more psychologically recurring ( $\bar{X}=10.03$ ) and disconnecting ( $\bar{X}=9.28$ ) emotions than men ( $\bar{X}=8.86, \bar{X}=7.91$ , respectively). There is no significant difference between draining sub-dimension and gender [ $t_{(304)}=1.86, p=0.06$ ].

**Table 1.** T-Test Results Between Toxic Emotional Experiences and Gender

Toxic Emotional Experiences Sub-Dimensions	Gender	N	Mean	S	df	$t$	$p$
Psychologically Recurring	Male	174	8.86	3.56	304	2.58	0.01
	Female	132	10.03	4.41			
Disconnecting	Male	174	7.91	3.19	251.408	3.30	0.00
	Female	132	9.28	3.86			
Draining	Male	174	8.69	3.75	304	1.86	0.06
	Female	132	9.53	4.12			

Table 2 shows ANOVA results between toxic emotional experiences and age groups. From the analysis, it can be concluded that there exists a significant difference between the age groups in terms of disconnecting [ $F_{(2-303)}=5,709, p=0.00$ ] and draining [ $F_{(2-303)}=4,954, p=0.01$ ] sub-dimensions. To figure out which age groups are significantly different with others, the Scheffe multiple comparison test is conducted. With disconnecting sub-dimension, this test shows that 40 and above years old group is significantly different with 20 to 29 and 30 to 39 years old groups. Regarding draining sub-dimension, this difference was observed only between 20 to 29 years old and 40 and above age group. In contrary to disconnecting and draining, the psychologically recurring sub-scale shows no significant difference between age groups [ $F_{(2-303)}=0,818, p=0.44$ ]. Thus, age is an important factor in analyzing employees' toxic emotional experiences. The results might imply that as individuals are getting older, they become used to toxins. This could be the reason why the amount of toxic emotional experiences decreases as people becoming more mature.



**Table 2.** ANOVA Results Between Toxic Emotional Experiences and Age Groups

Toxic Emotional Experiences Sub-Dimensions	Age Groups	N	Mean	S	F	p	Difference
Recurring	1. (20 to 29)	181	9.60	4.31	0.818	0.44	-
	2. (30 to 39)	102	9.05	3.59			
	3. (40 and above)	23	8.87	2.77			
Disconnecting	1. (20 to 29)	181	8.70	3.34	5.709	0.00	1-3 and 2-3
	2. (30 to 39)	102	8.69	3.99			
	3. (40 and above)	23	6.13	2.18			
Draining	1. (20 to 29)	181	9.49	3.97	4.954	0.01	1-3
	2. (30 to 39)	102	8.75	3.88			
	3. (40 and above)	23	6.91	3.09			

Table 3 shows correlation coefficients among research variables. For instance, toxic emotional experience was positively and significantly related to POS ( $r=0.17$ ,  $p<0.01$ ), psychological withdrawal behavior ( $r=0.19$ ,  $p<0.01$ ), and antagonistic work behavior ( $r=0.17$ ,  $p<0.01$ ). Negative correlations exist between POS and positive work behavior ( $r=-0.12$ ,  $p<0.05$ ), physical withdrawal behaviors ( $r=-0.26$ ,  $p<0.01$ ), and antagonistic behaviors ( $r=-0.19$ ,  $p<0.01$ ). Toxic emotional experience is positively related to NA ( $r=0.32$ ,  $p<0.01$ ). In addition to this all the dimensions of toxic emotional experience are positively correlated with NA. The remaining correlations are shown in the table.

**Table 3.** Correlation Coefficients Among Research Variables (N=306)

Variables	1	2	3	4	5	6	7	8	9	10	11
1. PA	1										
2. NA	-0.13*	1									
3. TEE	-0.07	0.32**	1								
4. Recurring	0.02	0.31**	0.77**	1							
5. Disconnecting	-0.08	0.22**	0.82**	0.41**	1						
6. Draining	-0.11	0.23**	0.84**	0.42**	0.60**	1					
7. POS	-0.11*	0.22**	0.17**	0.11	0.20**	0.11	1				
8. Positive	0.23**	0.00	0.06	0.13*	-0.04	0.04	-0.12*	1			
9. Psychological	-0.04	0.13*	0.19**	0.20**	0.16**	0.09	0.02	0.16**	1		
10. Physical	0.15*	-0.06	0.09	0.13*	0.04	0.04	-0.26**	0.23**	0.36**	1	
11. Antagonistic	0.11*	0.06	0.17**	0.16**	0.13*	0.11	-0.19**	0.34**	0.41**	0.62**	1

\* $p<0.05$ , \*\* $p<0.01$  (PA: positive affect, NA: negative affect, TEE: toxic emotional experiences, POS: perceived organizational support)

In the prediction of positive work behaviors, psychological withdrawal behaviors, physical withdrawal behaviors, and antagonistic behaviors, a SPSS three-block hierarchical regression analysis was performed. The collinearity statistics obtained stipulate that all tolerance values are greater than 0.5 and the VIF values are lower than 2.00 indicating that the analysis is out of multicollinearity or collinearity problems.

*RQ2:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict positive work behaviors?

Table 4 shows the hierarchical regression results on positive work behaviors. The first block of the hierarchical regression includes only PA which explain 5% in the total variation of positive work behaviors [ $R^2=0.05$ ,  $F_{(1,304)} = 16.912$ ,  $p=0.00$ ]. PA is found to be statistically significant at  $p=0.00$ . The second block includes PA and recurring sub-dimensions which explains 7% of the total variance of positive work behavior [ $R^2=0.07$ ,  $F_{(2,303)}=11.006$ ,  $p=0.00$ ].



It is seen that the recurring sub-dimension is found to be significant at  $p=0.03$ . The third block which had POS shows that 8% of the total variance is explained by positive work behaviors [ $R^2=0.08$ ,  $F_{(3,302)}=8.757$ ,  $p=0.00$ ]. The results indicate that POS had effect on positive work behaviors. In this analysis, three separate blocks of predictors as whole are examined to check the weight of variance in predicting positive work behaviors using the  $R^2$ . Overall, PA ( $\beta=0.22$ ,  $p=0.00$ ), recurring ( $\beta=0.14$ ,  $p=0.03$ ), and POS ( $\beta=-0.11$ ,  $p=0.04$ ), significantly predict positive work behaviors. While PA and recurring sub-dimension have positive effect on positive work behaviors, POS predicts negatively.

**Table 4.** Hierarchical Regression Results on Positive Work Behavior

Predictor variables	<i>B</i>	<i>S.E B</i>	$\beta$	<i>t</i>	<i>p</i>	<i>R</i>	$R^2$	$\Delta R^2$
1.	-	-	-	-	-	0.23	0.05	0.05
PA	0.19	0.05	0.23	4.15	0.00			
2.	-	-	-	-	-	0.26	0.07	0.02
PA	0.19	0.05	0.23	3.98	0.00			
Recurring	0.20	0.09	0.14	-1.71	0.03			
3.	-	-	-	-	-	0.28	0.08	0.01
PA	0.18	0.05	0.22	3.83	0.00			
Recurring	0.20	0.09	0.14	2.22	0.03			
POS	-0.09	0.04	-0.11	-2.01	0.04			

*RQ3:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict psychological withdrawal behaviors?

In Table 5, the first block of the hierarchical regression includes NA which explain only 2% of the total variation of psychological withdrawal behaviors [ $R^2=0.02$ ,  $F_{(1,304)}=5.171$ ,  $p=0.02$ ]. The second block includes NA, psychologically recurring, and disconnecting sub-dimensions which explains 5% of the total variance of psychological withdrawal behaviors [ $R^2=0.05$ ,  $F_{(3,302)}=5.399$ ,  $p=0.00$ ]. It is seen that only recurring dimension ( $\beta=0.17$ ,  $p=0.02$ ) positively and significantly predicts psychological withdrawal behavior in the second step. Therefore, it can be said that toxic emotional experiences predict psychological withdrawal behaviors only through recurring dimension.

**Table 5.** Hierarchical Regression Results on Psychological Withdrawal Behavior

Predictor variables	<i>B</i>	<i>S.E B</i>	$\beta$	<i>t</i>	<i>p</i>	<i>R</i>	$R^2$	$\Delta R^2$
1.	-	-	-	-	-	0.13	0.02	0.02
NA	0.13	0.06	0.13	2.19	0.02			
2.	-	-	-	-	-	0.23	0.05	0.03
NA	0.07	0.06	0.06	1.07	0.27			
Recurring	0.19	0.08	0.17	2.51	0.02			
Disconnecting	0.14	0.09	0.11	1.49	0.20			

*RQ4:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict physical withdrawal behaviors?

In Table 6, the first block of the hierarchical regression includes PA. This variable explains only 2% of the total variation of physical withdrawal behaviors [ $R^2=0.02$ ,  $F_{(1,304)} = 6.707$ ,  $p=0.01$ ]. The results indicate that PA ( $\beta=0.14$ ,  $p=0.01$ ) predicts physical withdrawal behavior significantly in the first step. The second block includes PA and psychologically recurring sub-dimension which explains 4% of the total variance of physical withdrawal behaviors [ $R^2 = 0.04$ ,  $F_{(2,303)} = 5.853$ ,  $p=0.00$ ]. Both PA ( $\beta=0.13$ ,  $p=0.01$ ) and psychologically recurring ( $\beta=0.15$ ,  $p=0.03$ ) predicts physical withdrawal behavior in the second step. The third block which had POS, shows that 11% of the total variance explaining physical withdrawal behaviors. In this step PA ( $\beta=0.11$ ,  $p=0.04$ ) and psychologically recurring,  $\beta=0.15$ ,  $p=0.01$ ) positively, and POS ( $\beta=-0.26$ ,  $p=0.00$ ) negatively predicts physical withdrawal behavior.

**Table 6.** Hierarchical Regression Results on Physical Withdrawal Behavior

Predictor variables	<i>B</i>	<i>S.E B</i>	$\beta$	<i>t</i>	<i>p</i>	<i>R</i>	$R^2$	$\Delta R^2$
1.	-	-	-	-	-	0.15	0.02	0.02
PA	0.06	0.02	0.14	2.48	0.01			
2.	-	-	-	-	-	0.19	0.04	0.02
PA	0.05	0.02	0.13	2.33	0.01			
Recurring	0.10	0.05	0.15	2.25	0.03			
3.	-	-	-	-	-	0.32	0.11	0.07
PA	0.05	0.02	0.11	2.01	0.04			
Recurring	0.10	0.04	0.15	2.32	0.01			
POS	-0.09	0.02	-0.26	-4.64	0.00			

*RQ5:* Do PA/NA, toxic emotional experiences (psychologically recurring, disconnecting, draining sub-dimensions), and perceived organizational support significantly predict antagonistic work behaviors?

In Table 7, only PA is included in the first block of the hierarchical regression. It explains only 1% of the total variation of antagonistic withdrawal behaviors [ $R^2=0.01$ ,  $F_{(1,304)}=3.891$ ,  $p=0.04$ ]. Results indicate that PA ( $\beta=0.12$ ,  $p=0.04$ ) has an important role when predicting antagonistic withdrawal behaviors. The second block includes PA, psychologically recurring, and disconnecting sub-dimensions which explains 4% of the total variance of antagonistic withdrawal behaviors [ $R^2=0.03$ ,  $F_{(3,302)}=4.590$ ,  $p=0.00$ ]. It is found that PA ( $\beta=0.12$ ,  $p=0.04$ ) and psychologically recurring ( $\beta=0.12$ ,  $p=0.04$ ) significantly and positively predict antagonistic work behavior in the second step. The third block which had POS, shows that 9% of the total variance explaining antagonistic work behaviors. In this step psychologically recurring ( $\beta=0.13$ ,  $p=0.03$ ), and disconnecting ( $\beta=0.12$ ,  $p=0.05$ ) positively, POS ( $\beta=-0.21$ ,  $p=0.00$ ) negatively predict antagonistic work behavior.

**Table 7.** Hierarchical Regression Results on Antagonistic Work Behavior

Predictor variables	<i>B</i>	<i>S.E B</i>	$\beta$	<i>t</i>	<i>p</i>	<i>R</i>	$R^2$	$\Delta R^2$
1.	-	-	-	-	-	0.11	0.01	0.01
PA	0.05	0.03	0.12	2.13	0.04			

2.	-	-	-	-	-	0.21	0.04	0.03
PA	0.05	0.03	0.12	2.07	0.04			
Recurring	0.09	0.05	0.12	1.99	0.05			
Disconnecting	0.07	0.05	0.08	1.36	0.18			
3.	-	-	-	-	-	0.29	0.09	0.04
PA	0.04	0.03	0.09	1.72	0.09			
Recurring	0.09	0.05	0.13	2.17	0.03			
Disconnecting	0.10	0.05	0.12	1.98	0.05			
POS	-0.09	.023	-0.21	-3.76	0.00			

## CONCLUSION

Throughout this study, the effect of positive and negative affect, toxic emotional experiences and perceived organizational support on positive work behaviors, psychological and physical withdrawal behaviors, and antagonistic work behaviors was investigated. In addition, it was tested whether toxic emotional experiences differ according to gender and age. For this purpose, public and private sector employees in Benin Republic were selected as the sample group of the study. According to results it can be said that women have more psychologically recurring and disconnecting emotions than men. There was no significant difference according to gender for the draining sub-dimension. According to ANOVA results between toxic emotional experiences and age groups, it can be concluded that there exists a significant difference between the age groups in terms of disconnecting and draining sub-dimensions. Scheffe multiple comparison test shows that 40 and above years old group is significantly different with 20 to 29 and 30 to 39 years old groups. Regarding draining sub-dimension, this difference was observed only between 20 to 29 years old and 40 and above age group. In contrary to disconnecting and draining, the psychologically recurring sub-scale shows no significant difference between age groups. Thus, age can be thought as an important factor in analyzing employees' toxic emotional experiences. As individuals are getting older, they become used to toxins. Relationships between toxic emotional experiences and research variables were also examined. The results show that there is a positive and significant relationship between toxic emotional experiences and negative affect, psychological withdrawal and antagonistic work behavior. The hierarchical regression results revealed that only psychologically recurring sub-dimension predict psychological withdrawal behaviors. In addition to this, positive affect, psychologically recurring sub-dimension together with diminished perceived organizational support predict positive work behaviors, and physical withdrawal behaviors. The remarkable finding is that employees who experience toxic emotions and perceive less support from their organization may exhibit antagonistic work behaviors.

As it is generally the case in research, this study got some few drawbacks and limitations that make it difficult to generalize the findings. As a result, it may be preferable to perform this study on a specific occupational and age groups with different sample from similar business sectors. Despite these limitations, the current study adds to the research literature by examining the role of affectivity, toxic emotions, and perceived organizational support on positive work behaviors, withdrawal behaviors, and antagonistic work behaviors.

## REFERENCES

1. Adler, J. M. & Hershfield, H. E. (2012). Mixed emotional experience is associated with and precedes improvements in psychological well-being. *PLoS ONE*, 7(4). Doi: 10.1371/journal.pone.0035633
2. Armstrong, J. S. (1988). Organizational behavior and human decision processes. *International Journal of Forecasting*, 4(3), 513. Doi: 10.1016/0169-2070(88)90125-2
3. Bartunek, J. M. & Frost, P. J. (2004). Toxic Emotions at Work: How Compassionate Managers Handle Pain and Conflict. *The Academy of Management Review*, 29(1), 141. Doi:

10.2307/20159022

4. Bindl, U. K. & Parker, S. K. (2010). Feeling good and performing well? Psychological engagement and positive behaviors at work. *Handbook of Employee Engagement: Perspectives, Issues, Research and Practice*, 385–398.
5. Chu, L. C. (2014). Mediating toxic emotions in the workplace - the impact of abusive supervision. *Journal of Nursing Management*, 22(8), 953–963. Doi: 10.1111/jonm.12071
6. Cropanzano, R., Howes, J. C., Grandey, A. A. & Toth, P. (1997). The relationship of organizational politics and support to work behaviors, attitudes, and stress. *Journal of Organizational Behavior*, 18(2), 159–180. Doi: 10.1002/(SICI)1099-1379(199703)18:2<159::AID-JOB795>3.0.CO;2-D
7. Cropanzano, R., Weiss, H. M., Hale, J. M. S. & Reb, J. (2003). The structure of affect: Reconsidering the relationship between negative and positive affectivity. *Journal of Management*, 29(6), 831–857. Doi: 10.1016/S0149-2063(03)00081-3
8. Cropanzano, R., & Wright, T. A. (1999). A 5-year study of change in the relationship between well-being and job performance. *Consulting Psychology Journal*, 51(4), 252–265. Doi: 10.1037/1061-4087.51.4.252
9. Dai, K. & Qin, X. (2016). Perceived organizational support and employee engagement: Based on the research of organizational identification and organizational justice. *Open Journal of Social Sciences*, 04(12), 46–57. Doi: 10.4236/jss.2016.412005
10. Diener, E., Larsen, R. J., Levine, S., & Emmons, R. A. (1985). Intensity and frequency: Dimensions underlying positive and negative affect. *Journal of Personality and Social Psychology*, 48(5), 1253–1265. Doi: 10.1037//0022-3514.48.5.1253
11. Eisenberger, R., Huntington, R., Hutchison, S. & Sowa, D. (1986). Perceived organizational support. *Journal of Applied Psychology*, 71(3), 500–507. Doi: 10.1037/0021-9010.71.3.500
12. Goldman, A. (2008). Company on the couch: Unveiling toxic behavior in dysfunctional organizations. *Journal of Management Inquiry*, 17(3), 226–238. Doi: 10.1177/1056492608318157
13. Hulin, C. L., & Hanisch, K. A. (1991). General attitudes and organizational withdrawal: An evaluation of a causal model. *Journal of Vocational Behavior*, 39(1), 110–128. Doi: 10.1016/0001-8791(91)90006-8
14. Iverson, R. D., Olekalns, M. & Erwin, P. J. (1998). Affectivity, organizational stressors, and absenteeism: A causal model of burnout and its consequences. *Journal of Vocational Behavior*, 52(1), 1–23. Doi: 10.1006/jvbe.1996.1556
15. Johns, G. (2002). The psychology of lateness, absenteeism, and turnover. In N. Anderson, D. Ones, & S. Deniz (Eds.), *Handbook of industrial, work and organizational psychology* (pp. 232–252). Thousand Oaks, CA, US: Sage
16. Judge, T. A., & Larsen, R. J. (2001). Dispositional affect and job satisfaction: A review and theoretical extension. *Organizational Behavior and Human Decision Processes*, 86(1), 67–98. Doi: 10.1006/obhd.2001.2973
17. Jurist, E. L. (2005). Mentalized affectivity. *Psychoanalytic Psychology*, 22(3), 426–444. Doi: 10.1037/0736-9735.22.3.426
18. Kiefer, T. & Barclay, L. J. (2012). Understanding the mediating role of toxic emotional experiences in the relationship between negative emotions and adverse outcomes. *Journal of Occupational and Organizational Psychology*, 85(4), 600–625. Doi: 10.1111/j.2044-8325.2012.02055.x
19. Lawrence, S. A. (2008). The case for emotion-induced toxicity: Making sense of toxic emotions in the workplace. *Research Companion to Emotion in Organizations*, 2003, 73–89. Doi: 10.4337/9781848443778.00013
20. Lehman, W. E. K. & Simpson, D. D. (1992). Employee substance use and on-the job

- behaviors. *Journal of Applied Psychology*, 77(3), 309–321. Doi: 10.1037/0021-9010.77.3.309
21. Li, X. (2020). Workplace bullying, perceived organizational support and turnover intention in manufacturing factory: Evidence from China. *OALib*, 07(10), 1–11. Doi: 10.4236/oalib.1106886
  22. Luo, H. (2020). Review of research progress on perceived organizational support and organizational identity. *Open Journal of Business and Management*, 08(02), 809–819. Doi: 10.4236/ojbm.2020.82050
  23. Mayes, B. T., Finney, T. G., Johnson, T. W., Shen, J., & Yi, L. (2017). The effect of human resource practices on perceived organizational support in the People's Republic of China. *International Journal of Human Resource Management*, 28(9), 1261–1290. Doi: 10.1080/09585192.2015.1114768
  24. Moore, C., Detert, J., Trevino, L. K., Baker, V. L. & Mayer, D. M. (2012). Why employees do bad things: Moral disengagement and unethical. *Personnel Psychology*, 65, 1–48. Doi: 10.1111/j.1744-6570.2011.01237.x
  25. Panaccio, A. & Vandenberghe, C. (2009). Perceived organizational support, organizational commitment and psychological well-being: A longitudinal study. *Journal of Vocational Behavior*, 75(2), 224–236. Doi: 10.1016/j.jvb.2009.06.002
  26. Pennebaker, J. W. (1997). Writing about emotional experiences as a therapeutic process. *Psychological Science*, 8(3), 162–166. Doi: 10.1111/j.1467-9280.1997.tb00403.x
  27. Rhoades, L., & Eisenberger, R. (2002). Perceived organizational support: A review of the literature. *Journal of Applied Psychology*, 87(4), 698–714. Doi: 10.1037/0021-9010.87.4.698
  28. Sagie, A., Birati, A. & Tziner, A. (2002). Assessing the costs of behavioral and psychological withdrawal: A new model and an empirical illustration. *Applied Psychology*, 51(1), 67–89. Doi: 10.1111/1464-0597.00079
  29. Sears, G. J., Zhang, H. & Han, Y. (2016). Negative affectivity as a moderator of perceived organizational support - work outcome relationships. *Personality and Individual Differences*, 98, 257–260. Doi: 10.1016/j.paid.2016.04.026
  30. Sege, R. D. & Harper Browne, C. (2017). Responding to ACEs with hope: Health outcomes from positive experiences. *Academic Pediatrics*, 17(7), S79–S85. Doi: 10.1016/j.acap.2017.03.007
  31. Shapira-Lishchinsky, O., & Even-Zohar, S. (2011). Withdrawal behaviors syndrome: an ethical perspective. *Journal of Business Ethics*, 103(3), 429–451. Doi: 10.1007/s10551-011-0872-3
  32. Shepherd, D. A. & Cardon, M. S. (2009). Negative emotional reactions to project failure and the self-compassion to learn from the experience. *Journal of Management Studies*, 46(6), 923–949. Doi: 10.1111/j.1467-6486.2009.00821.x
  33. Stein, M. (2007). Toxicity and the unconscious experience of the body at the employee-customer interface. *Organization Studies*, 28(8), 1223–1240. Doi: 10.1177/0170840607079527
  34. Sulaiman, M., Ragheb, M. A. & Wahba, M. (2019). Perceived organization support role in creating an innovative work behavior. *OALib*, 06(05), 1–14. Doi: 10.4236/oalib.1105372
  35. Suls, J. (2018). Toxic affect: Are anger, anxiety, and depression independent risk factors for cardiovascular disease? *Emotion Review*, 10(1), 6–17. Doi: 10.1177/1754073917692863
  36. Tan, L. P., Yap, C. S., Choong, Y. O., Choe, K. L., Rungruang, P. & Li, Z. (2019). Ethical leadership, perceived organizational support and citizenship behaviors: The moderating role of ethnic dissimilarity. *Leadership and Organization Development Journal*, 40(8), 877–897. Doi: 10.1108/LODJ-04-2019-0160
  37. Watson, D., Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to anxiety and depressive disorders. *Journal of Abnormal Psychology*, 97(3), 346–353. Doi: 10.1037/0021-843X.97.3.346

38. Watson, D., Clark, L. A. & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. Doi: 10.1037/0022-3514.54.6.1063
39. Zhang, L. Bu, Q. & Wee, S. (2016). Effect of perceived organizational support on employee creativity: Moderating role of job stressors. *International Journal of Stress Management*. 23(4), 400-417. Doi: 10.1037/str0000025



**SAĞLIK ÇALIŞANLARINDA İŞ SAĞLIĞI GÜVENLİĞİ ve MOTİVASYON İLİŞKİSİ****THE RELATIONSHIP OF OCCUPATIONAL HEALTH SAFETY AND MOTIVATION IN HEALTHCARE WORKERS****Doç. Dr. Rabia SOHBET<sup>1</sup>, Ali Tilki<sup>2</sup>***(<sup>1-2</sup>)-Gaziantep Üniversitesi, Sağlık Bilimleri Enstitüsü, Halk Sağlığı Hemşireliği Programı, Hemşirelik Anabilim Dalı, Gaziantep, Türkiye*<sup>1</sup>ORCID No: 0000-0002-1835-8479 <sup>1</sup><sup>2</sup>ORCID No: 0000-0001-9465-0685**Özet**

Uluslararası Çalışma Örgütü (ILO) Dünyada her yıl meslek hastalıkları ve kazalar yüzünden 2.2 milyon insanın hayatını kaybettiğini, 270 milyon insanın kaza geçirdiğini ve 160 milyon insanın da iş sebebiyle kısa veya uzun süreli hastalandığını açıklamıştır. Dolayısıyla, meslek hastalıkları ve kazaların önlenmesi, toplum için ekonomik kazanım sağlayacağı gibi, işletmeler için de iyi uygulama örneği teşkil edecektir. En geniş anlamıyla motivasyon; davranışı harekete geçiren fizyolojik/psikolojik eksiklik, ihtiyaç /herhangi bir hedefe yönelmiş dürtü ile başlayan süreçtir.

Bu araştırma, kesitsel tanımlayıcı türde 15.11.2019-16.03.2020 tarihleri arasında Şanlıurfa İli Mehmet Akif İnan Eğitim ve Araştırma Hastanesinde çalışan 2100 çalışandan 1870'ine uygulanmıştır. Verilerin toplanmasında çalışanların tanıtıcı özelliklerini ve iş sağlığı güvenliğine ait bilgi, durum ve tecrübelerini ölçen anket formu, motivasyon düzeyi için Çok Boyutlu İş Motivasyon Ölçeği kullanılmıştır. Verilerin değerlendirilmesinde SPSS 25.0 (Statistical Package for Social Science) paket programı kullanılmıştır. Bağımsız değişkenlerin karşılaştırılmasında  $\chi^2$  testi ve cronbach alfa katsayısı kullanılmıştır.

Araştırmamızda: sağlık çalışanlarının; %45,7'si 30-39 yaş aralığında; %51'i bayan, %76,7'si evli, %40,4'ü hemşire; %36,9'u 6-10 yıl mesleki çalışma yılı aralığında; %47,1'i Lisans ve üstü eğitim düzeyinde olduğu saptanmıştır.

Katılımcıların; %48,6'sı kısmen işe devamsızlık sorunu yaşarken, %39,6'sı az tehlikeli sınıfta; %45,2'si meslek hastalıklarına yakalanma yönünde riskli birimde çalıştığı, %98,7'si İşyeri sağlık güvenlik biriminin kurulduğunu, %79,6'sı İşyerinde risk değerlendirmesi ekibi oluşturulduğu saptanmıştır. %99,6'sı İşyerinde acil durum planları hazırlandığını, %76,6'sı işyerinde yangınla mücadele ve tahliye tatbikatı yapıldığı, %99,5'i İşyerinde çalışan temsilcisi görevlendirildiğini, %99,0'ı İşyerinde iş sağlığı ve güvenliği kurulu oluşturulduğunu, %58,8'i sağlık muayeneleri düzenli yapıldığı saptanmıştır. %39,7'si Çalışma ve Sosyal Güvenlik Bakanlığı bilgilendirme toplantıları ile iş sağlığı güvenliği mevzuatı bilgilerine ulaştığı saptanmıştır. %37,8'i koruyucu ekipmanları sıklıkla kullanmakta, %55,3'ü meslek hastalıklarını bildiği, %42,0'ı koruyucu ekipmanın tek başına meslek hastalıklarından korumaya yeterli, %98,4'ü ramak kala olaylar ile ilgili raporlar hazırlanıyor saptanmıştır.

Araştırmamızda Çok Boyutlu Motivasyon Ölçeğinin cronbach alfa değeri 0,82 hesaplanmıştır.

**Anahtar Kelimeler:** İş Sağlığı, İş Güvenliği, İş Sağlığı Güvenliği, Motivasyon, Sağlık Çalışanları

**Abstract**

The International Labor Organization (ILO) announced that 2.2 million people die every year due to occupational diseases and accidents in the world, 270 million people have accidents and 160 million people get sick for short or long-term due to work. Therefore, the prevention of occupational diseases and accidents will not only provide economic gain for the society, but also set an example of good practice for businesses. Motivation in its broadest sense; It is the process

that starts with a physiological/psychological deficiency, a need/an impulse directed towards any goal that activates the behavior.

This cross-sectional descriptive study was applied to 1870 of 2100 employees working in Şanlıurfa Mehmet Akif İnan Training and Research Hospital between 15.11.2019 and 16.03.2020. A questionnaire measuring the introductory characteristics of the employees and their knowledge, status and experience of occupational health and safety was used to collect the data, and the Multidimensional Job Motivation Scale was used for the motivation level. SPSS 25.0 (Statistical Package for Social Science) package program was used to evaluate the data. The  $\chi^2$  test and the Cronbach's alpha coefficient were used to compare the independent variables.

In our research: health workers; 45.7% of them are between the ages of 30-39; 51% are female, 76.7% are married, 40.4% are nurses; 36.9% of them are in the range of 6-10 years of professional work; It was determined that 47.1% of them were at the undergraduate and higher education level.

Participants; While 48.6% of them had the problem of partly absenteeism, 39.6% were in the less dangerous class; It has been determined that 45.2% of them work in the risky unit to catch occupational diseases, 98.7% of them work in the workplace health and safety unit, 79.6% of them a risk assessment team is formed in the workplace. 99.6% stated that emergency plans were prepared at the workplace, 76.6% fire-fighting and evacuation drills were carried out at the workplace, 99.5% employee representatives were appointed at the workplace, 99.0% occupational health and safety committees were established at the workplace. It was determined that 58.8% of them had regular health examinations. It was determined that 39.7% of them had access to occupational health and safety legislation information through the Ministry of Labor and Social Security information meetings. It was determined that 37.8% use protective equipment frequently, 55.3% know occupational diseases, 42.0% use protective equipment alone to protect against occupational diseases, 98.4% prepare reports about near misses. .

In our study, the cronbach alpha value of the Multidimensional Motivation Scale was calculated as 0.82.

**Keywords:** Occupational Health, Occupational Safety, Occupational Health And Safety, Motivation, Health Workers

## GİRİŞ ve AMAÇ

Dünya Sağlık Örgütü(WHO) ve Uluslararası Çalışma Örgütü'nün (ILO) karma komisyonuna göre; “İş sağlığı her meslekteki işçilerin fiziksel, ruhsal ve sosyal iyiliklerini en üst düzeyde koruma ve geliştirmeyi; işçilerin çalışma koşullarından ötürü sağlıklarını kaybetmelerinin önlenmesini; işçilerin işyerindeki sağlığa zararlı faktörlerden kaynaklanan risklerden korunmasını; işçinin fiziksel ve psikolojik donanımına uygun işte çalışmasının sağlanmasını ve özetle işin insana uyarlanması ve her bir insanın işine adapte edilmesini amaçlar”(WHO, 2005). İş sağlığının etkileri işçi ile etkileşim halinde olan her bireye yansıdığı için geniş bir etki alanına sahiptir. İş güvenliği; bir işin yapılması anında çalışan bireylerin karşılaştığı tehlikelerin ortadan kaldırılmasını/en aza indirilmesi hususunda teknik önlemleri içeren bir kavramdır ve çalışma ortamına ilişkin önlemleri içerir, işyerinde kullanılan ekipmanlardan doğabilecek risklerin tespiti ve bunlara karşı nasıl koruma tedbirleri alınabileceği ile ilgilidir.(1). Uluslararası Çalışma Örgütü (ILO) dünyada her yıl meslek hastalıkları ve kazalar yüzünden 2.2 milyon insanın hayatını kaybettiğini, 270 milyon insanın kaza geçirdiğini ve 160 milyon insanın da iş sebebiyle kısa veya uzun süreli hastalandığını açıklamıştır. İSG'nin işyerinde etkili bir şekilde güvence altına alınmaması, işe devamsızlık, meslek hastalıkları ve iş kazalarının artışı ile sonuçlanmakta ve sürekli iş görememeye yol açabilir. Bu sadece insani boyut ile sınırlı olmayıp, aynı zamanda ekonomi üzerinde oldukça büyük negatif etkiye sahiptir(2). Motivasyon; Gündülemenin İngilizce karşılığı olan “motivation” kelimesinden türetilmiştir. En geniş anlamıyla motivasyon; davranışı harekete geçiren fizyolojik/psikolojik eksiklik, ihtiyaç /herhangi bir hedefe yönelmiş dürtü ile başlayan süreçtir ve direk olarak davranışın kaynağı ile ilgilenmektedir. Motivasyon konusunda

çok çeşitli varsayımlar ortaya atılmıştır. Elliot ve Dweck (2013) motivasyon faktörlerini örgüt içerisinde beraber çalışma ve terfi, yükselme kavramları ile özdeşleşmiştir. Bilindiği gibi her bir kişinin kendine özgü bir yapıda bulunması, çalışanların ihtiyaçlarının “tatmin” ve “motivasyon”larında farklılığa yol açtığı ortadadır. “Çalışanlara, sadece verilen görev ve talimatları uygulayan kişiler gözüyle bakmak yanlış olacaktır.(3). ABD’de yapılan araştırmada çalışanların %97’si motivasyonun verimliliklerine etkisinin çok büyük olduğunu, %92’si motivasyonun firmalarına bağlılıklarını sağlayan anahtar faktör görmektedir. Çalışanların iş tatmininin ve verimliliğinin yüksek olduğu şirketlerde, %38 daha yüksek müşteri mutluluğu ve memnuniyeti, %22 daha yüksek seviyede verimlilik ve %27 daha yüksek kar (kazanç) elde edildiği saptanmıştır.(4). Motivasyon konusunu ilk inceleyen yönetim uzmanlarının başında Abraham H. Maslow gelmektedir. İnsan ihtiyaçları ile ilgili 1943’de yazdığı makalesinde insan ihtiyaçlarını beş kategoriye ayırmıştır ve hiyerarşik olarak ele almış ve en alttaki ihtiyaçların karşılanmasının ardından insanın bir üstteki ihtiyaçlar kategorisine doğru yöneldiğini ifade etmiştir. Amerikalı bir psikolog olan Herzberg motivasyon teorisine yeni görüşler ilave etmiştir ve yaptıkları araştırmada, insan davranışlarını etkileyen iki faktör grubunun varlığını belirlemişlerdir. Bunlardan birinci faktör grubunun yokluğu işgörenleri kötümser yapıp iş te tatminsizliğe yol açmaktadır. Ancak bunların varlığı, kişileri güdülemeye yol açmaz yani işgören sadece bunlara sahip olmakla doyuma ulaşamamaktadır. İkinci grup faktörler personeli özendirici ve güdüleyici faktörlerdir. Bu faktörlerin mevcudiyeti, personeli motive eder ve işte başarılı olmaya teşvik eder. Herzberg ve arkadaşları, çalışanların çalışmaları ve başarılarıyla ilgili olan bu faktörleri ‘hijyen’(sağlık) ve ‘işe özendirici’(motivasyonel) faktörler olarak isimlendirmişlerdir.(5). Bundan dolayı araştırmamızın amacı araştırmaya katılan sağlık çalışanlarında iş sağlığı güvenliği ile iş motivasyonu arasındaki ilişkiyi tespit etmek, sağlık çalışanlarının İSG ve motivasyon yönünden bilgi, tutum ve davranışları saptamak amacıyla yapılmıştır.

### GEREÇ VE YÖNTEM

Bu araştırma, sağlık çalışanlarında iş sağlığı güvenliği ve motivasyon ilişkisini belirlemek amacıyla kesitsel tanımlayıcı türde yapılmıştır.

Araştırma verileri 15.11.2019-16.03.2020 tarihleri arasında Şanlıurfa İli Mehmet Akif İnan Eğitim ve Araştırma Hastanesinde çalışan sağlık çalışanlardan yazılı kurum izni alınarak toplanmıştır.

Araştırmanın evrenini; Şanlıurfa İli Mehmet Akif İnan Eğitim ve Araştırma Hastanesinde çalışan sağlık çalışanları(n=2100) oluşturmaktadır. Sağlık çalışanlarının tamamına ulaşılmaya çalışılmış ancak süre, maliyet, iş yoğunluğu gibi engellerden çalışmaya katılmayı kabul eden toplam 1950 sağlık çalışanına anket formu uygulanmıştır. Çoklu işaretleme, sayfa atlama eksik işaretleme gibi hatalardan dolayı toplamda 1870 form analiz için uygun görülmüş ve örneklem olarak değerlendirilmiştir.

Araştırma verilerinin toplanmasında çalışanların tanıtıcı özelliklerini ve iş sağlığı güvenliğine ait bilgi, durum ve tecrübelerini ölçen anket formu, motivasyon düzeyi için Çok Boyutlu İş Motivasyon Ölçeği kullanılmıştır. **Çalışanların tanıtıcı özelliklerini ve iş sağlığı güvenliğine ait bilgi, durum ve tecrübelerini ölçen anket formu:** kaynakçadaki literatürler taranarak oluşturulan toplam 40 soru bulunmaktadır.

**Çok Boyutlu İş Motivasyon Ölçeği:** Çok Boyutlu İş Motivasyonu Ölçeği (ÇBİMÖ) Likert tip olup, 19 maddeden oluşmaktadır. Her bir maddeye ilişkin cevaplama 7 derece üzerinden hiç uygun değil (1), çoğunlukla uygun değil (2), uygun değil (3), orta (4), uygun (5), oldukça uygun (6) ve tamamen uygun (7) arasında yapılmaktadır. Ölçek orijinalinde altı alt ölçekten oluşmaktadır. Bu alt ölçekler motive olmama (amotivation), dışsal düzenleme-sosyal (extrinsic regulation social), dışsal düzenleme-maddesel (extrinsic regulation material), içe yansıtılan düzenleme (introjected regulation), kişisel düzenleme (identified regulation) ve içsel motivasyondur (intrinsic motivation). Alt ölçek puanları açısından iç tutarlılık bağlamında güvenilirliği belirlemek amacıyla Cronbach alfa hesaplanmıştır. Buna göre alfa katsayılarının motive olmama alt ölçeği için .72 içsel motivasyon alt ölçeği için .73, dışsal düzenleme-sosyal alt ölçeği için .78, kişisel düzenleme alt

ölçeği için .76, dışsal düzenleme-maddesel alt ölçeği için .80 ve içe yansıtılan düzenleme alt ölçeği için .73 olduğu belirlenmiştir. (6) Araştırmamızda Alt ölçek değerleri açısından iç tutarlılığı bağlamında ölçeklerin güvenilirliğini belirlemek için yapılan cronbach alfa katsayıları hesaplanmıştır. Motive olmama alt ölçeği için 0,73 içsel motivasyon alt ölçeği için 0,88, dışsal düzenleme-sosyal alt ölçeği için 0,79, kişisel düzenleme alt ölçeği için 0,62, dışsal düzenleme-maddesel alt ölçeği için 0,67 ve içe yansıtılan düzenleme alt ölçeği için 0,54 olduğu tespit edilmiştir. Araştırmamızda kullanılan bu ölçeğin cronbach alfa değeri 0,82 hesaplanmıştır. Verilerin kodlanması ve değerlendirilmesi bilgisayar ortamında SPSS 22.00 paket programında yapılmıştır. Ölçeğin güvenilirliğinin araştırılmasında Cronbach's Alpha katsayısından yararlanılmıştır. Araştırmaya katılan çalışanların tanıtıcı özellikleri, iş sağlığı güvenliği bilgi, tutum düzeyleri ile tanıtıcı özellikleri düzeyleri arasındaki ilişkileri ölçmek için Ki Kare Testi, tanıtıcı ve iş sağlığı güvenliğine ait bilgi, tutum ve tecrübeler için sayı ve yüzdelikler kullanılmıştır.

### BULGULAR

**Tablo 1: Sağlık Çalışanlarının Sosyo-Demografik Özellikler**

Yaş	Sayı	%
20-29 arası	646	34,6
30-39 arası	859	45,7
40-49 arası	326	17,5
50-59 arası	39	2,2
<b>Cinsiyet</b>		
Kadın	954	51,0
Erkek	916	49,0
<b>Medeni durum</b>		
Evli	1435	76,7
Bekar	435	23,3
<b>Meslek</b>		
Hemşire	756	40,4
Ebe	35	1,9
Doktor	293	15,7
Teknikerler (anestezi, ameliyathane, radyoloji, laboratuvar, diyaliz, perfüzyonist ve paramedik)	113	6,0
Temizlik personeli	365	19,5
Diğer (diyetisyen, fizyoterapist, odyolog, eczacı ve sosyal hizmet uzmanı)	28	1,5
Sekreteryaya (veri giriş elemanı, bilgi işlem ve tıbbi dökümantasyon sekreterlik)	280	15,0
<b>Mesleki çalışma yılı</b>		
1-5 yıl arası	45	22,9
6-10 yıl arası	436	36,9
11-15 yıl arası	398	21,2
16-20 yıl arası	245	13,1
21-25 yıl arası	85	4,5
26-33 yıl arası	26	1,4
<b>Eğitim durumu</b>		
Ortaokul	80	4,3
Lise	436	23,3
Ön lisans	474	25,3
Lisans ve üstü	880	47,1
<b>Toplam</b>	<b>1870</b>	<b>100</b>

Tablo 1'de sağlık çalışanlarının; %45,7'si 30-39 yaş aralığında; %51'i kadın, %76,7'si evli, %40,4'ü hemşire; %36,9'u 6-10 yıl mesleki çalışma yılı aralığında; %47,1'i Lisans ve üstü eğitim düzeyinde olduğu saptanmıştır.

**Tablo 2: Sağlık Çalışanlarının İş ve İşyeri Özellikleri**

İş Yerinde Çalışan Kişi Sayısı	Sayı (n)	%
6-9 Kişi	45	2,4
10-19 Kişi	536	28,6
20-29 Kişi	745	39,8
30-39 Kişi	461	24,7
40-44 Kişi	83	4,5
<b>İşe Devamsızlık Sorunu Yaşama</b>		
Evet	389	20,8
Hayır	572	30,6
Kısmen	909	48,6
<b>Çalışılan Birimin Tehlike Sınıfı</b>		
Az Tehlikeli	731	39,1
Tehlikeli	628	33,6

Çok Tehlikeli	378	20,2
Bilmiyorum	133	7,1
<b>Birimdeki Koruyucu Ekipman Yeterliliği</b>		
Evet	687	36,7
Hayır	171	9,1
Kısmen	1012	54,1
<b>Birimin Meslek Hastalıklarına Yakalanma Riski</b>		
Evet	845	45,2
Hayır	269	14,4
Kısmen	756	40,4
<b>Toplam</b>	<b>1870</b>	<b>100</b>

Tablo 2’de %39,8’i 20-29 kişi ile birlikte çalışmakta; %20,8’i işe devamsızlık sorunu yaşamakta; %39,1’i az tehlikeli, %33,6’sı tehlikeli birimde çalışmakta; birimdeki koruyucu ekipmanı %54,6’sı kısmen yeterli, %9,1’i yetersiz bulmakta; birimin meslek hastalıklarına yakalanma riskine %45,2’si evet demiştir.

**Tablo3:Çalışanlarda İş Kazası Meslek Hastalığı Önlemede İşveren Sorumluluğu Dağılımı**

İş kazalarının %98’inin, meslek hastalıklarının %100’ünün önlenabilir olduğunun bilgisi	Sayı (n)	%
Evet	949	50,7
Hayır	921	49,3
<b>İşyeri dışındaki kişi ve kuruluşlardan hizmet alınması, işveren sorumluluğunu ortadan kaldırması</b>		
Evet	1631	87,2
Hayır	239	12,8
<b>Toplam</b>	<b>1870</b>	<b>100</b>

Tablo 3’de sağlık çalışanları; %50,7’si İş kazalarının %98’inin, meslek hastalıklarının %100’ünün önlenabilir olduğunu, %87,2’si işyeri dışındaki kişi ve kuruluşlardan hizmet alınması, işveren sorumluluğunu ortadan kaldıracağını ifade etmiştir.

**Tablo4:Çalışanlarda İş Sağlığı Güvenliği Kanunu İle İlgili Bilgi Tutum Davranış Dağılımı**

<b>6331 Sayılı İSG Kanunun Uygulanabilir Bulması</b>	<b>Sayı (N)</b>	<b>%</b>
Evet	1231	65,8
Hayır	131	7,0
Kısmen	508	27,2
<b>6331 Sayılı Kanunun Yükümlülüklerini Bilmesi</b>		
Evet	796	42,6
Hayır	453	24,2
Kısmen	621	33,2
<b>6331 Sayılı Kanunundan Doğan Haklarını Talep Etmesi</b>		
Evet	818	43,7
Hayır	146	7,8
Kısmen	906	48,4
<b>6331 Sayılı Kanunun İkincil Düzenlemeleri Hakkında Kurumsal Düzeyde Bilgisi</b>		
Evet	368	19,7
Hayır	626	33,5
Kısmen	876	46,8
<b>Kanunun Kurumsal Düzeyde Olumsuz Etkileri İle Karşılaşma</b>		
Evet	1114	59,6
Hayır	157	8,4
Kısmen	599	32,0
<b>Kanunun Uygulanması İle Kurumda İş Kazası/Ramak Kala Olaylarda Azalma Gözlemlenme</b>		
Evet	878	47,0
Hayır	162	8,7
Kısmen	830	44,4
<b>Kanunun, Ulusal Düzeyde Güvenlik Kültürünün Oluşmasına Katkısının Varlığı</b>		
Evet	926	49,5
Hayır	137	7,3
Kısmen	807	43,2
<b>Toplam</b>	<b>1870</b>	<b>100</b>

Tablo 4’de Sağlık çalışanları; 6331 sayılı İSG kanunu %65,8’i uygulanabilir bulmuş, 6331 sayılı Kanun uyarınca sağlık çalışanları yükümlülüklerini %42,6’sı bildiği, 6331 sayılı Kanunu ile doğan haklarını; %43,7’si tam talep etmektedir. 6331 sayılı Kanunun ikincil düzenlemelerini %46,8’i kısmen bildiğini söylemiştir. Kanunun kurumsal düzeyde olumsuz etkileri ile karşılaşmaya %59,6’sı evet demiştir. Kanunun uygulanması ile kurumda, iş kazası/ramak kala olaylarda azalma gözlemlenmeye %47,0’ı evet demiştir. Kanunun, ulusal düzeyde güvenlik kültürü oluşmasına katkı sağlamasına %49,5’i sağlıyor demiştir.

**Tablo5:Koruyucu Ekipman, Meslek Hastalığı, İş Kazası Bilgi Tutum Davranış Dağılımı**

Koruyucu Ekipmanları Kullanma Sıklığı	Sayı (N)	%
Sıklıkla	707	37,8
Bazen	623	33,3
Nadiren	540	28,9
<b>Meslek Hastalıkları Hakkında Yeterli Bilgi Sahibi Olma</b>		
Evet	916	49,0
Hayır	258	13,8
Kısmen	696	37,2
<b>Meslek Hastalıklarını Bilmek</b>		
Evet	1035	55,3
Hayır	354	18,9
Kısmen	481	25,7
<b>Koruyucu Ekipmanlar Tek Başına Meslek Hastalıklarından Korumaya Yeterli Olma</b>		
Evet	786	42,0
Hayır	82	4,4
Kısmen	1002	53,6
<b>İş Kazası Bildiriminin Nereye Ve Nasıl Yapılacağına İlişkin Kurumsal Düzeyde Bilgi</b>		
Evet	1394	74,5
Hayır	476	25,5
<b>Meslek Hastalıkları Bildiriminin Nereye Ve Nasıl Yapılacağına İlişkin Kurumsal Düzeyde Bilgi</b>		
Evet	1390	74,3
Hayır	480	25,7
<b>Ramak Kala Olaylar İle İlgili Raporlar Hazırlanma</b>		
Evet	1840	98,4
Hayır	30	1,6
<b>Toplam</b>	<b>1870</b>	<b>100</b>

Tablo 5’de; koruyucu ekipmanları %37,8’i sıklıkla kullanmakta olduğu; meslek hastalıkları hakkında yeterli bilgiye %49,0’ı evet; meslek hastalıklarını bilmeye %55,3’ü evet demiştir. Çalışanları koruyucu ekipmanın tek başına meslek hastalıklarından korumaya %42,0’ı evet korumaya yeterli demiştir. Sağlık çalışanlarının; %74,5’i iş kazası bildiriminin nereye ve nasıl yapılacağına ilişkin kurumsal düzeyde bilgi sahibi olduğunu; %74,3’ü meslek hastalıkları bildiriminin nereye ve nasıl yapılacağına ilişkin kurumsal düzeyde bilgi sahibi olduğu ve %98,4’ü ramak kala olaylar ile ilgili raporlar hazırlandığını ifade ettiği bulunmuştur.

**Tablo6:Sağlık Çalışanları için İşyerinin İş Sağlığı Güvenliği Yönünden Özellikleri**

İşyerinde İşyeri Sağlık Güvenlik Biriminin Kurulması	Sayı (N)	%
Evet	1846	98,7
Hayır	24	1,3
<b>İşyerinin İSG Yükümlülükleri Konusunda Desteklenmesini İsteme</b>		
Evet	1479	79,1
Hayır	10	,5
Kısmen	381	20,4
<b>İşyerinde Risk Değerlendirmesi Ekibi Oluşturulma</b>		
Evet	1488	79,6
Hayır	4	,2
Kısmen	378	20,2
<b>İşyerinde Risk Değerlendirmesi Çalışması Yapılması</b>		
Evet	1148	61,4
Hayır	6	,3
Kısmen	716	38,3
<b>Risk Değerlendirmesi, Çalışanların İSG Eğitimleri, Sağlık Gözetimi, Acil Durum Planları Yükümlülüklerin, 30/12/2012 Tarihinden İtibaren İşyeri İçin Zorunlu Olduğunu Bilme</b>		
Evet	1326	70,9
Hayır	544	29,1
<b>İşyerinde Acil Durum Planları Hazırlanması</b>		
Evet	1862	99,6
Hayır	8	0,4
<b>İşyerinde Yangınla Mücadele Ve Tahliye Tatbikatı Yapılması</b>		
Evet	1433	76,6
Hayır	437	23,4
<b>İşyerinde Çalışan Temsilcisi Görevlendirilmesi</b>		
Evet	1861	99,5
Hayır	9	0,5
<b>İşyerinde İş Sağlığı Ve Güvenliği Kurulu Oluşturulması</b>		
Evet	1851	99,0
Hayır	19	1,0



<b>Toplam</b>	<b>1870</b>	<b>100</b>
---------------	-------------	------------

Tablo 6’da işyeri sağlık güvenlik biriminin kurulma durumuna %98,7’si evet, İşyerinin İSG yükümlülükleri konusunda desteklenmesini istemeye %79,1’i evet demiştir. %79,6’sı İşyerinde risk değerlendirmesi ekibi oluşturuldu; %61,4’ü işyerinde risk değerlendirmesi çalışması yapıldı demiştir. Risk değerlendirmesi, çalışanların İSG eğitimi, sağlık gözetimi, acil durum planlarının 30/12/2012 tarihinden itibaren işyeri için zorunlu olmasına %70,9’u evet demiştir. Sağlık çalışanlarının; %99,6’sı İşyerinde acil durum planları hazırlandı; %76,6’sı İşyerinde yangınla mücadele ve tahliye tatbikatı yapıldı; %99,5’i İşyerinde çalışan temsilcisi görevlendirildi, %99,0’ı İşyerinde iş sağlığı ve güvenliği kurulu oluşturuldu dediği saptanmıştır.

**Tablo7:Çalışanların İş Sağlığı Güvenliği Hak ve Sorumluluk, Bilgi Kaynak Dağılımı**

<b>İş Sağlığı Ve Güvenliği Mevzuatı Bilgilerine Ulaşmada En Çok Tercih Edilen Bilgi Kaynağı</b>	<b>Sayı (N)</b>	<b>%</b>
ÇSGB Bilgilendirme Toplantılarından	742	39,7
Meslek/İşveren Kuruluşlarından	679	36,3
Sendikalar, Kurum İçi / Kurumlar Arası Yazışmalardan	163	8,7
Basın	178	9,5
İnternet	108	5,8
<b>İş Sağlığı Ve Güvenliği Açısından Görev, Hak Ve Sorumluluklarını Bilme</b>		
Evet	867	46,4
Hayır	311	16,6
Kısmen	692	37,0
<b>Toplam</b>	<b>1870</b>	<b>100</b>

Tablo7’de sağlık çalışanlarının; %39,7’si ÇSGB bilgilendirme toplantıları, %36,3’ü meslek/ işveren kuruluşları ile iş sağlığı güvenliği mevzuatı bilgilerine ulaştığı, %46,4’ünün İş sağlığı ve güvenliği açısından görev, hak ve sorumluluklarını bildiği saptanmıştır.

**Tablo 8: İş Sağlığı Güvenliğinin Yaşa Göre Dağılımı**

<b>İşe Devamsızlık Sorunu Yaşama</b>	<b>Yaş</b>							
	<b>20-29 Yaş</b>		<b>30-39 Yaş</b>		<b>40-49 Yaş</b>		<b>50-55 Yaş</b>	
	Sayı	%	Sayı	%	Sayı	%	Sayı	%
Evet	133	34,2	188	48,3	62	15,9	6	1,5
Hayır	226	39,5	273	47,7	68	11,9	5	0,9
Kısmen	287	31,6	398	43,8	196	21,6	28	3,1
<b>Toplam</b>	<b>646</b>	<b>34,5</b>	<b>859</b>	<b>45,9</b>	<b>326</b>	<b>17,4</b>	<b>39</b>	<b>2,1</b>
<b>X<sup>2</sup>:36,586 Df:6 P:0,000</b>								
<b>Meslek Hastalıkları Yeterli Bilgi Sahibi Olma</b>								
Evet	323	35,3	398	43,4	168	18,3	27	2,9
Hayır	80	31,0	124	48,1	49	19,0	5	1,9
Kısmen	243	34,9	337	48,4	109	15,7	7	1,0
<b>X<sup>2</sup>:12,478 Df:6 P:0,047</b>								
<b>Birimin Meslek Hastalıklarına Yakalanma Yönünden Riski</b>								
Evet	288	34,1	375	44,4	161	19,1	21	2,5
Hayır	112	41,6	127	47,2	26	9,7	4	1,5
Kısmen	246	32,5	357	47,2	139	18,4	14	1,9
<b>X<sup>2</sup>:17,945 Df:6 P:0,006</b>								
<b>İş Sağlığı Ve Güvenliği Mevzuatı İle İlgili Bilgilere Ulaşmak İçin En Çok Hangi Bilgi Kaynakları</b>								
ÇSGB Bilgilendirme Toplantılarından	272	36,7	351	47,3	110	14,8	9	1,2
Meslek/İşveren Kuruluşlarından	263	38,7	306	45,1	99	14,6	11	1,6
Sendikalar, Kurum İçi / Kurumlar Arası Yazışmalardan	37	22,7	74	45,4	40	24,5	12	7,4
Basın	45	25,3	81	45,5	48	27,0	4	2,2
İnternet	20	26,9	47	43,5	29	26,9	3	2,8
<b>X<sup>2</sup>:68,877 Df:12 P:0,000</b>								
<b>Çalışanlar 6331 Sayılı Kanundan Doğan Hak Talep Etme</b>								
Evet	263	32,2	381	46,6	153	18,7	21	2,6
Hayır	32	21,9	71	48,6	37	25,3	6	4,1
Kısmen	351	38,7	407	44,9	136	15,0	12	1,3
<b>X<sup>2</sup>:28,561 Df:6 P:0,000</b>								
<b>Toplam</b>	<b>646</b>	<b>34,5</b>	<b>859</b>	<b>45,9</b>	<b>326</b>	<b>17,4</b>	<b>39</b>	<b>2,1</b>

Tablo8’de Sağlık çalışanlarında; İşe devamsızlık yaşamayanlar %47,7’si 30-39 yaş aralığında iken işe devamsızlık yaşayanların %48,3’ü 30-39 yaş aralığında olduğu saptanmıştır.

Sağlık çalışanlarında işe devamsızlık sorunu yaşama ile yaş arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0.05$ ). Meslek hastalıkları hakkında yeterli bilgi sahibi olanların %43,4'ü 30-39 yaş aralığında, iken yeterli bilgi sahibi olmayanların %48,1'i 30-39 yaş aralığında olduğu saptanmıştır. Sağlık çalışanlarında meslek hastalıkları hakkında yeterli bilgi sahibi olma durumu ile yaş arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0.05$ ). Çalışılan birimin meslek hastalıklarına yakalanma yönünden riskli olanların %44,4'ü 30-39 yaş aralığında iken riskli olmayanların %47,2'si 30-39 yaş aralığında olduğu saptanmıştır. Sağlık çalışanlarında çalışılan birimin meslek hastalıklarına yakalanma yönünden risk durumu ile çalışılan birimin tehlike sınıfı arasında anlamlı ilişki bulunmuştur( $p<0.05$ ). İş sağlığı ve güvenliği mevzuatı ile ilgili bilgilere ulaşmak için en çok kullanılan bilgi kaynağı olarak; ÇSGB Bilgilendirme Toplantılarından ulaşanların %47,3'ü 30-39 yaş aralığında olduğu bulunmuştur. Meslek/İşveren Kuruluşlarından ulaşanların %45,1'i 30-39 yaş aralığında olduğu saptanmıştır. Sendikalardan, Kurum içi / Kurumlar arası yazışmalardan ulaşanların %45,4'ü 30-39 yaş aralığında olduğu bulunmuştur. Basın yoluyla ulaşanların %45,5'i 30-39 yaş aralığında olduğu saptanmıştır. İnternet yoluyla ulaşanların ise %43,5'i 30-39 yaş aralığında olduğu saptanmıştır. Sağlık çalışanlarında iş sağlığı ve güvenliği mevzuatı ile ilgili bilgilere ulaşmak için en çok kullanılan bilgi kaynakları ile yaş arasında istatistiksel anlamda ilişki bulunmuştur( $p<0.05$ ). 6331 Sayılı Kanun'dan doğan hak talep edenlerin %46,6'sı 30-39 yaş, %2,6'sı 50-59 yaş iken 6331 Sayılı Kanun'dan doğan hak talep etmeyenlerin %48,6'sı 30-39 yaş aralığında olduğu saptanmıştır. Sağlık Çalışanlarının 6331 Sayılı Kanundan doğan hak talep etme durumuna göre yaş arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0.05$ ).

## SONUÇ VE TARTIŞMA

Çalışmaya katılanların %42,6'sının 6331 sayılı Kanun uyarınca yükümlülüklerini bildiği, %43,7'sinin hakların talep ettiğini, %46,8'i bu kanunun ikincil düzenlemelerini kısmen bildiğini söylemiştir. Çalışmamızın aksine Terzi ve ark.(2019) çalışmasında hemşirelerin %20'sinin iş sağlığı ve güvenliği yasasını okuduğunu saptadı(7). Öztürk ve ark.(2012), Akkaya ve ark.(2018) çalışmalarda hemşirelerin %61,5'inin iş güvenliğine ilişkin kanundan haberlerinin olmadığını, %46'sının iş güvenliğine ilişkin kanunu ve duyuruyu okumadığı belirtilmektedir(8,9). Çalışmamızda kişilerin bu konuda bilgi sahibi olduğu görülmektedir. Sağlık çalışanlarında iş sağlığı ve güvenliği mevzuatı ile ilgili bilgilere ulaşmak için en çok kullanılan bilgi kaynakları, birimdeki koruyucu ekipmanı yeterli bulma ile çalışılan birimin tehlike sınıfı arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0,05$ ). İş yerinde çalışan kişi sayısı ile çalışılan birimin tehlike sınıfı arasında istatistiksel anlamlı ilişki bulunmamıştır( $p>0.05$ ). Saygun 2012 yılındaki çalışmasında tehlike kaynaklarından etkilenme süresinin artması ile işteki gerilim ve diğer sağlık sakıncaları ortaya çıktığı söylemiştir(10). Abbasoğlu ve ark. 2006 yılında yaptığı çalışmada Sağlık çalışanlarının iş güvenliği gerekliliklerini kanıksamış olmaları da gösterdikleri özen ve dikkat konusunda eksikliğe neden olmaktadır (11).Sağlık çalışanlarında işyerinde acil durum planlarının yapılması durumu ile eğitim düzeyi arasında istatistiksel anlamlı ilişki bulunmamıştır ( $p>0,05$ ). Araştırmamıza benzer şekilde Terzi ve ark. 2019 yılındaki çalışmasında ve Çil 2016 yılı araştırmaları eğitim durumuna göre iş güvenliği alt boyutları arasında anlamlı ilişki bulunmuştur (7,12). Araştırmamızda sadece işyerinde acil durum planlarının yapılması eğitim düzeyi ile anlamlı ilişki yoktur. Bunun sebebinin herkesin aynı seviyede acil durum planı yapabilme kabiliyetine sahip olması olduğu düşünülmektedir. Sağlık çalışanlarında iş yerinde İSG birimi kurulması ile kurumsal meslek hastalıkları bildirimini nereye nasıl yapılacağını bilme, birimdeki yeterli koruyucu ekipmanı olma, 6331 Sayılı İSG Kanunun İkincil Düzenlemeleri hakkında kurumsal bilgi, işyerinde acil durum planlama, İş kazalarının %98'inin, meslek hastalıklarının %100'ünün önlenabilir olduğunun bilme, iş kazası bildirimini nereye ve nasıl yapılacağına ilişkin kurumsal düzeyde bilgi, ramak kala olaylar ile ilgili rapor hazırlanma, iş sağlığı ve güvenliği kurulu oluşturulma, iş sağlığı ve güvenliği açısından görev, hak ve sorumlulukları bilme, 6331 Sayılı Kanunu uygulanabilir bulma, 6331 Sayılı Kanun uyarınca yükümlülüklerini bilme, çalışılan

birimin meslek hastalıklarına yakalanma yönünden risk, meslek hastalıklarını bilme, meslek hastalıkları hakkında yeterli bilgi sahibi olma, koruyucu ekipman kullanma sıklığı, 6331 Sayılı Kanun'dan doğan hak talep etme ile yürütülen meslek arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0.05$ ). Sağlık çalışanlarında koruyucu ekipman kullanma sıklığı, çalışan kişi sayısı ile meslek arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0.05$ ). Araştırmamıza benzer şekilde Karaer ve Özmen (2016)'da çalışanların mesleklerine göre iş güvenliği durumları incelendiğinde diğer sağlık personelinin fiziksel ortamla ilgili ifadelerde iş güvenliğini daha düşük değerlendirdiği ve aralarında istatistiksel olarak anlamlı fark olduğu görülmüştür(14). Tüzüner ve Özarslan'ın (2011) çalışmasında da hemşirelerin iş güvenliği konusundaki durumları doktor ve hizmetlilere göre anlamlı bir ilişki vardır(17). Sağlık Çalışanlarının 6331 Sayılı Kanundan doğan hak talep etme, iş sağlığı ve güvenliği mevzuatı ile ilgili bilgi kaynakları, meslek hastalıkları hakkında bilgi sahibi olma, işe devamsızlık ile yaş arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0.05$ ). Çalışmamıza paralel sonuçlar Öztürk'ün (2012) çalışması yaş ile genel iş güvenliği alt boyutları arasında anlamlı ilişki göstermiştir(8). Karabulak'ın (2015) çalışmasında benzer olmayan sonuçlar elde edilmiştir (15). Sağlık çalışanlarında iş sağlığı ve güvenliği mevzuatı ile ilgili kullanılan bilgi kaynakları, İş kazalarının %98'inin, meslek hastalıklarının %100'ünün önlenabilir olduğunun bilme, meslek hastalıkları hakkında yeterli bilgi sahibi olma, koruyucu ekipman kullanma sıklığı, sağlık muayenelerinin düzenli yapılması, sağlık muayenelerinin düzenli yapılması, çalışılan birimin meslek hastalıklarına yakalanma yönünden riski, meslek hastalıklarını bilme, işe devamsızlık sorunu yaşama, birimdeki koruyucu ekipmanı yeterli bulma ile mesleki çalışma yılı arasında istatistiksel anlamda ilişki bulunmuştur( $p<0.05$ ). Sağlık çalışanlarında 6331 Sayılı Kanundan doğan hak talep etme, işyerinde risk değerlendirme ekibi oluşturulma ile mesleki çalışma yılı arasında istatistiksel anlamlı ilişki yoktur( $p>0.05$ ). Terzi ve ark.(2019) ve Çil (2016) araştırmalarında Fiziksel Ortama bağlı ifadeler haricinde diğer tüm ifadelerle mesleki çalışma yılı arasında anlamlı ilişki bulunmuştur(7,12). Çelikalp ve ark. (2016) araştırmalarında mesleki çalışma yılı iş güvenliği ile ilgili anlamlı ilişki olmadığı göstermiştir(13). Bu sonuçlar, çalışma deneyiminin iş güvenliği algısını/iş güvenliğinin düzeyini değişik şekillerde etkileyebileceği söylenebilir. Araştırmamıza benzer şekilde Karaer ve Özmen araştırması (2016) hemşirelerin medeni duruma göre iş güvenliği düzeylerinin anlamlı olarak ilişkisinin olduğu görülmüştür(14). Karaer ve Özmen (2016 ), Aldem ve ark.(2013) çalışmalarında iş güvenliği alt boyut düzeyleri açısından çalışmamızdaki sonuçlara benzer genel iş güvenliği anlamında benzer olmayan sonuçların elde edildiği bazı araştırmalar vardır (14,16). Çalışmamızda İş yerinde çalışan kişi sayısı ile medeni durum arasında istatistiksel anlamlı ilişki bulunmuştur( $p<0.05$ ). Sağlık çalışanlarında işe devamsızlık ile cinsiyet arasında istatistiksel anlamlı ilişki bulunmamıştır( $p>0.05$ ). Karaer ve Özmen çalışmasında (2016) cinsiyete göre sağlık çalışanlarının iş güvenliği arasında anlamlı fark bulunmuştur(14). Aldem ve ark.(2013), Tüzüner ve Özarslan (2011), Piyal ve ark.(2000) yılındaki çalışmalarda cinsiyetin iş güvenliği algısı üzerinde etkili olmadığını gösteren bulgular da yer almaktadır (16-18). Sağlık çalışanları çok boyutlu iş motivasyon ölçeğinde çalışanların yarısına yakını, şimdiki işimde çaba sarf ederim aksi halde, kendimi mahcup hissederim, bu iş, kişisel değerlerimle uyumlu olduğu için işimde çaba sarf ediyorum, işimde çaba sarf ederim aksi halde, kendimi kötü hissederim, işimde yeterince çaba sarf edersem başkaları (işveren, amir vb.) bana daha fazla iş güvenliği sağlarlar, işimde çaba sarf etmenin benim için özel bir anlamı var, işim anlamsız olmasına rağmen neden hala bu işi yaptığımı bilmiyorum, ilginç olduğu için işimde çaba sarf ediyorum, çaba sarf etmeye değer olmadığını düşündüğüm için işimde az çaba gösteriyorum demıştır. Katılımcıların az bir kısmı, zamanımı israf ettiğimi düşündüğüm için işimde çaba sarf etmiyorum, heyecan verici olduğu için, işimi yaparken eğlendiğim için, başkalarının (amir, meslektaş, aile vb.) onayını almak için, başkalarının(amir,meslektaş,aile vb.) bana daha fazla saygı duyması için, başkalarının (amir, meslektaş, aile vb.) bana yönelik eleştirilerinden kaçınmak için, bu işte çaba sarf etmenin kişisel olarak önemli olduğunu düşündüğüm için, kendimle gurur duymamı sağladığı için, kendimi kanıtlamak zorunda olduğum için işimde çaba sarf ediyorum. İşimde yeterince çaba sarf edersem

başkaları (işveren, amir vb.) beni ekonomik olarak ödüllendirirler, işimde yeterince çaba sarf etmezsem işimi kaybetme riskim olur demiştir. Karaer ve Özmen(2016) çalışanların iş doyumuna yönelik yapılan çalışmalarda, erkek çalışanların kadın çalışanlardan daha doyumlu olduklarını göstermiştir(14).

### ÖNERİLER

- İş sağlığı ve güvenliği ve motivasyon alanında eğitimlerin artırılması
- Tüm meslek gruplarında en üst düzeyde eğitim seviyesinin sağlanması
- Kurumlarda iş güvenliği ve motivasyon uygulamalarının artırılması ve denetlenmesi
- İş sağlığı ve güvenliği, motivasyon kanun ve tebligatlarının artırılıp ulaşılabirliğinin arttırılması
- Personellerin teşvik edilip kendi motivasyon ve iş sağlığı güvenliğinin arttırılması
- Çalışma ortam ve şartlarının iyileştirme yoluyla en az risk ve en üst motive edici özelliklerin kazandırılması
- Cinsiyet, meslek, yaş, birim, eğitim düzeyi vb. bazlı eğitimlerin planlanıp uygulanıp denetlenmesi
- Çalışanlarda sağlık , güvenlik ve motivasyonun koruyup geliştirmesinin bilinci arttırmalı ve önemi anlatılmalı
- İş sağlığı güvenliği ve motivasyon konusunda araştırmaların teşvik edilmesi

### KAYNAKLAR

1. Türkiye’de İş Sağlığı ve Güvenliği Algısı Araştırma Raporu (2017))
2. İş Sağlığı – Güvenliği ve Verimlilik İlişkisi Hesapro Projesi (Nisan 2013)
3. Çalışanların İç ve Dış Motivasyon Tekniklerine Bakış Açılarının Değerlendirilmesi; Yerel Yönetim Örneği (Ufuk Selen 2016)
4. İşgören Motivasyonu Sağlamada Kullanılan Araçlar: Uludağ Kış Otellerinde Bir Araştırma (Dr. Cemal İnce Aralık 2017))
5. Çalışanların İş Güvencesi ve Genel İş Davranışları İlişkisi: Bir Alan Çalışması (İsmail Bakan,Tuba Büyükbeşe )
6. Demircioğlu ve Centel, (2012). İş Hukuku, Tıpkı 16.Bası, Beta yayınevi, s.154.
7. Terzi B , Polat Ş , Azizoğlu F , Ateş N , Güngörmüş E , İşsever H . Hemşirelerde İş Güvenliğinin Bazı Değişkenler Yönünden İncelenmesi. Süleyman Demirel Üniversitesi Sağlık Bilimleri Dergisi. 2019; 10(3): 260-267.
8. Öztürk H, Babacan E, Anahar ÖE. Hastanede çalışan sağlık personelinin güvenliği. Gümüşhane Sağlık Bilimleri Dergisi 2012; 1(4): 252-268.
9. Akkaya G, Atay S. Hastanede çalışan hemşirelerin iş güvenliği. HSP 2018; 5(1): 59-64.
10. Saygun M (2012). Sağlık çalışanlarında iş sağlığı ve güvenliği sorunları. TSK Koruyucu Hekimlik Bülteni, 11(4), 373 - 382.
11. Abbasoğlu S, Emiroğlu C, İlhan NM, Koşar L, Kesedar S, Müezzinoğlu A. Sağlık Çalışanlarının Sağlığı Kime Emanet? Toplum ve Hekim. 2006; 21(3): 173-179.
12. Çil G. Hastanede çalışan hemşirelerin iş güvenliği düzeyinin saptanması. [Yüksek Lisans Tezi]. Lefkoşe, Yakın Doğu Üniversitesi Sağlık Bilimleri Enstitüsü, 2016.
13. Çelikkalp Ü, Varol Saraçoğlu G, Keloğlu G, Bilgiç Ş. Hemşirelerin çalışma ortamlarında iş güvenliği uygulamalarını değerlendirmesi. TAF Preventive Medicine Bulletin 2016; 15(5): 408-413.
14. Karaer G, Özmen D. Sağlık çalışanlarının iş güvenliği: devlet hastanesi örneği. Türkiye Klinikleri J Nurs Sci 2016; 8(4): 306-16.
15. Karabulak H. Birinci ve ikinci basamak sağlık kurumlarında çalışan hemşirelerin iş güvenliğinin ve çalışma ortamının sağlık davranışlarına etkisi. [Yüksek Lisans Tezi]. Erzurum, Atatürk Üniversitesi Sağlık Bilimleri Enstitüsü, 2015.
16. Aldem M, Arslan FT, Kurt AS. [Employee safety among health care professionals]. Tıp Araştırmaları Dergisi 2013;11(2):60-7.

17. Tüzüner VL, Özaslan BÖ. [A research based on the evaluation of occupational safety and health applications in hospitals]. Journal of the School of Business Administration, Istanbul University 2011;40(2):138-54.
18. Piyal B, Çelen Ü, Şahin N, Piyal B. [Job satisfaction of health care workers of Ankara University Faculty of Medicine Hospital]. Ankara Üniversitesi Tıp Fakültesi Mecmuası 2000; 53(4):241-50.

## LOCAL DETERMINATION OF BROKEN POINT COORDINATES OF BUILDING PLOTS IN SEPARATE ZONING ISLANDS WITH THE COLLINS METHOD

AYRIK NİZAMLI İMAR ADALARINDA BİNA PARSELLERİ KIRIK NOKTA  
KOORDİNATLARININ YERSEL ŞEKİLDE COLLİNS METODU İLE TAYİNİ

<sup>1</sup>Selim TAŞKAYA

\*<sup>1</sup>Artvin Vocational School Department of Architecture and Urban Planning, Artvin, Turkey.

\*Orcid No: <https://orcid.org/0000-0002-4290-3684>

### Abstract

Zoning can be defined as the optimization of a piece of land for people to live on. While determining the zoning areas, the area to be developed as a cluster is determined and the zoning boundaries are passed. The process of making the pieces of land prosperous within the boundaries of zoning becomes possible with the creation of zoning islands and roads. On the other hand, there are various types of zoning islands according to their intended use. While some of these islands are written on the zoning sheets as legends to meet the housing need, some of them are commercial, residential + commercial, central business areas, religious facility area, police station, local playgrounds, green areas, etc. way it occurs. When the details of residential areas are entered, the formation of buildings, which are living spaces, is created according to the building regulations. Basically, three types of separate, block and adjacent building regulations exist according to the Zoning Law in Turkey. The most preferred building order in the lands opened for new building permits is the split order. The building parcels that are formed after the zoning diameters are given in the discrete areas are formed in the middle. That is, building parcels are a subset of zoning parcels. As a result of these pulls, the number of convex edges of the parcel, one less than the building fracture points are formed. In addition to technological tools such as GPS, terrestrial point determination methods are available in determining the spatial location, that is, the coordinates of the fracture points. One of them is the collins method, which is one of the back estimation methods. The Collins method is the process of determining the coordinates of the unknown point of the building parcel, which is formed by the drawing distances of a zoning parcel whose coordinates at three fixed points are known, by using the circle passing through the point where the angle and distance lengths between at least two known fixed points and the unknown points are desired. In our study, it was tried to find the traditionally local coordinates of the broken points of the building parcels that may occur according to the floor height and floor area settlement coefficients with the collins method from the zoning parcels in the form of discrete layout.

**Keywords:** Seperated order, Building parcel, Collins Method

### Özet

İmar, bir arazi parçasının insanların üzerinde yaşayabileceği en iyi haline getirilmesi olarak tanımlanabilir. İmar sahaları belirlenirken öncelikle bir küme gibi imara alınacak saha belirlenerek imar sınırları geçirilir. İmar sınırları içerisinde arazi parçalarının bayındır hale getirilmesi işlemi imar adalarının, yolların oluşturulması ile mümkün hale gelir. İmar adalarının ise kendi içerisinde kullanım amacına göre çeşitleri mevcuttur. Bu adaların bir kısmı konut ihtiyacını gidermek üzere lejant olarak imar paftalarına işlenirken, bir kısmı ticari, konut + ticari, merkezi iş alanları, dini tesis alanı, karakol, mahalli oyun alanları, yeşil alanlar vb. şekilde oluşur. Konut alanları detayına girildiğinde ise yaşam alanları olan



binaların oluşumu yapı nizamlarına göre meydana getirilir. Temelde üç tip ayrık, blok ve bitişik yapı nizamları, Türkiye’deki İmar Kanununa göre mevcuttur. Yeni yapı iznine açılan arazilerde en çok tercih edilen yapı nizamı ayrık nizamdır. Ayrık nızamlı alanlarda özellikle imar çapları verildikten sonra oluşan bina parselleri ortada oluşur. Yani bina parselleri imar parsellerinin alt kümesidir. Bu çekmeler sonucunda parselin konveks şeklinde kaç kenar varsa bir eksiği kadar bina kırık noktaları oluşur. Oluşan kırık noktalarının mekânsal yerinin yani koordinatlarının belirlenmesinde gps gibi teknolojik araçlarının yanı sıra yersel nokta belirleme metotları mevcuttur. Bunlardan biriside geriden kestirme metotlarından olan collins metodudur. Collins metodu, sabit üç noktasındaki koordinatları bilinen bir imar parselinin çekme mesafeleri ile oluşan bina parselinin bilinmeyen noktasının koordinatlarının, bilinen en az iki sabit nokta ile bilinmeyen noktalar arası açı ve mesafe uzunluklarının bulunması istenilen noktadan geçen daireden yararlanılarak belirleme işlemidir. Çalışmamızda ayrık nizam şeklindeki imar parsellerden collins metodu ile kat yüksekliği ve taban alanı oturum katsayılarına göre oluşabilecek bina parsellerinin kırık noktalarının geleneksel şekilde yersel olarak koordinatlarının bulunmasına çalışıldı.

**Anahtar Kelimeler:** Ayrık nizam, Bina parseli, Collins Metodu

## 1. Introduction

One of the largest sectors of our country is activities in the field of construction. Although the construction sector has stagnated from time to time, it has never lost its importance in the construction of a new country since the first years of the republic. The construction works carried out by the Ministry of Public Works and Settlement continued under the name of the Ministry of Environment and Urbanization, which was later changed. In order for citizens or official institutions to build on a land, they have to get permission from the municipalities within the boundaries of the municipality's zoning and adjacent area, and from the special provincial administrations outside the boundaries of the municipality's zoning and adjacent areas (Zoning Law, 2021; Taşkaya, 2019). If it is a cadastral parcel, the relevant immovable, that is, if the application of the 18th article and the consolidation of the parcel, its abandonment to the road or its creation from the road have not been made, the construction permit cannot be granted in its current form (Zoning Law, 2021). If the parcel is in the shape of the land within the normal zoning limits, and if it is outside the zoning limits, it is allowed for construction if it is undetected or uncreated, with at least one road frontage (Zoning Law, 2021; Taşkaya, 2019).

Regardless of the type of construction, residential, commercial, industrial, residential+trade or vineyard areas outside the zoning boundaries, or whatever will be done outside the zoning contiguous borders, the first step of the process is the zoning diameter. Zoning diameter is the process of giving the drawing distances in accordance with the building regulation, in the national coordinate or local coordinate system, within the framework of the planned type or unplanned type areas regulation. After the zoning diameter is given to a plot, the project phase is started. It is the basic initial zoning diameter for construction in a place (Taskaya, 2019).

Zoning diameters are given in 3 main axes as separate, adjacent and in block order. Where the front, depth and corner coordinates and the raw data obtained from the existing land coincide on the plan, the drawing distances are given according to the construction order of that plan (Taşkaya, 2019).

## 2. Method

Building parcels formed by zoning diameter drawing distances can be found by traditional geodetic methods using unknown coordinates from known coordinates by taking the direction

from the corner coordinates of the zoning parcels. One of them is the collins shortcut method (Anonymous1, 2021).

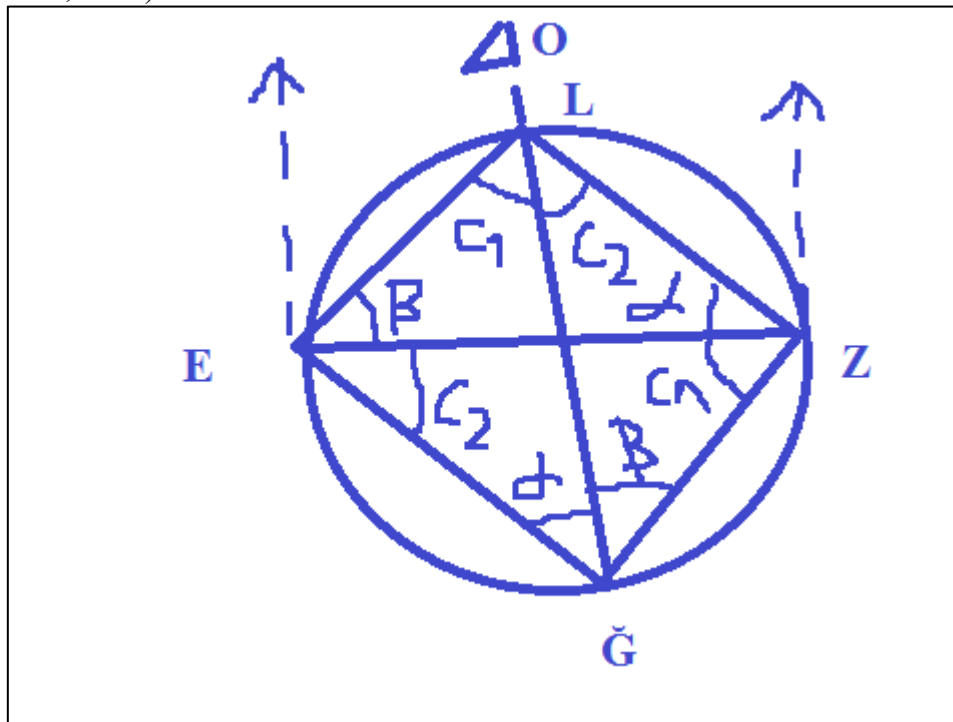


Figure 1. Collins Method Demonstration (Anonymous1, 2021).

In Figure 1, the coordinates of the desired point are found mathematically with the help of angle and length by passing circles from E, Z, Ĝ, whose coordinates are known to the L point, whose coordinates are desired to be found, from E and Z points (Anonymous1, 2021).

$$\sqrt{(y_2 - y_1)^2 - (x_2 - x_1)^2} \quad (\text{Anonymous2, 2021}).$$

From the above formula, the difference between Y coordinates and X coordinates is the length between two points (Anonymous2, 2021).

$$\frac{y^2 - y_1}{x^2 - x_1} = A \quad (\text{Anonymous1, 2021}).$$

If  $\arctan(A)$  is from the formula, angles are tried to be found (Anonymous1, 2021). Angles and lengths are found in this way by triangulating with the help of the theorem of sines. In the field of cartography, angle calculations are made with grad angle unit (Anonymous1, 2021).

$$XL = XE + \cos((EL) + \beta)EL \quad (\text{Anonymous1, 2021}).$$

$$YL = YE + \sin((EL) + \beta)EL \quad (\text{Anonymous1, 2021}).$$

Angle calculations are completed by adding angle units according to +/- 200 grad direction (Anonymous1, 2021).

### 3. Findings

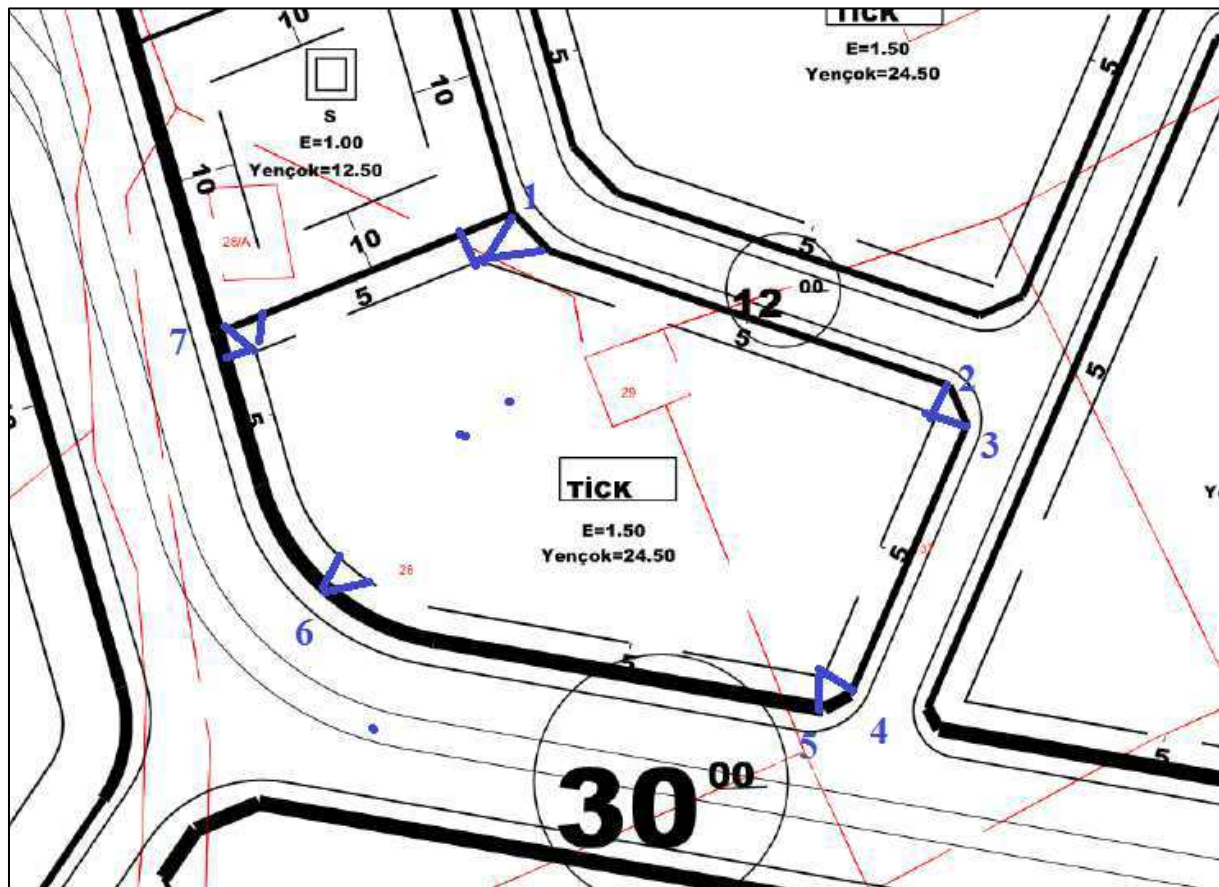


Figure 2. Zoning status image (Url-1,2019).

In Figure 2, on an island with a Commercial Housing zoning status, a building sitting area is created by drawing 5 meters on the parts facing the road, in an area with a maximum of 8 floors with a height of 1.50 and a height of 24.50. How many corner coordinates of the zoning plot can be traditionally found locally with the help of angles and lengths from known coordinates to the unknown.

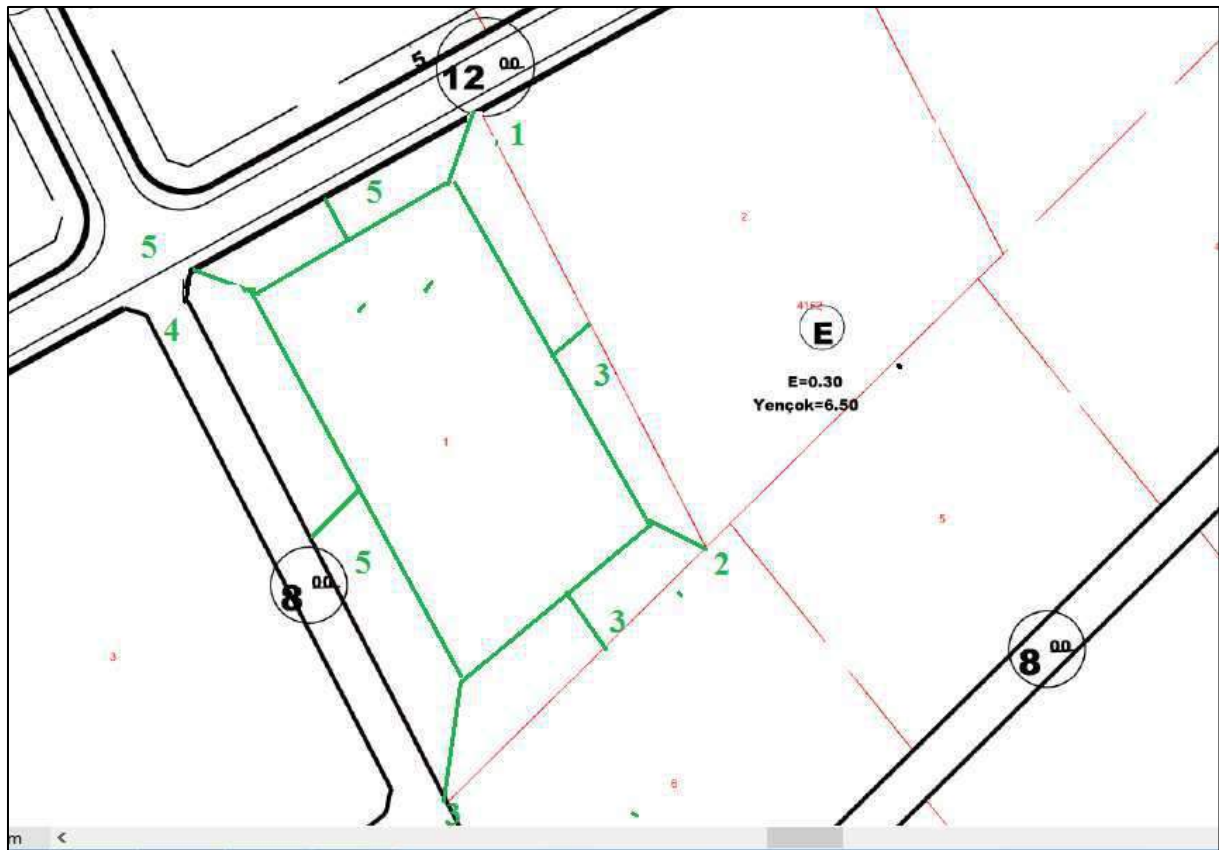


Figure 3. Zoning status view (Ur-1, 2019).

In Figure 3, since the corner coordinates of a total of 5 zoning parcels are known in the area with an equivalent of 0.30 and a maximum height of 2 floors, the corner coordinates of the building parcel can traditionally be found on the area with the help of this method, as a result of the pulling distances.

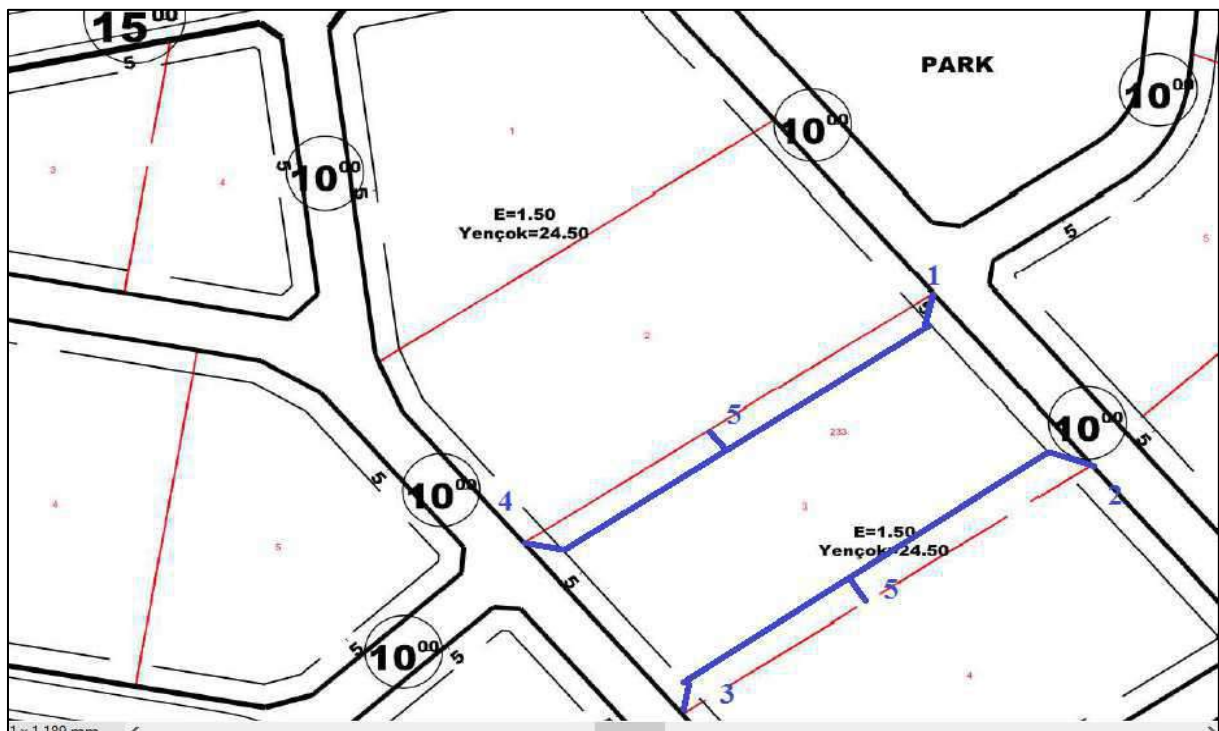


Figure 4. Zoning status view (Url-1, 2019).

In Figure 4., the appearance of a zoning parcel, which is shown as a separate layout, after the residence area is given as a building parcel, occurs in this way. Building coordinates can also be found locally from known coordinates with this method.

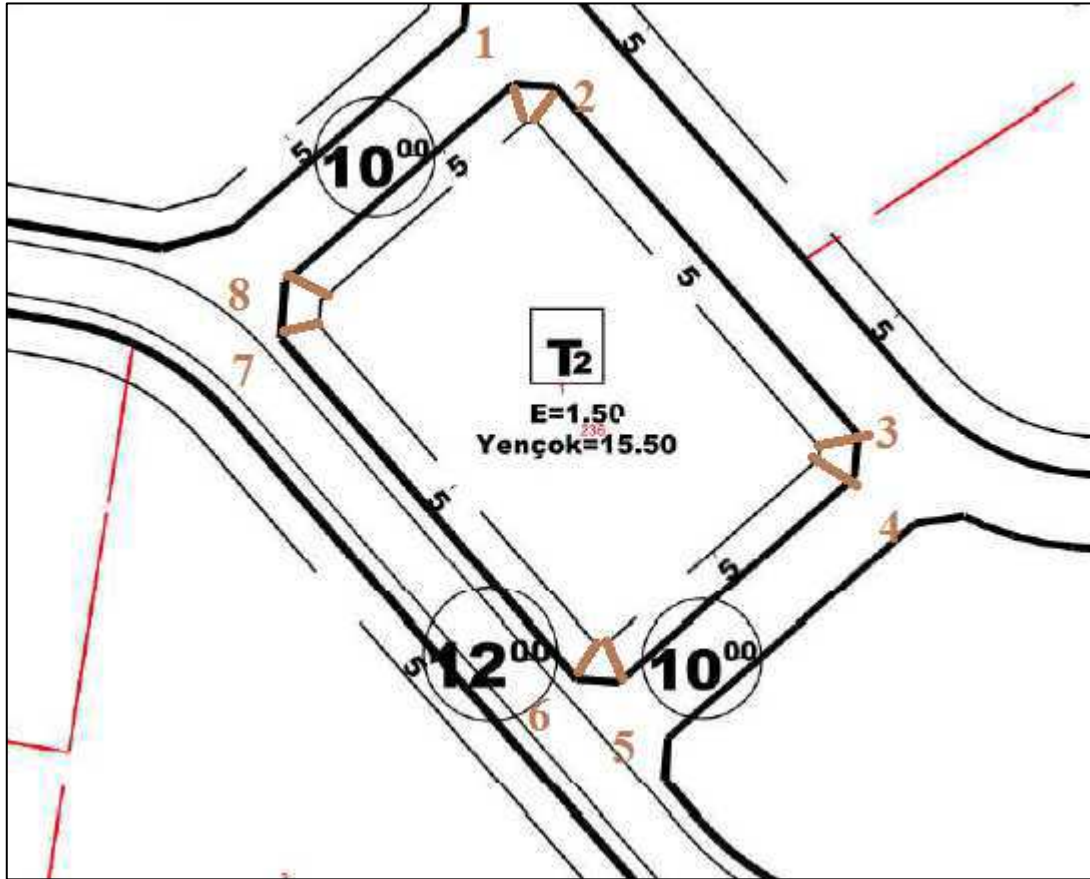


Figure 5. Zoning status view (Url-1, 2021).

In Figure 5., a zoning island-based parcel specified as T2 as a commercial and legend provides the opportunity to stock up to a maximum of 5 floors, so the zoning diameters are given by drawing 5 meters each. In this way, a separate parcel, that is, a parcel with a garden, was formed. Corner coordinates can be found locally by making the angle and distance from the known point to the unknown.



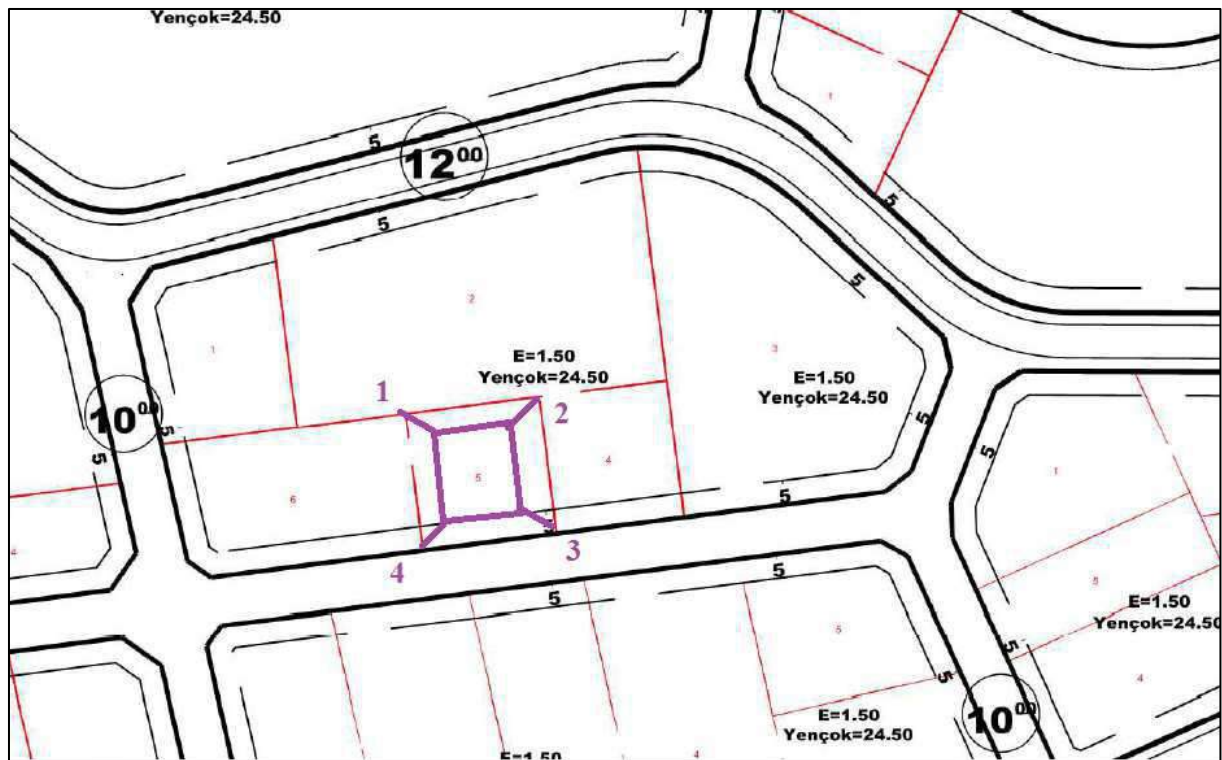


Figure 6. Zoning status image (Url-1, 2019).

In Figure 6, the appearance of a zoning parcel, which is shown as a separate layout, after the residential area is given as a building parcel, looks like this. Building coordinates can also be found locally from known coordinates with this method.

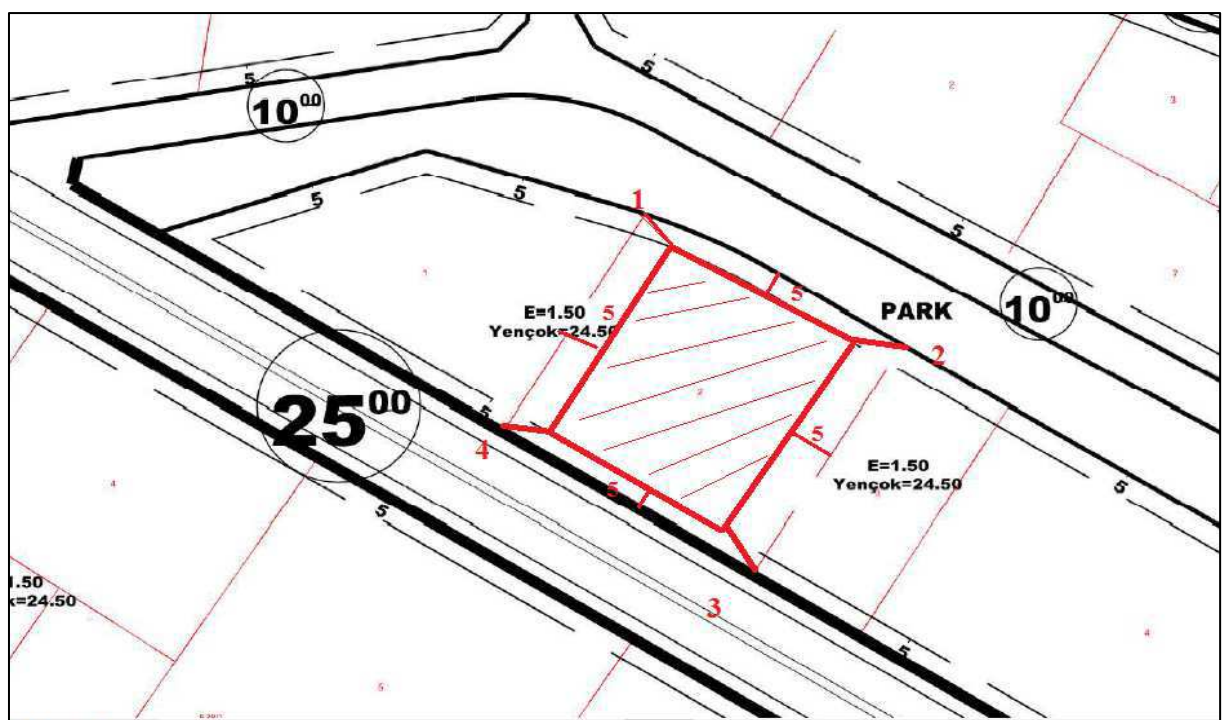


Figure 7. Zoning status view (Url-1, 2019).



In Figure 7., the zoning diameter of a zoning parcel, whose precedent is 1.50 and its height is maximum 24.50, is drawn 5 meters from each side to form a building parcel with a garden. Again, by making triangulation from the points whose coordinates are known, the desired building corner fracture points are found from the angles and distances.

As seen in the examples, the parcels on an island in the form of a separate arrangement in a zoning plan usually take the building settlement area in the middle after the zoning diameters are drawn. Thus, the coordinates of the broken points from the triangular sections formed between the zoning parcel and the building parcel can be determined locally.

#### 4. Conclusion

The main starting point of the constructions is the correct use of the parcel in the whole of the islands as a result of the correct urbanism understanding. This basic starting point is called zoning diameters. It is to apply the pulling distances correctly according to the building regulations, in line with the law, regulation, plan notes and case law decisions. Considering all the parcels in an island, zoning diameters should be given, especially considering the properties and architectural projects of the properties. Otherwise, unplanned urbanization and island-based construction problems will occur.

In line with a new urbanization, in order to increase the wide roads and the rate of green space per capita, separate and block orders should be applied to the plans and construction structure of new settlement areas. In city centers, it would be correct to apply two or three parcels together with the condition of meeting the zoning diameters, minimum frontage and depth conditions. In cases where this does not allow, if the construction is completed on the whole island, the zoning diameter should be given according to the building regulations. Especially in commercial areas, the pulling distance on the ground should not be broken by any city council determined plan notes, just as it is in residences. The precedents shown in the diameters during the project should be applied, especially by complying with the zoning diameters, and the residual areas (fire stairs, elevator shafts) should be included in these precedents.

Since the zoning parcels in convex geometry, which are shown in the figure with the zoning diameters and the drawing distances are given, turn into building parcels, and in cases where satellite receiver systems such as GPS and CORS are not connected, or in case of point location studies with terrestrial mapping tools, the corner points of the zoning parcels are clear, and they are measured during cadastral studies. Since the coordinate of the building was tried to be found, it was tried to show the coordinates and side lengths of the building parcels by adding coordinates from the geometrically known point by passing simple circles from the angle and distance calculation with the terrestrial estimation method like Collins.

resources

1. Anonymous1, (2021). Surveying Engineering and Technician Lecture Notes.
2. Anonymous2, (2021). Analytical Geometry Lecture Notes.
3. Zoning Law, (2021). Official Gazette, Vol:24. Pages:1-378.
4. Taşkaya, S., (2019). A Research on Reconstruction and Urban Planning Activities in Local Governments, Municipality Between 2014-2019, The Case of Elazığ Province. International Journal of Eastern Anatolia Science, Engineering and Design, 1(1), 14-28.
5. Taşkaya, S., (2019). A Research on Zoning Diameters, which are the Basic Points for Construction Permits. International Journal of Eastern Anatolia Science, Engineering and Design, 1(2), 142-153.
6. URL-1, (2019). Municipality of Elazığ, <https://www.elazig.bel.tr/meclis-gundem-kararlari-ebelediye-138>, (Access Date: 12 August 2019).

**LOCALITY IN FURNITURE FEATURES: EASTERN BLACK SEA REGION****MOBİLYA ÖZELLİKLERİ BAKIMINDAN YÖRESELLİK: DOĞU KARADENİZ BÖLGESİ****Şebnem ERTAŞ BEŞİR<sup>1\*</sup>, İrem BEKAR<sup>2</sup>**<sup>1</sup> *Akdeniz University, Faculty of Architecture, Department of Interior Architecture, Antalya, Turkey.*<sup>2</sup> *Karadeniz Technical University, Faculty of Architecture, Department of Interior Architecture, Trabzon, Turkey.***Abstract**

The concept of locality, which has found a wide place in the works produced in the field of sustainable architecture, has been a source used in providing solutions to the problems experienced despite changing and developing conditions. The local characteristics that form the cultural bridges between the generations constitute the harmonious pattern of the solutions developed in line with the centuries-old life experiences of humanity in the environment of the common mind, reflecting the local materials and techniques, local production traditions and local identity. Among the local features, which are considered in a wide framework, local furniture is the elements that need to be protected and sustainability must be ensured, together with the cultural, semantic and technical characteristics of the region. In the study, the concept of locality is discussed in terms of local furniture, which forms an important part of the local environment. Furniture that enabling certain actions to meet in the building differs from region to region, causing the formation of unique furniture characters in each region. Furniture mostly takes shape according to the life in the region, the place where they are used or the materials used independently of the place or the place. In the study, the Eastern Black Sea Region was considered due to its rich cultural diversity and the concept of locality in furniture was examined according to the fixed-moving nature of the furniture, its place in the organization of the space and its material. Thus, it is aimed to create an inventory for the sustainability of local identity by providing an intergenerational cultural flow of local furniture.

**Keywords:** Eastern Black Sea, Furniture, Locality, Local Furniture

**Özet**

Sürdürülebilir mimarlık alanında üretilen çalışmalarda kendine geniş bir yer bulan yöresellik kavramı, değişen ve gelişen koşullara karşı yaşanan problemlerde çözümün sağlanmasında başvurulan bir kaynak olmuştur. Nesiller arasındaki kültür bağlantılarının oluşmasını sağlayan yöresel özellikler, yöreye has malzeme ve yapım gelenekleriyle yöresel kimliğini yansıtan, insanoğlunun yüzyıllar boyunca oluşmuş ortak birikimleri doğrultusunda ortaya koydukları çözümlerin uyumlu birlikteliğinin bir sonucudur. Geniş bir çerçevede ele alınan yöresel özellikler içerisinde yöresel mobilyalar da bölgeye dair taşıdığı kültürel, anlamsal ve teknik özellikleri ile birlikte korunması ve sürdürülebilirliğinin sağlanması gereken unsurlardır. Çalışmada yöresellik kavramı yöresel çevrenin önemli bir parçasını oluşturan yöresel mobilyalar ele alınmıştır. Yapı içinde belirli eylemleri karşılayabilmesine olanak sağlayan mobilyalar yöreden yöreye farklılık göstererek her bölgede özgün mobilya karakterlerinin oluşmasına neden olmaktadır. Mobilyalar çoğunlukla mekanı oluşturan ya da mekandan bağımsız bir biçimde yöredeki yaşantıya, kullanıldıkları mekana veya kullanılan malzemeye göre şekil alır. Çalışmada zengin kültürel çeşitliliğe sahip olması nedeniyle Doğu Karadeniz Bölgesi ele alınmış ve mobilyalarda yöresellik kavramı mobilyanın sabit ya da hareketli oluşu,

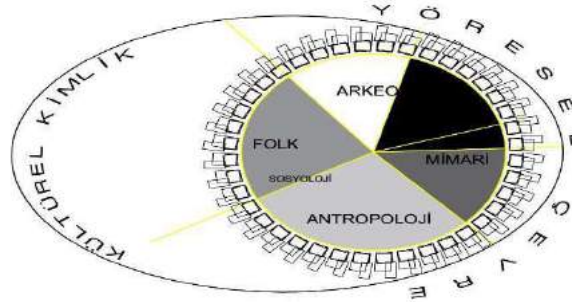
mekan örgütlenmesindeki yeri ve malzemesine göre incelenmiştir. Böylece yöresel mobilyaların kuşaklar arası bir kültür akışı sağlanarak yöresel kimliğin sürdürülebilirliği adına bir envanter oluşturmak hedeflenmektedir.

**Anahtar kelimeler:** Doğu Karadeniz, Mobilya, Yöresellik, Yöresel Mobilya

## GİRİŞ

Yöresel kelimesi İngilizcedeki “vernacular” kelimesinden türemiştir. Bir yöreye özgü anlamına gelen “yöresel” kelimesi; mimaride belirleyici ve niteleyici durumu ifade etmektedir (Kuban, 1995). Aynı zamanda bir yöreye ait olma, içinde bulunduğu yörenin özelliklerini yansıtmaya, kültürünü özümseme ve toplum ile bütünleşmiş değerleri ifade eden yöresellik kavramı çalışma-tasarım, yapım-kullanım gibi mimari bölümleri özgün bir bütün olarak bir araya getirir (Kısa Ovalı ve Delibaş, 2016; Glassie, 1990).

Yöresel çevreler içerisinde bulunan kültüre ait somut veya somut olmayan değerlerin bütünü ifade etmektedir. Yöresel çevreler; mimarlık, folklor, sosyoloji, arkeoloji, antropoloji, kültürel coğrafya ve çevre ve davranış bilimleri gibi çeşitli disiplinlerin konusu olmuştur (Şekil 1).



**Şekil 1.** Yöresel çevre

Günümüzde yerel kimliğin kaybolması yöresel çevrelerle ilgili yaklaşımları gündeme getirmektedir. Rapoport (1980), yöresel çevrelere yönelik olarak, dört farklı tavra işaret etmektedir.

- Yöresel çevrelerin tamamen göz ardı edilmesidir.
- Yöresel çevrelerin varlığı kabul edilir ancak önemsenmeyerek dikkate alınmaz.
- Yöresel çevreleri sadece görsel açıdan ele alan ve değerlendiren bir diğer tavırda, bu tür çevrelerin biçimsel özellikleri romantikleştirilmekte ve abartılmakta, buna karşı içeriği ve ardında yatan nedenler, prensipler araştırılmadan yüzeysel bir yaklaşımla biçimler kopya veya taklit edilmektedir.
- Yöresel çevreler, çevre-davranış bilimleri ile ilgili kuramlardan, modellerden, kavramlardan yararlanılarak analiz edilebilir ve önemli ipuçları, prensipler ve dersler alınarak bu çıkarımlar tasarıma uygulanabilir.

Sürdürülebilir mimarlık alanında üretilen çalışmalarda kendine geniş bir yer bulan yöresel mimarlık, yaşadığımız kentsel problemlere her türlü çözümün sağlanmasında başvurulacak bir kaynaktır. Kuşaklar arasındaki kültür köprülerini oluşturan yöresel mimari; yöreye özgü malzeme ve tekniklerle, yöresel yapım geleneklerini ve yerel kimliği yansıtan, insanlığın ortak akıl çevresinde yüzyıllık yaşam deneyimleri doğrultusunda geliştirdikleri mimari/mekânsal çözümlerin uyumlu örüntüsünü oluşturmaktadır (ICOMOS, 2013; Kısa Ovalı ve Delibaş, 2016). Yöresel mimari, bir tasarım yöntemine bağlı eğitilmiş profesyonel mimarlar tarafından değil, gündelik yaşamın içinden gelen yapı ustaları tarafından inşa edilen yapılar olarak tanımlanmaktadır (Kısa Ovalı ve Delibaş, 2016). Yöresel mimarlık kavramının literatürde; geleneksel mimarlık, yerli mimari, kırsal mimarlık, spontane mimarlık, halk mimarlığı, mimarsız mimarlık, yöre mimarisi, anonim mimarlık, vernaküler mimari gibi farklı isimlerle kullanıldığı görülmektedir (Rudofsky, 1965; Bektaş, 2001; Ovalı ve Delibaş, 2016). İç

mimarlıkta yöresellik plan özellikleri açısından, yapım tekniği ve malzeme özellikleri açısından, donatı özellikleri açısından ve süsleme özellikleri açısından olabilmektedir. Çalışmada yöresellik kavramı kırsal kesimlerinde bulunan yöresel çevrenin önemli bir parçasını oluşturan yöresel mobilyalar ele alınmıştır. Oturma, yemek yeme, çalışma, yatma, uyuma gibi eylemleri karşılayabilmesine olanak sağlayan mobilyalar yöreden yöreye farklılık göstermektedirler. Donatılar çoğunlukla mekanı oluşturan yada mekandan bağımsız bir biçimde yöredeki yaşantıya, ihtiyaçlara göre ya da kullanılan malzeme ve işçiliklere göre şekil alır. Çalışmada yöreden yöreye farklı biçimlenmelerde karşımıza çıkan mobilyalar sabit-hareketli oluşuna göre, mekan örgütlenmesine göre ve malzemesine göre incelemektedir. Bu kapsamda Doğu Karadeniz bölgesindeki yöresel mobilyalar ele alınmıştır. Böylece yöresel mobilyaların kuşaklar arası bir kültür akışı sağlanarak yöresel kimliğin sürdürülebilirliği adına bir envanter oluşturmak hedeflenmektedir.

### **Doğu Karadeniz Geleneksel Konutlarında İç Mekan**

Geçmişin izlerini taşıyan konutlar; yörede yaşayan insanların ve onları üreten ustaların yaşamlarını, sosyal ilişkilerini, kültürünü ve yaşam öncelikleri gibi birçok özelliği yansıtmaktadır. Konutların temel mekânı, içerisinde yeme-içme, oturma, yemek pişirme, dinlenme gibi günlük işlerin yapıldığı, aşhane adlı mekândır. (Fidan vd., 2016). Karadenizin doğu kesim geleneksel konutlarında, genelde iki giriş kapısı bulunmakta ve konuta öncelikle aşhane ve hayat mekanları yer almakta ve evlerin girişleri doğrudan bu mekâna açılmaktadır. Bu alan mutfak bölümü ve oturma eylemlerinin geçtiği yerdir (Özdemir, 1989). Hayat, genellikle evin manzaraya açılan yönünde konumlandırılan, aşhaneden sonraki ikincil ortak mekândır (Fidan vd., 2016)

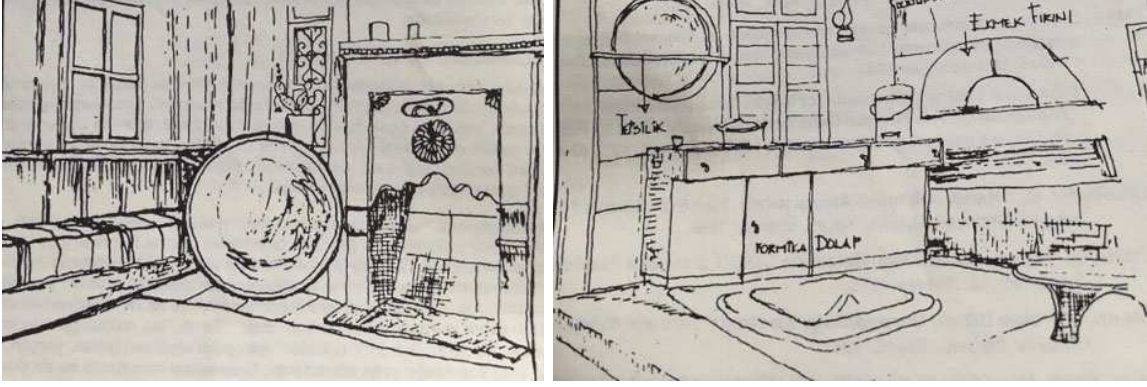
Doğu Karadeniz Bölgesi'nde konutların iç mekan düzenleri genellikle hayat ve etrafını çevrelemiş odalardan oluşmaktadır. Odalar genellikle gerektiğinde oturma veya yatma eylemini karşılayabilmek için dönüştürülebilir olarak organize edilmektedir. Bölgedeki iç mekan biçimlenişi temelde benzer özellikler gösterirken ailedeki kişi sayısı veya aile yapısındaki diğer farklılıklar sebebiyle oda sayıları değişiklik gösterebilmektedir.

Yaşam kültürünün konutlara ve mekanın biçimlenmesine yansımaları olarak kabul edilen bir diğer unsur ise kullanılan donatı ve mobilyalardır. Örneğin aşhanede bulunan ocak, konutun odak noktasıdır. Isınma, uyuma, yemek pişirme ve yeme eylemleri ocağın başında gerçekleştiğinden önemli bir donatı ve aynı zamanda kültürel gösterge olarak görülmektedir. Ayrıca ocak başı aile bireylerinin toplanma yeri olup burada sohbetler edilmektedir. Bu ve bunun gibi birçok donatı kullanıldığı bölgenin kültürel göstergelerindendir. Donatıların yöresel isimleri, malzemesi, yapım tekniği, kullanım şekli, kullanım amacı ve kullanım alanı aslında o bölgenin özgün yöresel özelliklerini yansıtmaları yönüyle korunması ve gelecek nesillere aktarılması gereken kültüre değerlerdir.

### **Doğu Karadeniz Bölgesinde Yöresel Mobilyalar**

Coğrafya, gelenekler ve dinî davranışların belirlediği yaşam tarzı ve üretim şekli gibi toplumun sosyo-kültürel yapısı, yöresel farklılıkların belirleyicisi olmaktadır. Doğu Karadeniz Bölgesi de Türkiye'de yer alan diğer altı bölgeden kültürel kimlik özellikleri ile ayrılmakta; çoğunlukla kırsal yerleşimlerde yer alan özgün mimari doku kadar başka önemli bir ifade aracı olarak yöresel mobilyalar da dikkat çekmektedir (Şekil 2).





Şekil 2. Doğu Karadeniz Bölgesi'nde kullanılan yöresel mobilyalar (Özdemir, 1989)

Konutlarda kullanılan mobilyalar ve araç gereçlerde günlük yaşantının bir parçası olmakla beraber tasarım, kullanım amacı ve malzeme açısından da özgün değer taşımaktadır. Doğu Karadeniz geleneksel konutlarında mobilyalar sabit ve hareketli olmak üzere karşımıza çıkmaktadır. Birden çok kullanımın gerçekleştiği mekânda kullanılan araç ve gereçler genellikle taşınabilir olarak tasarlanmışlardır (Eruzun ve Sözen, 1996). Geleneksel konutların genelinde dolap ve ocak dışında sabit donatı ögesine rastlanmamaktadır. Bu özellik aynı zamanda çoğu geleneksel Türk evi için de geçerlidir. Donatılar hareketli, yani gerektiği zaman kurulup, sonra da kaldırılabilen türden olduğundan bir mekan içinde her türlü eylemin gerçekleşmesine imkan vermektedir (Özdemir, 1989).

Doğu Karadeniz geleneksel konutlarında yöresel mobilyalar yapılan eylemlere sınıflandırıldığında genel olarak oturma, yemek pişirme-yeme, yatma ve depolama eylemleri olarak incelenmektedir. Oturma eylemi; 'seki' üzerine konulan 'minder' ya da 'seder'lerde yapılmaktadır. Seder yüksekliği ve genişliği geleneksel oturma biçimine yani 'bağdaş kurmaya' elverişlidir. Ayrıca geleneksel bir alışkanlık olarak ev halkı yerde minderler üzerinde oturmayı da tercih etmektedir (Özdemir, 1989). Yatma eylemi; birçok kırsal kesim konutlarında olduğu gibi yere serilen 'yer yatakları'nda gerçekleşmektedir. Bununla birlikte 'karyola' ve 'divanlar' da kullanılmaktadır. Bebekler için ise beşikler kullanılmaktadır. Beşik ögesi eğmeçli ayakları olan ve sallanabilen donatılardır (Özdemir, 1989). Yemek yeme eylemi; ahşaptan yapılan 'yer sofrası' ve 'bakır sini'lerde yapılmakta ve aynı kaptan yenilmektedir. Yemekten sonra sofrası ve sini kaldırılmaktadır (Özdemir, 1989). Yemek pişirme eylemi; 'bakır tencere', 'bakır kazan' ve 'saç ayağı' ile birlikte ocakta gerçekleşmektedir (Özdemir, 1989). Ocak, yemek pişirme işlevinin yanı sıra kış aylarında ısınma ve yanan ateşin korlarından mangal yakma gibi birçok eylemin gerçekleştirildiği önemli bir yapı elemanıdır (Eruzun ve Sözen, 1996). Depolama/Saklama eylemi; kiler, yüklük ve tereklerde yapılmaktadır. Hemen her evde bulunan kiler yiyeceklerin depolandığı yerdir. İçinde 'ekmek dolabı' ile birlikte 'yayık', yağ ve yoğurt kapları da bulunmaktadır. Ahşaptan yapılan ekmek dolabı büyük kapaklı göz ve çekmecelerden oluşmaktadır (Özdemir, 1989). 'Yüklük' ise yatak ve yorganların saklandığı yerdir. Büyük kapsamlı konutların hemen hepsinde bulunmaktadır. 'Terek' ise mutfak araç gereçlerinin saklandığı kaşıklik, kepeçlik gibi detayları bulunan sabit donatılar olup, kapalı dolap ve açık raf sisteminden oluşabilmektedir (Özdemir, 1989).

Doğu Karadeniz Bölgesi, iklimi gereği bol orman ve ağaçlık alanlara sahiptir. Bu durum yerel halkın ahşap malzemeye kolaylıklar erişebilmesini sağlamaktadır. Ağaç türleri arasında kestane, kızılğaç, gürgen, çam ağacı, fındık gibi oldukça çeşitlidir. Neme dayanıklı ağaç türleri genellikle dış mekânda kullanılırken diğer türler iç mekânda tercih edilmektedir. Birçok ev eşyası ve araç gereçler bu malzemeler de yöredeki çeşitli ağaçlardan yapılmış ahşap malzemeler kullanılarak üretilmektedir. Bunların bir kısmı zanaat ürünleriyken birçoğunun da sanat değeri taşıdığı görülmektedir. Ahşap kullanımı kadar taş ve demirin kullanılarak yapıldığı donatı ve

alet örneklerine de sıklıkla rastlanmaktadır. Sepet, baston, bakır eşyalar, bıçak, taş değirmen, sandık ve beşik gibi eşyalar bunlardan bazılarıdır (Şekil 3).



Şekil 3. Bakır araç gereçler, Sepet, Bıçak


Geçmişte kullanılan bu donatılardan bazıları süreç içerisinde korunamayıp yok olurken bazıları günümüzde de varlığını sürdürmeye devam etmektedir. Doğu Karadeniz kırsal kesimlerinde de yerel donatılara hala rastlanmaktadır. Bu donatıların bir kısmı işlevselliğini kaybetmiş fakat anı değeri sebebiyle saklanmakta bir kısmı ise hala kullanılmaya devam etmektedir.

### Doğu Karadeniz Mobilyalarının Yöresel Özelliklerinin İncelenmesi

Çalışma kapsamında literatürdeki kaynaklar ve yapılan araştırmalar doğrultusunda Doğu Karadeniz’de kullanılan veya geçmişte kullanılmış olan mobilyalar tespit edilerek bazı yöresel özellikler açısından incelenmiştir. Yöresel özellikler mobilyanın sabit-hareketli oluşu, mekan örgütlenmesindeki yeri ve malzeme kullanımı açısından ele alınmıştır.


Ocak, konutta yemek pişirme eyleminin gerçekleştiği ve ısınmak için de kullanılan sabit bir yapı elemanıdır. Genellikle taş malzemeden üretilir (Tablo 1).

Tablo 1. Ocak

	“Ocak”
	<input type="radio"/> Hareketli <input checked="" type="radio"/> Sabit
	<input checked="" type="radio"/> Mutfak <input type="radio"/> Yatak Odası <input type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input type="radio"/> Ahşap <input checked="" type="radio"/> Taş <input type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma


El değirmeni, mısırları öğütmek hazırlamak amacıyla konutlarda iç mekan veya dış mekanda kullanılan taşınabilir bir elemandır. Taş malzemeden üretilen el değirmeninin tutma kısmı ahşaptan üretilmektedir (Tablo 2). Yaygın kullanımı ile el değirmeni olarak bilinen donatı şoromul, şeromili, (Trabzon), Şorombil (Rize), eldaşı (Gümüşhane), gibi isimlerle de anılmaktadır (Öztürk, 2017).

Tablo 2. El değirmeni

	“El değirmeni”
	<input checked="" type="radio"/> Hareketli <input type="radio"/> Sabit
	<input checked="" type="radio"/> Mutfak <input type="radio"/> Yatak Odası <input type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input type="radio"/> Ahşap <input checked="" type="radio"/> Taş <input type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma

Yayık, süt yağını tereyağına dönüştürmek için kullanılan geleneksel bir araçtır (Tablo 3). Günümüzde Doğu Karadeniz’de bazı kırsal kesimlerde kullanımı hala devam etmektedir.


Tablo 3. Yayık

	“Yayık”
	<input checked="" type="radio"/> Hareketli <input type="radio"/> Sabit
	<input checked="" type="radio"/> Mutfak <input type="radio"/> Yatak Odası <input type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input checked="" type="radio"/> Ahşap <input type="radio"/> Taş <input type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma




Yüklük, yatak, yorganların vb. ev eşyalarının depolandığı yerdir. Doğu Karadeniz geleneksel konutlarının birçoğunda bulunmaktadır. Sabit bir eleman olan yüklük ahşap malzemeden üretilmektedir (Tablo 4).

Tablo 4. Yüklük

	“Yüklük”
	<input type="radio"/> Hareketli <input checked="" type="radio"/> Sabit
	<input type="radio"/> Mutfak <input checked="" type="radio"/> Yatak Odası <input checked="" type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input checked="" type="radio"/> Ahşap <input type="radio"/> Taş <input type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma

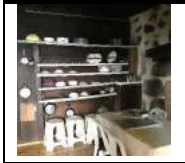
Kuzine, hem ısınmaya hem üzerinde yemek pişirmeye yarayan büyük yatay sobadır (Tablo 5). Hareketli bir donatı olan kuzine konut içerisinde veya konut dışarısında ‘merek’ olarak da bilinen ek yapı içerisinde kullanılmaktadır.

Tablo 5. Kuzine

	“Kuzine”
	<input checked="" type="radio"/> Hareketli <input type="radio"/> Sabit
	<input checked="" type="radio"/> Mutfak <input type="radio"/> Yatak Odası <input checked="" type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input type="radio"/> Ahşap <input type="radio"/> Taş <input checked="" type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma


Terek, mutfak araç gereçlerinin saklandığı sabit donatılar olup, kapalı dolap veya açık raf sisteminden oluşabilmektedir (Tablo 6).

Tablo 6. Terek

	“Terek”
	<input type="radio"/> Hareketli <input checked="" type="radio"/> Sabit
	<input checked="" type="radio"/> Mutfak <input type="radio"/> Yatak Odası <input type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input checked="" type="radio"/> Ahşap <input type="radio"/> Taş <input type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma


Sini, üzerinde yemek yenen genellikle bakır veya pirin malzemeden üretilen, yuvarlak bir forma sahip geniş tepsidir (Tablo 7). İhtiyaç duyulduğunda kurulup işi bitince kaldırılmaktadır. Altına sofra bezi serilerek kullanılabileceği gibi sini altı ile yükseltilerek de kullanılabilmektedir.

Tablo 7. Sini

	“Sini”
	<input checked="" type="radio"/> Hareketli <input type="radio"/> Sabit
	<input checked="" type="radio"/> Mutfak <input type="radio"/> Yatak Odası <input checked="" type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input type="radio"/> Ahşap <input type="radio"/> Taş <input checked="" type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma


Sini altı, siniyi yerden yükseltmek amacıyla kullanılan katlanabilir bir donatıdır (Tablo 8). Genellikle ahşap malzemeden üretilmektedir. İhtiyaç duyulduğunda kurulup işi bitince kaldırılmaktadır.

Tablo 8. Sini altı

	“Sini altı”
	<input checked="" type="radio"/> Hareketli <input type="radio"/> Sabit
	<input checked="" type="radio"/> Mutfak <input type="radio"/> Yatak Odası <input checked="" type="radio"/> Oturma Odası <input type="radio"/> Sofa/Hol <input type="radio"/> Banyo <input type="radio"/> Veranda/Avlu <input type="radio"/> Giriş
	<input checked="" type="radio"/> Ahşap <input type="radio"/> Taş <input type="radio"/> Metal <input type="radio"/> Yün Malz. <input type="radio"/> Deri <input type="radio"/> Cam <input type="radio"/> Bitkisel Lif <input type="radio"/> Toprak <input type="radio"/> Alçı <input type="radio"/> Karma


Divan, üzerinde yatma veya oturma eylemlerinin gerçekleştiği arkalıksız, üzerine minder veya yastık konularak kullanılan bir mobilyadır (Tablo 9). Yatak odalarında, oturma alanlarında veya ortak kullanılan mekanlarda kullanılabilmektedir.

Tablo 9. Divan

	“Divan”
	● Hareketli ○ Sabit
	○ Mutfak ● Yatak Odası ● Oturma Odası ○ Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	● Ahşap ○ Taş ● Metal ● Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma


Sedir, genellikle arkılığı olmayan üzerine minder veya yastık konularak kullanılan oturma veya yatma eylemlerini karşılayan bir mobilyadır (Tablo 10). Sabit veya hareketli örneklerine rastlanabilmektedir.

Tablo 10. Sedir

	“Sedir”
	● Hareketli ● Sabit
	○ Mutfak ● Yatak Odası ● Oturma Odası ● Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	● Ahşap ○ Taş ○ Metal ● Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma


Beşik, bebekler için kullanılan beşikler eğmeçli ayakları olan ve sallanabilen mobilyalardır (Tablo 11). Üzerinde yöresel süslemelere rastlanabilen beşikler ahşaptan üretilmektedir.

Tablo 11. Beşik

	“Beşik”
	● Hareketli ○ Sabit
	○ Mutfak ● Yatak Odası ● Oturma Odası ○ Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	● Ahşap ○ Taş ○ Metal ● Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma


Külek, içinde yağ, yoğurt, süt, peynir vb. ürünleri saklamak için kullanılan yaklaşık beş litre hacme sahip ahşap kaplardır (Tablo 12). Doğu Karadeniz’de farklı yörelerde kilek, gülek, kütek gibi isimlerle de bilinmektedir.

Tablo 12. Külek

	“Külek”
	● Hareketli ○ Sabit
	● Mutfak ○ Yatak Odası ○ Oturma Odası ○ Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	● Ahşap ○ Taş ○ Metal ○ Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma

Sacayak, üç ayağı bulunan üzerinde tencere gibi metal malzemeli mutfak eşyalarının belirli bir yükseklikte durabilmesini ve yemek pişirme eyleminin gerçekleşmesini sağlayan bir tür ocak başı donatısıdır (Tablo 13). Genellikle mutfakta veya yemek pişen yerlerde saklanmaktadır.


Tablo 13. Sacayak

	“Sacayak”
	● Hareketli ○ Sabit
	● Mutfak ○ Yatak Odası ○ Oturma Odası ○ Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	○ Ahşap ○ Taş ● Metal ○ Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma

Gügüm, genellikle bakır malzemeden üretilen, gövde bölümü şişkin, kulplu ve ağız kapaklı olan su kabıdır (Tablo 14). Ocakta veya kuzinede su ısıtmak amacıyla kullanılmaktadır. Doğu Karadeniz’de farklı bölgelerde kukma ismiyle de bilinmektedir.


Tablo 14. Gügüm

	“Gügüm”
	● Hareketli ○ Sabit

	● Mutfak ○ Yatak Odası ○ Oturma Odası ○ Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	○ Ahşap ○ Taş ● Metal ○ Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma


Sağrak, kapaklı ahşap yağ saklama kabı (Ordu, Giresun, Sanmsun, Trabzon) olarak bilinmektedir (Tablo 15). Rize ve Artvin illerinde sağrak ekmek yoğurulan bakır tekneye verilen isimdir (Öztürk, 2017).

**Tablo 15. Sağrak**

	"Sağrak"
	● Hareketli ○ Sabit
	● Mutfak ○ Yatak Odası ○ Oturma Odası ○ Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	● Ahşap ○ Taş ○ Metal ○ Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma

Sandık, eşyaları saklama veya kolay taşınabilmesini sağlamak amaçlı kullanılan bulunan sandıklar bulunduğu bölgenin kültürel özelliklerine bağlı olarak farklılaşmakta ve üzerinde yöresel süslemelere rastlanabilmektedir (Tablo 16).

**Tablo 16. Sandık**

	"Sandık"
	● Hareketli ○ Sabit
	○ Mutfak ● Yatak Odası ● Oturma Odası ○ Sofa/Hol ○ Banyo ○ Veranda/Avlu ○ Giriş
	● Ahşap ○ Taş ○ Metal ○ Yün Malz. ○ Deri ○ Cam ○ Bitkisel Lif ○ Toprak ○ Alçı ○ Karma

Doğu Karadeniz’de incelenen yöresel mobilyalarda bölgeye özgü yaşam biçimi, kültürel özellikleri, geçim kaynağı, iklimsel faktörler gibi çeşitli unsurların etkisiyle şekillenmiştir. Bu unsurların her biri mobilyanın sabit-hareketli oluşu, mekan örgütlenmesindeki yeri ve malzemesini de etkilemektedir.

## SONUÇ

Geleneksel mobilyalar bulunduğu bölgenin kültürel özellikleri, iklim, bitki örtüsü gibi çeşitli etkilerle birlikte şekillenmektedir. Doğu Karadeniz iklimi gereği bol orman ve ağaçlık alanlara sahiptir. Coğrafyasının sunduğu geniş orman alanları, yerel halkın ahşap malzemeye kolay ulaşmasına dolayısıyla yörede ahşabın kullanımının ve yapım tekniklerinin gelişmesine neden olmuştur.

Çalışmada ele alınan mobilyalar arasında ocak ve yüklük dışında bulunan mobilyalar dışında diğer mobilyalar hareketli mobilyalardır. Bu nedenle Doğu Karadeniz geleneksel mobilyaların birçoğu gerektiği zaman kurulup, sonra da kaldırılabilen türden olduğundan bir mekan içinde her türlü eylemin gerçekleşmesine imkan vermektedir. Mobilyalarda kullanılan malzemeler incelendiğinde taş, ahşap ve metal malzemelerden yapıldığı görülmektedir.

Geçmişte kullanılan bu donatılardan bazıları süreç içerisinde korunamamış ve yok olmaktadır. Eskiye dair izler barındıran ve bölgenin geçmişini anlamamızda bir köprü görevi gören bu elemanların korunarak geleceğe taşınması önemli bir konudur. Böylece yöresel mobilyaların kuşaklar arası bir kültür akışı sağlanarak yöresel kimliğin sürdürülebilirliği adına bir envanter oluşturulmaktadır.

## KAYNAKLAR

- Bektaş C, 2001. Halk Yapı Sanatı, İstanbul, Literatür Yayınları.  
 Eruzun C. ve Sözen M 1996. Anadolu’da Ev ve İnsan, İstanbul: Creative Yayıncılık  
 Glassie H. 1990. Architects, Vernacular Traditions, And Society, Traditional Dwellings and Settlements Review (TDSR), No 2, p. 9-21.

- ICOMOS, 2013. ICOMOS Türkiye Mimari Mirası Koruma Bildirgesi 2013, [http://www.icomos.org.tr/Dosyalar/ICOMOSTR\\_0623153001387886624.pdf](http://www.icomos.org.tr/Dosyalar/ICOMOSTR_0623153001387886624.pdf) [Erişim tarihi 11 Aralık 2015]
- Kuban D. 1995. The Turkish Hayat House, İstanbul, Eren Yayıncılık.
- Fidan MS, Yaşar ŞŞ, Yaşar M, Alkan E 2016. Türk Doğu Karadeniz Evlerinin Geleneksel Mimarisi ve Tasarım Özellikleri. Mugla Journal of Science and Technology
- Ovalı KP ve Delibaş N 2016. Yerel Mimarinin Sürdürülebilirliği Kapsamında Kayaköy'ün Çözümlemesi. Analysis of Kayaköy Within the Scope of the Sustainability of the Vernacular Architecture”, YTÜ, Mimarlık Fakültesi, Megaron Dergisi, 11(4):515-529.
- Öztürk Ö 2017. Değirmen Terminolojisi (Doğu Karadeniz bölgesinde), Doğu Karadeniz Bölgesinde kapacak isimleri <https://ozhanozturk.com/>
- Rapoport A 1980. Buildings and Society (Ed. Anthony D. King). Vernacular architecture and the cultural determinants of form. Roudledge and Kegan Paul, London.
- Rudofsky B 1965. Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture, Newyork, Doubleday&Company, Inc.

# İÇ MEKÂN TASARIMINDA SÜRDÜRÜLEBİLİRLİĞİN WABI SABI ÜZERİNDEN ÖRNEKLERLE İNCELENMESİ EXAMINATION OF SUSTAINABILITY IN INTERIOR DESIGN WITH EXAMPLES THROUGH WABI SABI

Gülşah KARYAĞDI<sup>1\*</sup>

<sup>1</sup>Beykent University, Faculty of Engineering and Architecture, Interior Architecture, Istanbul, Turkey.

ORCID: 0000-0002-5377-1074

## Özet

Modern dünyanın en büyük sorunlarından olan çevre kirliliği, küresel ısınma, hızlı nüfus artışı, sanayileşme, ekolojik sistemin bozulması, salgın hastalıklar ve aşırı tüketim yakın gelecekte insanlığın çevresel, ekonomik ve sosyal tehditlerle karşılaşabileceğini göstermektedir. Tüketim alışkanlıklarının doğal kaynakların kendini yenileme sürecinin çok üstünde olması ve mevcut kaynakların ihtiyaç fazlası olarak tüketilmesi her alanda “*Sürdürülebilirlik*” kavramının benimsenmesinde önem kazanmaktadır. Bilimsel ve teknolojik gelişmelerle beraber artan yaşam kalitesinin, tüketici ihtiyaçlarının değişmesine ve yeni bir tüketim kültürünün ortaya çıkmasına sebep olduğundan bahsedilmektedir. Değişen tüketici ihtiyaçlarının yaşamsal gereksinimleri karşılamada ayrıcalık ve itibar göstergesine dönüştürüldüğünden söz edilebilmektedir. Tüketim şekliyle farklılaşma ihtiyacının giderildiği düşüncesi, satın alma iradesinin insan hakimiyetinden çıktığı ve manipüle edildiği günümüzde, ihtiyaç fazlası bir çok ürünün yaşam alanlarında istiflenerek işlevlerini yitirmelerine neden olduğu gözlemlenmektedir. Doğal kaynakların kendini yenileyebilmesine olanak sağlayabilecek tüketim anlayışının yaygınlaşması, var olan kaynakların korunması, temel ihtiyaçların ön plana çıkarılması; dengeli, barışçıl, sade, kendini olduğu gibi kabul eden Japon dünya görüşü ve yaşam şekli olan “*Wabi-Sabi*” ile bütünleşebilmektedir. Modern dünyanın yarattığı estetik kavramı, kusursuzu arama eğilimi, her şeyin bir düzen içinde olması gerektiği görüşleri, yaşam alanlarında kullanıcılar üzerinde baskı oluşturmaktadır. Kullanıcısı ile bütünleşen iç mekânlar, kullanıcısına konforla beraber kişisel zevk ve tercihlerini yansıtmaya imkânı da sağlamalıdır. Mükemmel estetik anlayışını sorgulayan ve bireyin kendi farkındalığının ön plana çıkmasına önem veren “*Wabi-Sabi*” ise iç mekânlara özgünlük getirmektedir. Çalışmada iç mekânlarda kullanılacak donatıların ve malzemelerin tüketim trendlerinden bağımsız, var olanı korumaya yönelik, sürdürülebilir olmasına dikkat çekmek amaçlanmıştır. Çalışma kapsamında *Wabi-Sabi*’nin iç mekân tasarımı ile bütünleşmesinin mobilya, malzeme ve iç mekân uygulama örnekleri üzerinden incelenmesi planlanmaktadır. Araştırma içeriğinde nitel analiz ve bilgi toplama yöntemi kullanılacaktır. Çalışma sonunda mobilya ve malzeme seçimlerinin yanı sıra mevcutun da korunmasıyla beraber popüler eğilimlerden uzak, temel ihtiyaçlara yönelik özgün yaşam alanlarının elde edilebileceği ön görülmektedir.

**Anahtar Kelimeler:** İç Mekân, Tasarım, Wabi Sabi, Mobilya, Sürdürülebilirlik

## Abstract

Environmental pollution, global warming, rapid population growth, industrialization, deterioration of the ecological system, epidemic diseases and excessive consumption, which are among the biggest problems of the modern world, show that humanity may face environmental, economic and social threats in the near future. The fact that the consumption habits are far above the self-renewal process of natural resources and that the existing resources are consumed as surpluses gain importance in adopting the concept of



"sustainability" in every field. It is mentioned that the increasing quality of life with scientific and technological developments has led to changes in consumer needs and the emergence of a new consumption culture. It can be said that changing consumer needs are transformed into an indicator of privilege and prestige beyond meeting vital needs. It is observed that today, when the thought that the need for differentiation is met by the way of consumption is removed from human domination and the will to buy is manipulated, many surplus products are stacked in living spaces and cause them to lose their functions. Expanding the understanding of consumption that will allow natural resources to renew themselves, protecting existing resources, bringing basic needs to the fore; It can integrate with Wabi Sabi, a balanced, peaceful, simple, self-accepting Japanese worldview and lifestyle. The concept of aesthetics created by the modern world, the tendency to seek perfection, the views that everything should be in order, put pressure on users in their living spaces. Interior spaces that integrate with the user should provide the user with comfort as well as the opportunity to reflect their personal tastes and preferences. "Wabi-Sabi", questioning the perfect aesthetic understanding and giving importance to the individual's own awareness, brings originality to interiors. In the study, it is aimed to draw attention to the fact that the equipment and materials to be used in interior spaces are independent from consumption trends, aiming to protect the existing and sustainable. Within the scope of the study, it is planned to examine the integration of Wabi-Sabi with interior design through furniture, materials and interior application examples. Qualitative analysis and information collection method will be used in the research content. At the end of the study, it is foreseen that original living spaces for basic needs, away from popular trends, can be obtained with the protection of the existing furniture and material selections.

**Keywords:** Interior, Design, Wabi Sabi, Furniture, Sustainability

## 1. GİRİŞ

Günümüzde gelişen sanayileşmenin üretimi arttırması ve tüketimin fazlalaşması beraberinde en büyük sorunlardan biri olan çevre kirliliğini getirmektedir. Hava, su, toprak, gürültü ve görüntü kirliliği, iklim değişikliği, ekosistemin bozulması, radyoaktif kirlilik ve atıklar küresel tehdit boyutuna ulaşmaktadır. Doğal çevrenin insan müdahalesi ile bozulmaya başlaması, nüfus artışı, plansız kentleşme ve hızlı sanayileşme, doğal kaynakların aşırı tüketimi ve atıklar doğanın ekolojik ve biyolojik dengesini bozmaktadır. Doğal dengelerin bozulması iklim ve doğal bitki örtüsü değişikliklerine sebep olabilmekte ve biyolojik çeşitliliği tehdit etmektedir. Doğanın kendini yenileyebilmesine olanak sağlamadan tüketilen birçok kaynağın, yakın bir gelecekte gıda ve su yetersizliği gibi birçok farklı tehditlerle ekonomik ve sosyal sorunlara yol açabileceğinden söz edilmektedir. Küresel boyutta büyük sorunların önüne geçebilmek ve önlem alabilmek için doğal kaynakların devamlılığını sağlamak, her alanda sürdürülebilirliğe yönelik çözümler getirmek giderek önem kazanmaktadır. Bunun için dünya ülkelerince gerekli önlemler alınmaya çalışılmakta ve sürdürülebilir enerji, tarım, sanayi, ekonomi, tüketim, eğitim ve bunun gibi konular üzerinde dikkat çekici çalışmalarla farkındalık oluşturulmaya çalışılmaktadır.

1972 yılında Stockholm'de "BM İnsan Çevresi Konferansı (Stockholm Konferansı)", 1992 yılında Rio de Janeiro'da "BM Çevre Kalkınma Konferansı (Rio Konferansı)" ve 2002 yılındaki Johannesburg'da "Dünya Sürdürülebilir Kalkınma Zirvesi" gibi uluslararası toplantılarda çevre sorunlarının ortak sorunlar olduğuna, çevre, sosyal ve ekonomik kalkınmanın birlikte düşünülmesi gerektiğine, sürdürülebilir kalkınma için sürdürülebilir üretim ve tüketimin gerekliliğine, dikkat çekilmiştir. 1997 yılında Dünya Çevre ve Kalkınma Komisyonu tarafından hazırlanmış Brundtland Raporu'nda sürdürülebilir kalkınma kavramı ön plana çıkarılmıştır. 2015 yılında New York'ta "Gündem 2030: BM Sürdürülebilir Kalkınma Hedefleri (SKH)" kabul edilerek küresel boyutta sürdürülebilir kentler, iklim

değişikliği, kuraklıkla mücadele gibi önemli birçok konu sürdürülebilir kalkınma gündemine alınmıştır. Sürdürülebilir kalkınma genel olarak içinde bulunulan zamanın ihtiyaçları temin edilirken, gelecek kuşakların ihtiyaçlarını karşılayabilmesine olanak verecek şekilde kalkınmak olarak tanımlanabilmektedir (T.C. Dışişleri Bakanlığı, 2021).

Küresel çapta hükümetler, kurum ve kuruluşlar kapsamında alınan ve uygulanmaya çalışılan sürdürülebilirlik ilkeleri mimarlık, planlama ve tasarım disiplinlerini de kapsamaktadır. Yerleşim ve binaların %40 sera gazı olan CO2 salınımından, %12 su tüketiminden, %65 atıklardan, %71 elektrik tüketiminden sorumlu olmaları yeşil bina uygulamalarının gerekliliğine dikkat çekmektedir. BREEAM (Building Research Establishment Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design), IISBE (International Initiative for Sustainable Built Environment), CASBEE (Comprehensive Assessment for Building Environmental Efficiency) ve DGNB ((Deutsche Gesellschaft für Nachhaltiges Bauen) gibi yeşil bina sertifikaları sürdürülebilir yapıların yaygınlaşmasını desteklemekte ve teşvik etmektedir (Çevre Dostu Yeşil Binalar Derneği, 2021).

Yapı malzemelerinin doğal kaynaklara zarar vermeyen hammaddeler içermesi, üretim esansında az enerji kullanımı gerektirmesi önemli olmaktadır. Malzemelerin çevre dostu, yüksek performanslı, estetik, ekonomik, sağlıklı, geri dönüştürülebilir ya da yeniden kullanılabilir ve yerel kaynaklardan elde edilmiş olmasının göz önünde bulundurulması gerekmektedir. Çevre üzerindeki etkileri en aza indirmek için yapım sürecinin planlaması, sürecin verimli yönetilmesi ve yenilenebilir kaynakların kullanılması, inşaat aşamasında kullanılan malzeme israfının azaltılması, inşaatın elde edilen geri dönüştürülmüş atık malzemelerin kullanımı, binalarda enerji verimliliğinin artırılması sürdürülebilirlik için önemli olmaktadır (Tufan, Özel, 2018). Farklılaşan tüketici ihtiyaçları tüketim kültürünü değiştirmektedir. Tüketime dayalı yaklaşımlar yerine temel ihtiyaçları karşılamanın öncelik olduğu sürdürülebilir tüketim anlayışının yaygınlaşmasını ve kaynakların verimli kullanılmasını desteklemektedir. Tüketim kültürünü mevcut olanı korumaya ve tüketimi azaltmaya teşvik eden Japon dünya görüşü ve yaşam şekli olan Wabi-Sabi yaşam alanlarına özgün, sürdürülebilir bir yaklaşım getirmektedir.

Çalışmanın birinci bölümünde çalışma konusuna giriş yapılmakta, ikinci bölümünde iç mekân tasarımında sürdürülebilirliğe değinilmekte, üçüncü bölümünde Wabi-Sabi tanımı ve kısa tarihçesi hakkında bilgi verilmektedir. Dördüncü bölümde Wabi-Sabi'nin iç mekânlara yansması mobilya, malzeme ve iç mekân uygulama örnekleri üzerinden incelenmektedir. Sonuçta yaşam alanlarında var olanın korunması, mekânlar içinde asgari müdahaleler yapılması, ekolojik malzemelerin kullanılması, tüketimin azaltılması, mobilyaların yeniden işlevlendirilmesi ve mekânların sadeleşmesi uzun vadede kaynak kullanımını azaltacağı ve sürdürülebilirliğe katkı sağlayacağı ön görülmektedir.

## **2. İÇ MEKÂN TASARIMINDA SÜRDÜRÜLEBİLİRLİK**

Eğitim, iş, ulaşım, sağlık imkânlarının erişilebilir olması, sosyal etkinliklerin sürekliliği büyük kentlerde nüfusun artmasına, hızlı sanayileşme ve plansız kentleşme sürdürülebilir modern şehir hayatını tehlikeye atmakta ve beraberinde ciddi çevre sorunlarını da getirmektedir. Teknolojik ve bilimsel gelişmelerin yaşam kalitesini artırması büyük şehirlerde yoğunlaşan nüfusun tüketim ihtiyaçlarını farklılaştırmakta ve yeni bir tüketim kültürünün ortaya çıkmasına sebep olmaktadır. Tüketimin sürekliliği doğal kaynakların hızlı tükenmesine ve bu tüketim sonucunda artan atık miktarı çevre kirliliğine neden olmaktadır. Bu atıkların yeniden kullanımı, dönüştürülmesi ve geri kazanılması sürdürülebilirliğin devamı için önemli olmaktadır.

Yeme-içme, dinlenme, barınma gibi temel ihtiyaçların karşılanmasının yanında; sosyal, ekonomik ve çevresel gelişimleri de sağlayan mekânlara dönüşen konutlar, doğru mekânsal düzenlemelerle enerji, ısı, ışık ve su kaynaklarının verimli kullanımı sağlamak ve

kullanıcısı için gerekli konfor koşullarının oluşturulmasında çevre dostu ve insan odaklı yaklaşımlarıyla sürdürülebilirliğe katkı sağlamaktadır. Sürdürülebilir konut tasarımında sürece dâhil edilen doğru mekânsal organizasyon, doluluk boşluk, esnek kullanım sağlayan dönüştürülebilir alanlar, doğru malzeme seçimleri, sade tasarım gibi etkenlerin ekonomik, konforlu ve kullanıcısı ile bütünleşebilen, etkileşim sağlayabilen mekânların oluşturulmasını desteklemektedir. Konut mimarisinde yapının bulunduğu bölge ve iklim koşullarının, yakın çevre etkenlerinin dikkatte alınarak tasarım sürecine dâhil edilmesi, seçilen dış cephe ve yapı malzemeleri, yapının tasarım formu, kullanılan mekanik sistemler ve atık yönetimi de sürdürülebilirliğe katkı sağlamaktadır (Güney Yüksel, Seçer Kariptaş, 2019).

Kiralanabilir konutlarda kullanıcı sirkülasyonunun konut sahiplerine göre daha hızlı değişmesi, iç mekânların kullanım sürelerinin kısıtlanmasına neden olmaktadır. Her değişimde yapılan tadilat, bakım, yıkım ve onarımlar neticesinde kaynak kullanımı artmakta taş, demir, seramik, tuğla, agrega gibi inşaat atıklarının daha çok çıkmasına sebep olmaktadır. Popüler eğilimlere göre kullanım süresi sona ermeden değiştirilen hareketli ve sabit mobilyalar da çevre kirliliği ve kaynak israfına neden olmaktadır. Bu nedenle iç mekânlarda kullanılacak malzemelerin yeniden kullanımı ve geri kazanımı önem kazanmaktadır. Ekolojik çevre dostu, cam, kağıt, ahşap, karton, metal gibi geri dönüştürülebilir malzeme kullanmak, bilinçli malzeme seçimi yapmak ve bulunan coğrafyadaki malzemeleri tercih etmek, bakımı yapılabilir malzemelerden üretilmiş uzun ömürlü sabit ve hareketli mobilyaları tercih etmek ya da eski işlevini yitirmiş bir mobilyaya yeniden işlev kazandırıp yeniden kullanmak, su ve elektrik enerjisi kullanımı azaltabilecek ürünler seçmek sürdürülebilirliği desteklemektedir. Bunlara ek olarak iç mekân malzeme kullanımlarında doğal, dayanaklı, bakım gerektirmeyen akıllı ve işlevsel malzemelerin de tercih edilmesi uzun vadede kaynakların daha verimli kullanımına katkı sağlamaktadır. Tadilat, bakım ve onarım işleri neticesinde çıkan atıkların değerlendirilebilmesi için uygun tesislere ayrıştırılarak yönlendirilmesi de gerekmektedir.

Değişen tüketici ihtiyaçlarının temel ihtiyaçları karşılamanın ötesinde ayrıcalık ve itibar göstergesine dönüştürülmesi, tüketim şekliyle farklılaşma ihtiyacının giderildiği düşüncesinin yaygınlaşması aşırı tüketimi arttırmaktadır. Satın alma iradesinin birey kontrolünden çıktığı, pazarlama, reklam ve dijital platformlar üzerinden sürekli bir etkileşimle yönlendirildiği söylenebilmektedir. Tüketim eğilimlerinin moda ve popüler akımlara göre yönlendiği günümüzde, ihtiyaç fazlası birçok ürünün anlık bir güdüyle satın alınması mümkün olmaktadır (Baudrillard, 2021). İhtiyaç fazlası satın alınan birçok ürün yaşam alanlarında istiflenmekte, zamanla işlevlerini yitirmekte, artık beğenilmemekte ve istenmemektedir. Yönlendirilen tüketim eğilimlerini en aza indirebilmek için sürdürülebilir kaynak kullanımının benimsenmesi, bireysel ve toplumsal farkındalığın artması, tüketimin gereklilik anlayışa göre yönlendirilmesi önem kazanmaktadır. Modern dünyanın her alanda oluşturduğu baskıdan uzaklaşmak için öze ve doğaya dönüş bir diğer seçenek olarak gündemde yerini almaktadır. Bu bağlamda kökeni zen felsefesinden etkilenen ve zamanla kendi yerini bulan Japon dünya görüşü ve yaşam şekli olan *Wabi-Sabi*, zamanın geçişine barışçıl bir şekilde razı olmayı, hayatın ön görülemeyen olaylarını ve kusurlarını kabul etmeyi, basit anların mutluluğunun tadını çıkarmayı benimsemektedir. Bu bakış açısı ise yaşam alanlarına sadelik, doğallık, özgünlük ve sürdürülebilirlik olarak yansımaktadır.

### 3. WABİ-SABİ TANIMI VE KISA TARİHÇESİ

Japon kültüründe önemli bir yere sahip olan "*Wabi-Sabi*"nin birebir kelimelerle ifade edilmesinin pek mümkün olmadığı, gözle görülememesine rağmen etkisinin hissedildiği, yaşam deneyimlerine rehberlik eden dünya görüşü olduğundan söz etmek mümkündür (Kempton, 2019). Doğadan ilham alan, her şeyin gelip geçici olduğunu kabul eden ve kusurları güzelliğe dönüştüren bu bakış açısı, hayatı bütün duyularla deneyimlemeyi benimsemektedir. Beraber kullanıldığında derin anlamlar ifade eden *wabi* ve *sabi* kelimeleri, ayrı olarak farklı anlamlara da sahiptir. Birçok kaynakta farklı anlamlarla ifade edilen bu

kelimeler Japonca özgün içeriğinde Erdemir (2010)'e göre *‘‘üşüme, eğilme ve solmak’’* anlamında *‘‘sabi’’*, *‘‘doğa içinde yalnız yaşamının verdiği mutsuzluk; toplumdan uzaklık, cesaretsiz, ruhsuz, donuk duygusal durumu ifade etmek’’* anlamında *‘‘wabi’’* olarak tanımlanmaktadır. Kempton (2019) ise *Wabi Sabi* isimli kitabında farklı şekillerde yazılabilen *‘‘wabi’’* kelimesini *‘‘hafifletilmiş tat’’*, köken olarak *‘‘yoksulluk, yetersizlik ve çaresizlikle’’* bağlantılı olduğunu ve aynı zamanda *‘‘alçakgönüllülüğü, basitliği ve kanaatkârlığı sükunet ve memnuniyete dönüştüren bir düşünce biçimi’’* olduğundan bahsetmektedir. Wabi *‘‘basitlikte bulunan güzelliğin fark edilmesiyle oluşan his’’* olarak da tanımlanmaktadır (Kempton, 2019). Yine farklı şekillerde yazılabilen *‘‘sabi’’* kelimesi ise *‘‘küf, antika, görünüm, şık sadelik’’* ve *‘‘zamanla gelişen derin ve sakin bir güzelliği’’* anlatmaya başlamıştır (Kempton, 2019). Wabi kelimesinin estetik bir terim olarak kullanılması Sen no Rikyū'nun çay seremonileriyle başlamakta ve bu seremoniler aşırılık kültüründen uzaklaşıp hayatın doğallığından ilham alan sadeliğe dönüşmüştür (Kempton, 2019). Bu aşamaya gelmeden önce, 9. yüzyıl başında Japonya'ya Budist Keşiş Saichō tarafından getirilen çay, 8.yüzyıla kadar Çin'de ilaç olarak kullanılmıştır. Japonya'daki ilk zamanlarda saray çevresinde ilgi gören çay, Keşiş Eisai döneminde önem kazanmıştır. Uji şehri civarında yetiştirilen çayın kalitesi, Çin'den çok pahalıya ithal edilen çayla rekabet eder hale gelmiştir. 15. yüzyılda asalet, estetik ve dini özellikler taşıyan çay seremonilerde şık Çin porselenleri kullanılmaktadır (Erdemir, 2010). 16. Yüzyıl başlarında keşiş ve çay ustası Murata Shukō çay hazırlama ve içmede Zen prensiplerini fark ederek bu seremonilere yeni bir yaklaşım getirmiştir. Zenginlik ve statünün gösterildiği önemli bir sosyal etkinlik olarak görülen çay seremonileri, gösterişli çay evleri, şık ürünler zamanla yerlerini yerli Japon seramiklerin kullanıldığı, çay odalarında toplumun farklı tabakalarından insanların bir araya geldiği sohbet ortamlarının oluştuğu, sade samimi çay seremonilerine bırakmaya başlamıştır (Erdemir, 2010).

Japon estetiğinde telkin, aykırılık, basitlik ve bozulabilir olma gibi öne çıkan kavramlarla, geçiciliğin ve kusurluluğun kabulüne odaklanan bir dünya görüşü olan Wabi-Sabi doğası gereği kusurlu, süreksiz ve eksik olan güzelliği takdir etmektedir. Wabi'de basitlikte bulunan güzelliğin fark edilmesiyle oluşan his, derin incelik ve hoşnutluk, Sabi'de ise asimetri ve sadelik durumları da yansımaktadır. Var olana duyulan minnet ve takdir duygusu ile Wabi-Sabi estetiği ve ilkelerinde asimetri, pürüzlülük, incelik, karmaşadan uzaklık, ekonomiklik, sadelik, alçakgönüllülük, samimiyet ve hem doğal nesnelerin hem de doğanın güçlerinin takdir edilmesi ön plana çıkmaktadır. Gösterişsiz, sade yaşam ve yaşamışlıkların korunması, dinginlik, zarafet mobilya, malzeme ve uygulama teknikleri ile iç mekânlara yansıtmakta ve kullanıcıyla güçlü bir bağ kurmaktadır.

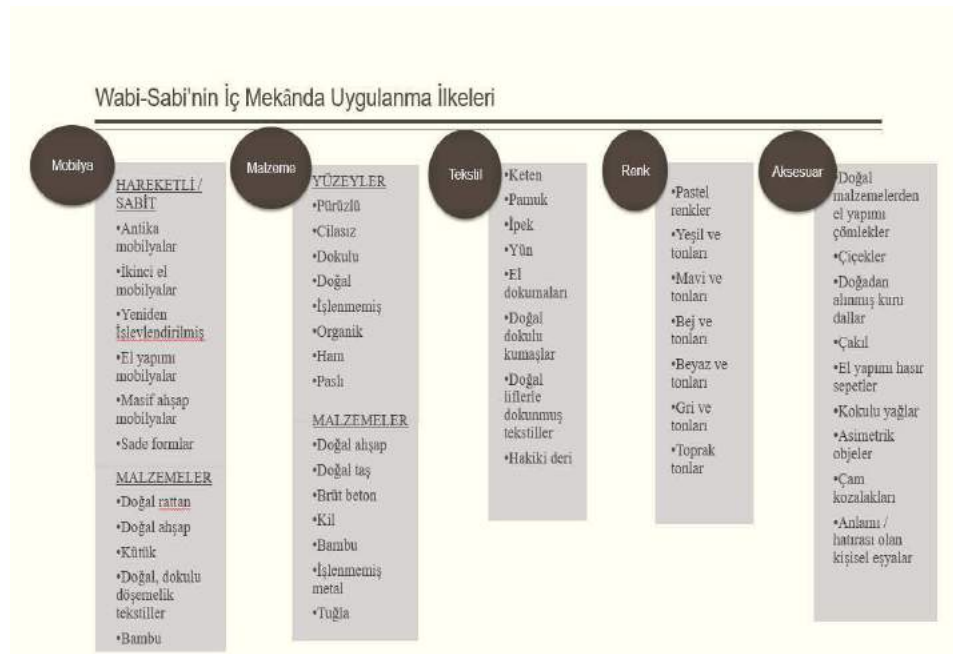
#### 4. WABİ-SABİNİN İÇ MEKÂNLARA YANSIMASI

Antik Yunan felsefelerine konu olan estetik ve güzellik kavramlarının; uyum ve birlik, simetri, sınırlılık, düzen, görüntü, biçim, uyum ve orantı birliği, mükemmel ölçülü, ideal, matematiksel oran üzerinden irdelenip tanımlanması, batı merkezli güzellik ve estetik anlayışına yön vermiş ve günümüze kadar ulaşmasını sağlamıştır (Doğan, 2017). İdeal güzelliği aramak, mükemmeli yakalamaya çalışmak, her şeyin bir düzen içinde olması gerektiği düşünmek ve bu bağlamda eğitim, iş, sosyal ve yaşam alanlarında birçok şeye müdahale etmeye çalışmak günümüz yaşam koşulları içinde kişiye psikolojik, sosyolojik ve ekonomik baskılar oluşturmaktadır. Bu baskılardan uzaklaşmak isteği rahatlatan, kendine odaklanabilmeyi sağlayan, sade, ferah ve doğa izleri taşıyan sürdürülebilir ve esnek kullanımlı yaşam alanlarına duyulan ihtiyacı arttırmaktadır. Sürekli değişen popüler eğilimler, dijital platformlar ya da dergiler üzerinden yaşam alanlarının nasıl olması gerektiği ya da neye benzemesi gerektiği yönünde önerilerde bulunmaktadır. Bu önerilerden

etkilenmek çoğu zaman yaşam alanlarında mevcut mekân verileriyle bağdaşmayan yanlış uygulamalara, beğenilen görseldeki etkiyi almak için gerekli olmayan mekânsal müdahalelere ya da kullanılmayan, zamanla beğenisinden vaz geçilen birçok mobilya, tekstil, aksesuar ve düzenleme elemanlarının iç mekânlarda birikmesine neden olabilmektedir. İhtiyaç fazlası alınan her şey, zamanla kullanıcı için işlevini yitirmekte ve bu fazlalıklardan kurtulma ihtiyacına neden olmaktadır. Wabi-Sabi ise yaşam alanlarının dergilerde ya da dijital medyada yer alan örnekler gibi olması gerekmediği ve ihtiyaç fazlası hiçbir şeyin yaşam alanlarında tutulmaması gerektiğini hatırlatmaktadır. Wabi-Sabi'ye göre mekân içinde olan her şey bir ihtiyaca ve amaca hizmet etmektedir. Mekânın düzenlenmiş bir sadelik ile kullanıcısına memnuniyet duygusuyla yeterlilik hissi oluşturmaya önem kazanmaktadır.

İlhamını doğadan alan Wabi-Sabi mekânsal anlamda da kusurları kucaklamaktadır. İç mekân donatı ve malzemelerinin kusursuz, düzeltilmiş, her şeyin birbiriyle uyumlu olması gerekliliği ve tamamen yenilenmiş olmasından ziyade mekânın tarihsel sürecinin, eskiliğinin ve kusurlarının mekânla bütünleşik olarak tasarımın bir parçası haline getirilmesi Wabi-Sabi'yi yansıtmaktadır. İç mekâna doğanın dahil edilmesi, mekân içinde bazı şeylerin tamamlanmamış olarak bırakılması, asimetrik, pürüzlü yüzeyler, organik malzemeler, ışık ve karanlık, doğa renkleriyle birlik olan yaşam alanlarının düzenlenmesi bu dünya görüşü ile yaşam alanlarına yansımaktadır. Basit ve sade alanlar, desenli döşemeler, mekân boyutlarıyla uyumlu mobilyalar, sergileme amaçlı kullanılan mobilyalar yerine depolama ihtiyacına çözüm getirebilecek dolaplar, mekân kullanımında esneklik ve beş duyuyu besleyebilecek materyallerin doku ve koku gibi yaşam alanlarında kullanılması, ‘‘ az çoktur’’ yaklaşımı ile Wabi-Sabi görüşünün iç mekânlara yansıtılmasına katkı sağlamaktadır. Yaşam alanlarında temel ihtiyaçları karşılayan mobilya donatıları olarak aileden kalan manevi değeri olan ya da ikinci el mobilyaların mevcut durumlarının korunarak kullanılması yaşanmışlıkları iç mekâna taşımaktadır. Antika mobilyalar, el yapımı ve doğal malzemelerin kullanıldığı dolap, masa, sehpa, sandalye, tekli koltuk gibi birçok hareketli ve sabit mobilya da kullanılabilir. Oturma elemanlarında dokulu kumaşlar tercih edilebilmekte ve yine mekân içinde örgü, doğal liflerle dokunmuş dokumalar, keten, pamuk, ipek gibi tekstiller, doğal boyalı el dokuması halılardan da faydalanılmaktadır. İç mekân renk uygulamalarında doğadan ilham alan sakinlik, huzur hissettiren pastel renkler, toprak, yeşil, mavinin tonları, bej, beyaz, griler kullanılmaktadır. Ham, doğal, işlenmemiş, cilalanmamış malzemeler, düzeltilmemiş ve malzemelerin organik özelliklerini ön plana çıkaran yüzeyler bir bütün içinde kullanılmaktadır. Brüt beton, doğal ahşap, tuğla, doğal taş, bambu, hasır, kil, eskitilmiş ahşap yüzeyler zemin ve duvar yüzeylerinde kullanılabilir. El yapımı toprak ya da doğal malzemelerden yapılmış aksesuarlar, hasır sepetler, doğanın içinden alınmış kuru dal, taş gibi elemanlar, bitki ve çiçekler tamamlayıcı ve mevsim geçişlerini hatırlatıcı öğeler olarak tercih edilebilmektedir. Duvar yüzeylerinde aile fotoğrafları, ahşap raflarda geçmişin izlerini taşıyan, manevi değeri yüksek olan elemanlar sergilenebilmektedir. İç mekâna kimlik kazandıran özelliklerin, zemin, duvar ve tavan yüzeylerindeki eskimiş malzemelerin karakteristik özelliklerinin korunması derinlik, güzellik ve özgünlük oluşturmaktadır. Wabi-Sabi ruhunun tüm tatlı kusurlarıyla evde yakalanması ise huzurlu ve dengeli bir benlik duygusundan, rustik bir estetiğe, daha yumuşak wabi-sabi anlarına sahip temiz, modern mekânlara kadar uzanmaktadır. Ahşap, rustik taş, rengi atmış beton, dokuma kilimler ve el yapımı rattan parçalar, aradaki tüm boşluklardan geçerek estetiği tanımlayan güven verici, yaşanmış bir izlenim yaratmaktadır.





**Tablo 1.** Wabi-Sabi'nin iç mekânda uygulanma ilkeleri tablosu, Gülşah Karyağdı, 2021

Wabi-Sabi'nin iç mekânlara yansması ile ilgili yapılan araştırmalar ve toplanan bilgiler doğrultusunda; mobilya, malzeme, tekstil, renk ve aksesuar kullanımlarına yönelik ‘‘Wabi-Sabi'nin İç Mekânda Uygulama İlkeleri’’ tablosu oluşturulmuştur. İç mekân uygulama örneklerinde, tabloda yer alan ilkelerin yaşam alanlarına yansması incelenmektedir.



**Resim 1.** Dolap, oturma elemanı, dresuar örnekleri, Studio Oliver Gustav, Kopenhag, Danimarka, Fotoğraflar: Line Klein Studio. (URL-1).

Resim 1’de yer alan ahşap antika dolaplar, masalar, sandalyeler ve çömlek vazolar Wabi-Sabi’ de kullanılabilir. Antika dresuar üzerinde duran vazo içindeki bir çiçek dalı, keten kumaşla giydirilmiş oturma elemanları, yılların izini taşıyan masif ahşap, camlı dolap ünitesi, zeminin olduğu gibi korunması ve renk paleti estetik bir denge oluşturmakta ve birbirleriyle bütünleşmektedirler.



**Resim 2.** Oturma elemanı örnekleri, Big Daddy's Antiques, Los Angeles, USA, 2015, (URL-2).

Resim 2'deki örneklerde zamanla renk ve doku değişmesi ile şekillenen metal malzemede, zamanın akışını yansıtan ahşap malzemede ve kullanıldıkça yumuşayan derinin yaşanmışlık ifadesini hakiki deri Le Corbusier tasarımı koltukta Wabi-Sabi izleri yakalanabilmektedir.



**Resim 3.** Zemin, duvar ve tavan malzeme uygulama ve mobilya örnekleri, RYB Project, Prodan Design, Kiev, Ukrayna, 2020, (URL-3).

Resim 3'teki doğal doku ve toprak tonlarıyla köklere dönen, yeni ve geleneksel unsurların Wabi-Sabi ile uyum içinde birleştiği iç mekân örnekleri görülmektedir. Duvar, tavan, kapı, zemin ve mobilyaların benzer renkleri içermesi dinlendirici bir etki yaratmaktadır. Kâse ve çömlekler ahşabın ham haliyle kullanılan raflarda sergilenmektedir. Oturma alanında kullanılan ahşap zemin, mutfak alanına geçişte beton dokulu zemine dönüşmektedir. Ahşap yemek masası, masa ve sandalyeler mekânı tamamlamaktadır.



**Resim 4.** İç mekân uygulama örnekleri, Wabi Sabi Apartment, Sergey Makhno Architects, Kiev, Ukrayna, 2017, Fotoğraflar: Andrey Avdeenko, (URL-4).

Resim 4 ‘te Ukraynalı mimar Sergey Makhno’nun kendi ailesi için tasarladığı çatı katı dairesinde kendi ülkesinin gelenekleriyle birleştirdiği Wabi-Sabi’yi yaşam alanlarına yansıttığı örnekler görülmektedir. Geçiş alanında kullanılan doğal ağaç gövdeleri ve iç mekânda kullanılan bitkiler doğanın izlerini yaşam alanlarına taşımaktadır.





**Resim 5.** İç mekân uygulama örnekleri, Wabi Sabi Apartment, Sergey Makhno Architects, Kiev, Ukrayna, 2017, Fotoğraflar: Andrey Avdeenko, (URL-5).

Resim 5'teki görsellerde geleneksel Ukrayna evlerinde kullanılan bir teknikle kilin iç mekân duvarlarına uygulandığı örnekler görülmektedir. Merdiven korkuluğunun ağaç dalından olması doğadan gelişin izlerini yansıtmaktadır. Resim 4 ve 5'teki görsellerde iç mekânda kullanılan renkler, doğal ahşap malzemeler, masif dresuar ve sehpa, çömlekler, aydınlatma elemanlarının yüzey dokusu, gün ışığının gölgelerle birleşerek duvar yüzeyine yansımaları Wabi-Sabi'yi iç mekânlara yansımaları görülmektedir. Kırsal görünüm ve hissine rağmen yaşam alanları aynı zamanda kullanıcıları için çağdaş donatılarla konfor sağlamaktadır. Doğada bulunan dört element; duvar yüzeylerinde uygulanan kil ile toprak, çeşitli sanat eserleri, nesneler ile ateş ve su, mekânsal organizasyon içindeki boşluklar ile hava yaşam alanlarında temsil edilmektedir. Dokuma halılar Ukrayna geleneksel zanaat ve kültürüne işaret ederken, işlevsel nesnelerden çok heykelleri andıran Makhno'nun metal abajurları, doğal iç mekana çağdaş bir unsur eklemenin bir yolu olarak yemek alanında kullanılmaktadır. Wabi-Sabi'nin çağdaş tasarımda yer bulabildiğinin örneği Makhno'nun evi ile örneklenmektedir. Doğal malzemelerin kullanılmasıyla el yapımı nesnelerin güzelliğini, sakinlik, pürüzlü dokular, koyu tonlar mekânlar ile bütünleşmektedir.



**Resim 6.** İç mekân uygulama örnekleri, The Greenwich Hotel Tribeca Penthouse, Axel Vervoordt – Tatsuro Miki, New York, USA, 2014, Fotoğraflar: Nikolas Koeni, (URL-5).

Resim 6'daki görsellerde zamanla aşınmış ahşap, taş ve çelik gibi doğal malzemeler, sade form kullanımı iç mekânlara sıcaklık ve yaşanmışlık hissi vermektedir. Çatı katının her alanında taş, çelik ve geri kazanılmış ahşap gibi malzemeler seçilerek iç ve dış mekânlarda sürdürülebilir tasarım benimsenmiştir. Dokunulmamış yüzeylerin ve yeni işlevler kazandırılarak kullanılan nesnelerin hikâyeleri huzur, sadelik ve alçakgönüllülük ile Wabi-Sabi'de hayat bulmakta ve her şeyin geçici ve kusurlu olduğunu hatırlatmaktadır. Kahverengi, gri, beyaz, mavi ve krem tonlardan oluşan renkler doğal ışığı sarmalayarak dingin mekânlar oluşturmaktadır.

Tablo 1'de yer alan ilkelere yönelik; mobilya, malzeme, renk, aksesuar ve tekstil uygulamalarının yaşam alanlarında Wabi-Sabi'yi yansıtan uygulama örnekleri görülmektedir. Günümüzdeki modern yapıların iç mekânlarında da Wabi-Sabi; özgün, ekonomik, sade, samimi, dingin, gösterişsiz, doğal, ekonomik ve sürdürülebilir ilkelerle uygulanabilmektedir.

## 5. SONUÇ

Günümüzde ekonomi, eğitim, sağlık gibi birçok alanda ilerleyen ve gelişen sanayi, bilim, teknoloji beraberinde küresel kapsamda; çevre kirliliği, kaynak yetersizliği ve iklim değişiklikleri gibi sorunları getirmektedir. Değişen tüketim kültürü de kaynak kullanımını olumsuz yönde etkilemektedir. Sürdürülebilirlik gelecek nesiller için kaynakların devamını sağlamak ve yaşanılabilir bir dünya bırakmak için önemlidir. Tarımdan suya, doğal kaynaklardan ekonomiye, eğitimden sağlığa, çevreden mimariye birçok alanda yenilenebilir enerjiler, dönüştürülebilir malzemeler, çevre dostu ürünler kullanmak önemlidir. Yeşil bina uygulamalarının yaygınlaşması, yapı ve iç mekânlarda kullanılan malzemelerin sürdürülebilir olması, enerji kayıplarının önlenmesi, doğru yerel malzemelerin kullanılması, bu alanlardan çıkan atık miktarının yönetilmesini kolaylaştırmakta, çevre kirliliğini azaltmakta ve doğal kaynakların daha verimli kullanılmasını sağlamaktadır. Sürdürülebilirliğin her alanda yaygınlaşması giderek önem kazanmaktadır.

Yaşam alanları kullanıcısının zevklerini, kişiliği, kültürünü, iç dünyasını yansıtırken kullanıcısının yaşam biçimini ve gündelik hayat akışı içinde duygu dünyasını da etkilemektedir. Yaşam alanları sosyal statüyü yansıtmaktan ziyade mekânsal anlamda kullanıcısına gerekli mahremiyeti, başkalarıyla sosyalleşebilmeyi ve kendini ifade edebilme imkânı da sağlamaktadır. Tüketime dayalı yaklaşımların, var olanı korumaya ve temel ihtiyaçları karşılamaya yönelik değişmesi, sürdürülebilir tüketim anlayışının benimsenmesi yaygınlaştırmaktadır. Sadeleşmek, mükemmelleştirmeye çalışmak yerine var olanda güzelliği görerek memnuniyet hissetmek, doğal döngünün içinde yer almayı Wabi-Sabi ile ön plana çıkarmaktadır. Wabi-Sabi'ye göre hiçbir şey sürmez, hiçbir şey bitmiş değildir ve bir şey mükemmel değildir. Mekânın kişiliğini yok etmeyen, ondaki bütün kusurları güzellik olan gören, doğadan ilham alan bir yaklaşım, mekân ve mekân içinde yaşayanları bütünleştirmekte ve kullanıcısına ait anılarla mekânın kendi özellikleri iyi bir uyum oluşturmaktadır. Wabi-Sabi'ye göre yaşam alanlarında kullanılan her şey bir amaca hizmet etmekte ve temel ihtiyaçların giderilmesini sağlamaktadır. Geniş çaplı mekânsal müdahaleler yerine, mobilya donatıları ile yaşam alanlarında esnek kullanım sağlanabilmektedir. İç mekânda duvar, tavan, zemin malzemelerinin mekânın tarihsel sürecinin, eskiliğinin ve kusurlarının mekânla bütünleşik olarak tasarımın bir parçası haline getirilmesi, gereken malzeme bakımlarının yapılması, malzeme ve mobilyaların eskimiş yüzey karakteristik özelliklerinin korunması ekonomik ve sürdürülebilir bir tüketim anlayışı ile kaynakların korunmasına katkı sağlamaktadır. Sabit ve hareketli mobilyalarda; antika, ikinci el ya da yeniden işlevlendirilmiş mobilya kullanımı ile mevcut sabit mobilya donatılarının bakımlarının yapılarak kullanılması mobilyaların atık haline gelmesini önlemektedir. Wabi-Sabi'nin iç mekânda uygulanma ilkeleri tablosu ve incelenen örneklerle göre; özgün, ekonomik, sade, samimi, dingin, gösterişsiz, doğal, ekonomik ve sürdürülebilir ilkelerle Wabi-Sabi günümüz iç mekanlarında da kolaylıkla uygulanabilmektedir.



Yapılan arařtırmalar ve toplanan bilgiler ışığında; iç mekânlarda kullanılacak malzemelerin uzun ömürlü, dönüřtürülebilir, sürdürülebilir olması, var olanın en etkin biçimde ya da yeniden işlevlendirilerek kullanılması, sürdürülebilir tüketim anlayışının benimsenmesi ve doğal kaynakların daha etkin kullanımı, çevre kirliliğini azaltma ve mevcut kaynakların korunması yönünde sürdürülebilirliğe katkı sağlaması ön görölmektedir.

#### KAYNAKLAR

1. Baudrillard, J. (2021). *Tüketim toplumu: söylenceleri/yapıları* (N. Tural, F. Keskin, Çev.; 15. baskı). Ayrıntı Yayınları.
2. Çevre Dostu Yeşil Binalar Derneği. (2021, Ağustos 3). *Yeşil bina*. <https://cedbik.org/tr/yesil-bina-7-pg>
3. Doğan, S. (2017). Antik Yunan felsefesinde ‘‘güzel’’ kavramı ve rönesans resim sanatına yansıma biçimleri. *Journal of Awareness*, 2 (3S), 451-462.
4. Erdemir, A. (2010). Genel hatlarıyla cha-no-yu. *Erciyes Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 1 (29), 42-52.
5. Güney Yüksel, F.C., Seçer Kariptaş, F. (2019) Konut iç mekanına sürdürülebilir yaklaşımlar, *Yakın Mimarlık Dergisi* 2 (2), 27-39.
6. Kempton, B. (2019). *Wabi sabi: kusurlu mükemmel bir hayat için Japon bilgeliği* (U. Mehter, Çev.; 1. Baskı). Pena Yayınları.
7. T.C. Dışişleri Bakanlığı. (2021, Ağustos 3). *Sürdürülebilir kalkınma*. <https://www.mfa.gov.tr/surdurulebilir-kalkinma.tr.mfa>
8. Tufan, M, Özel, C. (2018). Sürdürülebilirlik kavramı ve yapı malzemeleri için sürdürülebilirlik kriterleri. *Uluslararası Sürdürülebilir Mühendislik ve Teknoloji Dergisi*, 2 (1), 6-13.
9. URL 1: <https://olivergustav.com/available-works/> (05.08.2021)
10. URL 2: <https://www.bdantiques.com/blogs/news/16599945-the-japanese-philosophy-of-wabi-sabi> (05.08.2021)
11. URL 3: <https://prodan-design.com.ua/en/living-interiors/ryb> (05.08.2021)
12. URL 4: <http://mahno.com.ua/en/interior-design/view/wabi-sabi-apartment> (05.08.2021)
13. URL 5: <http://mahno.com.ua/en/interior-design/view/wabi-sabi-apartment> (05.08.2021)
14. URL 6: <https://www.archilovers.com/projects/141009/the-greenwich-hotel-tribeca-penthouse.html> (06.08.2021)

## AN ANATOMICAL AND CHEMICAL COMPARISON STUDY OF *EPIPREMNUM AUREUM* CULTIVATED IN SOIL AND SOILLESS

<sup>1</sup>Muazaz Azeez AL-Hadeethi, <sup>1</sup>Basma M. Al-Obaidi

<sup>1</sup>Biology Dep., Education College for Pure Sciences - Ibn Al- Haitham, Baghdad University, Iraq.

### Abstract

The present study took up the different ways to cultivate the species *Epipremnum aureum* by two habitat water and soil and comber the anatomical features of the root, stem, and leaf. The results showed amazing significant anatomical features to the ecosystem.

The root and stem anatomy showing decrease in all characters that studied but the leaf anatomy showing increase of palisade, spongy tissue thickness, midrib thickness, number of vessels in the xylem also the long and width of stomata of the soilless plants than soil ones. The upper epidermis empty from the stomata for the two treatment and the stoma diffuse in the lower epidermis, the type of it paracytic type.

Also the total of flavonoids in the plant that were growth in soil reached 140.489 ml/kg and in the water 140.385 ml/kg

**Keywords:** anatomy, chemical, *Epipremnum aureum*, water, soil

### Introduction

The Scientific classifications of the species *Epipremnum aureum* are:

Kingdom:Plantae

Clade:Monocots

Order:Alismatales

Family: Araceae

Subfamily:Monsteroideae

Tribe: Monstereae

Genus:Epipremnum Schott

Species:*Epipremnum aureum* (Linden & André) G.S.Bunting, 1964.

The species *Epipremnum aureum* of flowering plant native and endemic to Mo'orea in the Islands of French Polynesia (Meshram and Anju, 2014). This species considered as a public houseplant in temperate regions but has also become naturalized in the tropical and subtropical forests worldwide, in addition to the northern South Africa (Hung *et al.*, 2016) and Australia, South Asia, Pacific Islands, and West Indies (Qu *et al.*, 2002).

The plant has plenty of common names like Golden Pothos, Ceylon Creeper (Sawada and Oyabu, 2008) Hunter's Robe, Ivy Arum, Home Plant, Money Plant, Silver Vine, Solomon Islands Ivy, and Marble Queen, it is also called Devil's Ivy because it is impossible to die and it stays Shining and green even when lived in the dark (Meshram and Anju, 2014).

This species rarely flowering without artificial hormone and growth regulators and the researchers recorded the last natural flowering without any intervention was reported in 1964 (De-Costa *et al.*, 2011).

*Epipremnum aureum* is an evergreen vine to 20 m tall, the stem diameter up to 4 cm, climbing by the aerial roots which cling to surfaces, the leaves are alternate and heart-shaped up to 100 cm long and 45 cm width, and the new leaves are very smaller reached to 20 cm long also the flowers are produced in a spathe (Moodley *et al.*, 2007).

The flavonoids consider are part of the polyphenol in phytonutrients. Polyphenols are used in Chinese and the traditional Hindu system of medicine. According to the Global Healing Center (GHC), they are connecting with skin safeguard, the function of the brain, high blood sugar, and blood pressure organizing, in addition to antioxidant activity (Rosalind *et al.*, 2013).

In 1930 a new material was separated from the fruit of oranges, at that time it was thought to be a part of vitamins and was set as vitamin P, and then they recommend it this substance was a flavonoid (Hossain *et al.*, 2013). Araceae family comprising of many active medicinal plants like *Epipremnum aureum*, this genus competent of removing internal air pollutants like xylene, formaldehyde and benzene (Chetan *et al.*, 2011).

The anatomical study is rare thus the aim of this study knowing the anatomical features of the species *Epipremnum aureum* and comparing the anatomical differences between hydroponics and natural cultivation in the soil, also analyses the flavonoids in the extracts of leaves. This study consider newer in Iraq.

## Material and methods

### 1. Specimen's collection:

The plant was gain from the herbal garden of AL- Adhamiya north of Baghdad in April 2020 and cultivated in the plant garden of the college of education for pure science Ibn AL-Haitham in a different way the first plant cultivated in the soil and the second in the water

### 2. Specimen's conservation:

Plant materials obtained from fresh roots, stems and leaves were preserved in formalin acetic acid alcohol (FAA) for 24-28 hours which was prepared according to Johanson (1940) as follow: Ethyl alcohol (50 ml), Glacial acetic acid (5 ml), Formaldehyde 37- 40 % (10 ml) and Distilled water (35 ml), and then changed the solution by 70% alcohol.

### 3. Anatomical study:

#### A. Peeling epidermis:

Epidermis peeling was done at the middle of the lamina and the samples were prepared by mechanical scraping using a razor blade, then washing with distilled water and put in 5% sodium hypochlorite for 10-15 minute and then stained in 1% safranin for 30-45 minute, the excess stain was washed off with distilled water, Finally, the epidermal samples were put on the slides and mounted by cover slides prepared to were examined by KRÜSs light microscope and photographed using AmScope camera.

To determine the stomatal index as follows (Stace, 1965)

$$\text{Stomatal index} = \frac{\text{number of stomata}}{\text{number of stomata} + \text{number of ordinary epidermal cells}} \times 100$$

#### B. Permanent slides of cross sections for root, stem and leaves:

The samples of root, stem, and leaves were cut into small segments with a length of (0.5-2) cm, then were washed with distilled water and put in 70% alcohol, then put in the sectioning device for (24) h to for sectioning and leaching to remove O<sub>2</sub> from cells, then dehydrated in tertiary butyl alcohol (TBA) series. After that, the samples were put in paraffin for three days and then embedded in paraffin which is poured in woody boxes for sectioning with a sliding microtome.

Sectioning was performed using a sliding microtome (Leica SM 200R sliding) with a thickness of (8-12 µm) and the sectioning of ribbons was put on a water bath (40-45 C°) and then put on a hot plate (40 C°) for drying.

The wax was removed from the ribbon by different solutions as following: Xylene for (5mins.), Xylene+100% alcohol (1:1) for (5 mins.), Ether +100% alcohol (1:1) for (5 mins.), 100% alcohol for (5 mins.), 95% alcohol for (5 mins.), 70% alcohol for (5 mins.), the stained in 1% safranin in alcohol for (12-24) h then washing by distilled water, and after that dehydration the slides by 95% alcohol for (10 sec.), then but it in the Fast green for (1-3) sec. and to remove the excess stain clear by Clove oil + 100% alcohol + xylene (2:1:1) 2-3 times, Xylene + 100% alcohol (1:1) for (5 mins.), Xylene for (10 mins.). Finally the sections were mounted in D.P.X.

The prestaining and staining procedure was performed according to (Thammathaworn, 1996).

All permanent slides were examined by KRÜSs light microscope and photographed using AmScope camera.

#### **4. Chemical study**

##### **1. Preparation of the leaves for extraction**

The leaves were washed with distilled water and dried in the oven for 2 days, then were squashed by a grinder, the powder was stored for further use.

##### **2. Method of extraction**

The samples of leaves powder of *Epipremnum aureum* put in the Soxhlet device by using a crude continuous hot percolation process. The extraction was carried out for the polarity of the solvents by using the chloroform, acetone, and ethanol.

##### **3. Detection of flavonoids**

The extracts were treated with few drops of sodium hydroxide solution and the formation of intense yellow color, which becomes colorless on the addition of dilute acid, indicates the presence of flavonoids to alkaline reagent test. The flavonoids were extracted according to the method of Palanisamy *et al.*, (2012), the separation and diagnosis were made using a high performance liquid chromatography (HPLC) device, which is used to separate and purify the chemicals mixed with the extract. Plant parts and their comparison with standard samples.

#### **Results and dissection**

The measurements of root, stem, leaves appear in the table 1.

The results of this study show amazing variations by measurement of size, shape, and type between the cross-section of parts of the same plant in soil and soilless, these variations came from a variation in the environment in which the plant was grown (Reddy *et al.*, 2004). We will review it from the root to the leaves.

##### **A. Anatomy of the root:**

In the plant that is grown in the soil, the cross-section of the root has a circle shape with undulated epidermis and many root hairs covered the epidermis, the average thickness of the epidermis reached 33.5  $\mu$ , under the epidermis appeared 2-3 layers of sclerenchyma tissue and after it located many layers of parenchyma tissue, this tissue contains the ground tissue, the average thickness of it reached to 43.1 $\mu$ . (Tab. 1 & Shape 1).

The central cylinder located in the center consists of Pericycle which in turn consists of a single layer of cells surrounding vascular bundles, the vascular bundle is a radial type, consist of xylem and phloem which are located on the reciprocal radii. The average thickness of the vascular bundle reached 27.5 $\mu$ . The pith is absent because the vessels of xylem meet with each other in the center (Tab. 1 & Shape 1).

On the other hand, the plant grown in the water, the cross-section of root take quadrate shape, the epidermis thicker from the plant grown in soil, the decrease percentage -26.8%, also covered by many root hairs more than from the previous plant. The ground tissue also thicker than the other one about -18.3% of decrease percentage and consists of sclerenchyma tissue and parenchyma tissue (Tab. 1 & Shape 2).

The central cylinder located in the center consists of a Pericycle with a single layer of cells surrounding the vascular bundles, the vascular bundle is a radial type, consist of the xylem and phloem which are located on the reciprocal radii. The average thickness of the vascular bundle also thicker than from the previous plant reached -16.1%. Pith located in the center consists from parenchyma cell (Tab. 1 & Shape 2).

##### **B. Anatomy of the stem:**

The cross-section of the stem of the plant in the soil has a circle shape with some protrusions in the epidermis, the cuticle covered the epidermis, the average thickness reached 3.8 $\mu$ , and the average thickness of epidermis reached 20.4 $\mu$ , under the epidermis appeared 3-4 layers of sclerenchyma tissue and after it located many layers of parenchyma tissue, this tissue contains the ground tissue, the average thickness of it reached to 36.9 $\mu$ , (Tab. 2 & Shape 3).

The Pericycle consists of a single layer of cells surrounding the vascular bundles, the vascular bundle is lateral because the xylem and phloem located on the same radii and closed because absent the vascular cambium between the xylem and phloem, the vascular bundles consist of xylem have one metaxylem and one protoxylem, and the phloem located below it, also the vascular bundle surrounded by bundle sheath fiber, and the average thickness reached 25.4 $\mu$ . Some vascular bundles scattered in the ground tissue (Tab. 2 & Shape 3). Similar results were obtained by (Mohamed *et al.*, 2012)

While, the plant grown in the water, the cross-section of stem take the same shape of the other but differ in the measurement of the layers when the decrease percentage of cuticle reached -5.2% and the decrease percentage of epidermis reached -3.4%, under the epidermis appeared 5-7 layers of sclerenchyma tissue and after it located many layers of parenchyma tissue, this tissue contains the ground tissue, the decrease percentage of it reached to -22.7%, (Tab. 2 & Shape 4).

The Pericycle consists of a single layer of cells surrounding the vascular bundles, the vascular bundle is lateral and closed consist of xylem have 1-3 metaxylem and one protoxylem more than the plant that grown on the soil, and the phloem located below it, also the vascular bundle surrounded by bundle sheath fiber, and the decrease percentage reached -23.6%. Some vascular bundles scattered in the ground tissue also (Tab. 2 & Shape 4). This agree with (Olmos *et al.*, 2007 and Guerfel *et al.*, 2009)

### C. Anatomy of the leaves:

The measurements of stomata show in Table (3)

The epidermis of leaf in the species consists of the ordinary epidermal cells and stomata complex, the upper epidermis empty from the stomata in both the two treatments, but the plant is grown in the soil the epidermis of it contains many needle crystals in the upper epidermis. The lower epidermis has stomata, and the type of it paracytic type, that's mean the stomata have to guard cells parallel to the longitudinal axis of the stoma.

The differences between the two treatment by number and size of stomata, whereas the epidermis of the plant that grown in the soil have fewer stomata about 20-24 on the magnification power 10X and the number of it in the plant soilless reached 26-33 stoma in the same magnification power, also the size of the stomata between the plant grown in the soil and soilless variable, when the average of stomata long reached 38.4 $\mu$  and 53.8 $\mu$  respectively and the average width reached 24.9 $\mu$  and 29.3 $\mu$  respectively, also measure the stomata index reached 14 and 19.3 respectively (Shape 5 & 6). The increase in all the features of stomata in the plant that's grown in the water-related to increasing the evaporation from the stomata to get the excess water out of the plant in the form of water vapor, this agree with (Santandrea *et al.*, 1998 and Child *et al.*, 2003).

The data of leaves show in Table (4)

The blade of leaf in the soil was decreased in the layers of the transactional section of it more than in the ones of water. This decrement was corresponding to a decrease the percentage of cuticle about -27.5%, the upper epidermis about -33.5%, the lower epidermis about -27.8%, the palisade layer of leaf about -18.0%, also the spongy of leaf reached -20.7%.

Also, this action was linked with clear changes in the vascular bundle as compared to the soil of the plant, when the xylem vessels of the midrib were arrangement in as compared to the plants in water and have fewer vessels from the soilless plant. The decrease percentage of vascular bundle thickness -17.1%, the Midrib thickness about -7.0% and the vascular bundle thickness in the midrib reached -23.6% (Shape 7 & 8), that mean when the vascular bundles are large and have more vessels can control to the water absorption from the parts of plants, that mean when the vascular bundles are large and have more vessels can control the water absorption from the parts of plants and can expulsion the excess water on the need of plants, and this is what happened in the plant that was grown in water. These agree with (Weier *et al.*, 1974; Matsuda and Rayan, 1990 and Shao *et al.*, 2008).

### D. Total of flavonoid



The result of the total flavonoid contents of *Epipremnum aureum* is given in (Chart 1), The highest of it (140.489 mg/kg) amount of flavonoids content in the plants that were grown in the soil and the lowest about (140.385 mg/kg) in the plants that were grown in the water.

Table 1: anatomical characters of root cross-section of soil & soilless of the species *Epipremnum aureum*

Root Characters	<i>Epipremnum aureum</i> in the soil	<i>Epipremnum aureum</i> in the water	Decrease percentage %
Epidermis thickness	29.6-35.5 (33.5)	23.1-26.4 (24.5)	-26.8
Ground tissue thickness	41.6-44.2 (43.1)	33.7-36.5 (35.2)	-18.3
Vascular bundle thickness	31.1-33.6 (32.8)	26.2-29.1 (27.5)	-16.1

Table 2: anatomical characters of stem cross-section of soil & soilless of the species *Epipremnum aureum*

Stem Characters	<i>Epipremnum aureum</i> in the soil	<i>Epipremnum aureum</i> in the water	The variability %
Cuticle thickness	3.5-4.9 (3.8)	3.2-4.5 (3.6)	-5.2%
Epidermis thickness	19.4-22.1 (20.4)	18.5-20.1 (19.7)	-3.4%
Ground tissue thickness	35.2-38.4 (36.9)	26.5-29.7 (28.5)	-22.7%
Vascular bundle thickness	22.3-26.7 (25.4)	16.2-20.1 (19.4)	-23.6%

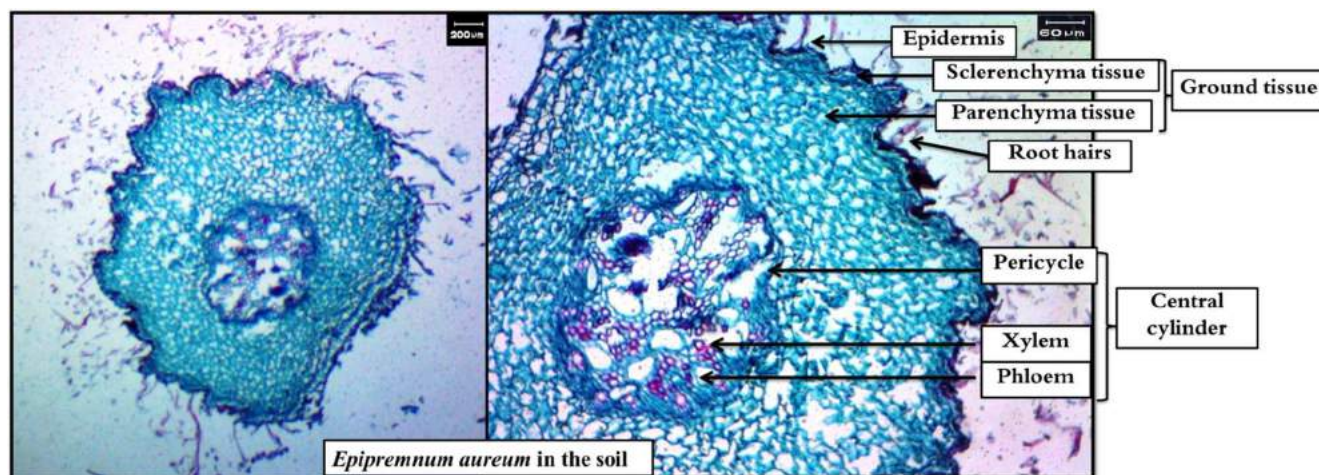
Table 4: Stomata characters of soil & soilless of the species *Epipremnum aureum*

Characters	Stomata long	Stomata width	Stomatal index	Number of stomata at 10X
<i>E. aureum</i> in soil	36.2-39.5 (38.4)	23.5-26.1 (24.9)	14	20-24 (22.1)
<i>E. aureum</i> in water	50.4-54.3 (53.8)	27.5-30.1 (29.3)	19.3	26-33 (29.6)

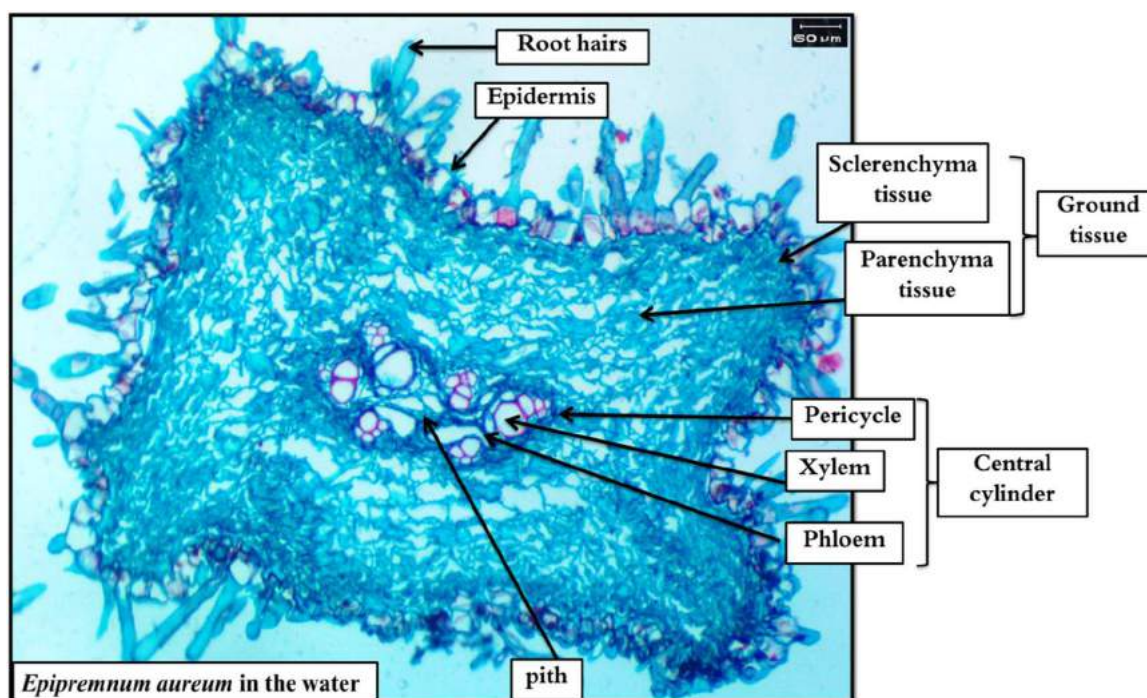
Table 3: anatomical characters of leaves transactional -section of soil & soilless of the species *Epipremnum aureum*

Leaves Characters	<i>Epipremnum aureum</i> in the soil	<i>Epipremnum aureum</i> in the water	The variability %
Cuticle thickness	2.5-3.5 (2.9)	3.1-4.1 (4.0)	-27.5%
Upper Epidermis thickness	16.3-18.4 (17.2)	20.3-26.4 (25.9)	-33.5%
Lower Epidermis thickness	12.2-15.6	19.4-21.3	-27.8%

	(14.8)	(20.5)	
Palisade thickness	33.5-36.2 (35.8)	41.8-44.5 (43.7)	-18.0%
Spongy thickness	47.1-50.6 (48.2)	58.7-61.2 (60.8)	-20.7%
Vascular bundle thickness	68.5-71.3 (70.1)	82.6-85.4 (84.6)	-17.1%
Midrib thickness	137.8-140.1 (139.6)	148.3-152.4 (150.2)	-7.0%
Vascular bundle thickness in the midrib	43.4-46.2 (44.5)	55.5-60.1 (58.3)	-23.6%

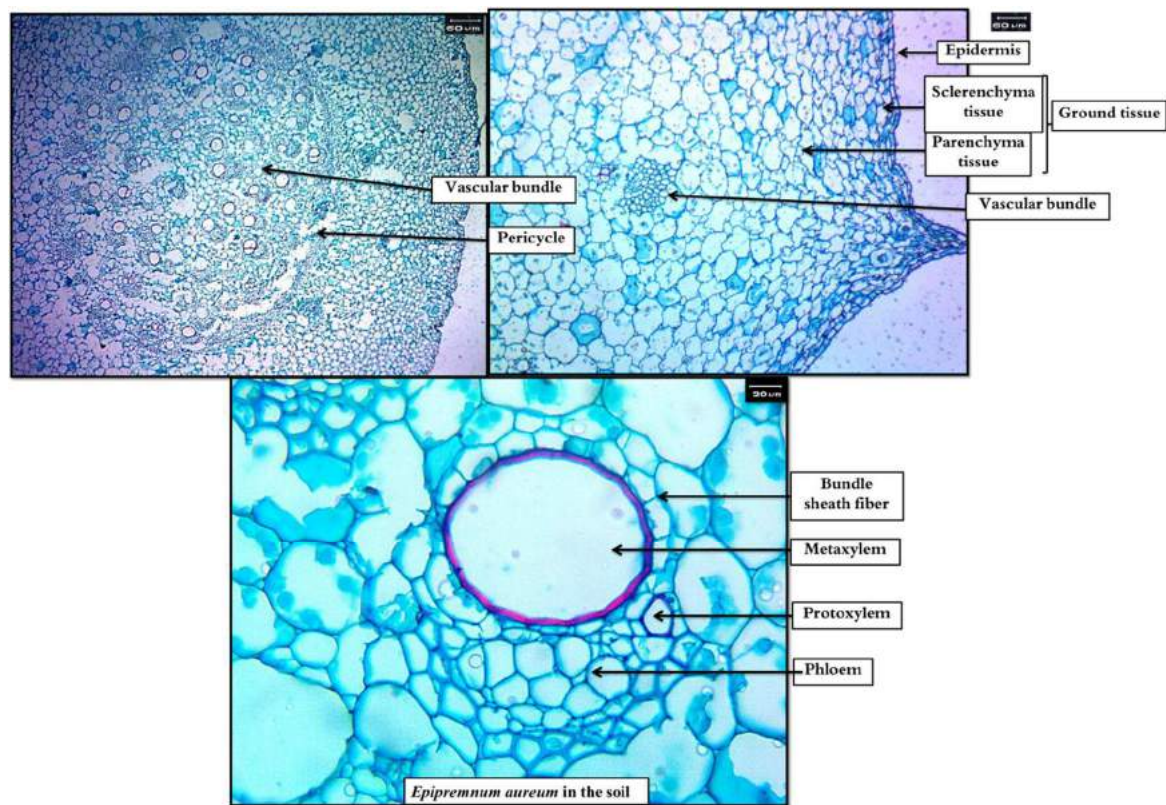


Shape 1: Root cross-section of the species *Epipremnum aureum* in soil.

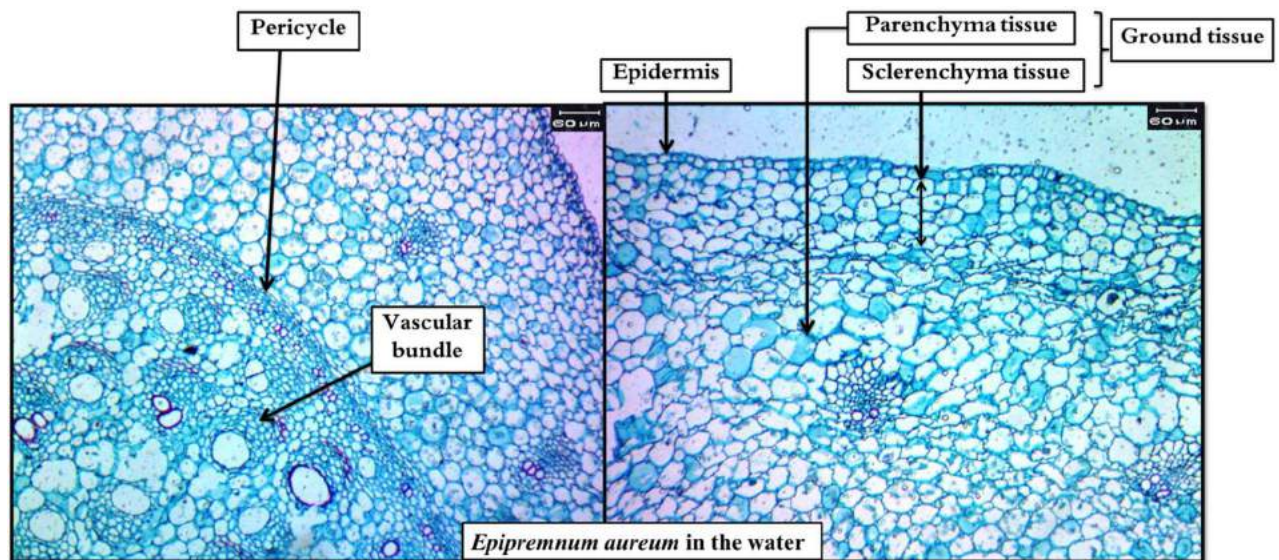


Shape 2: Root cross-section of the species *Epipremnum aureum* in soilless.

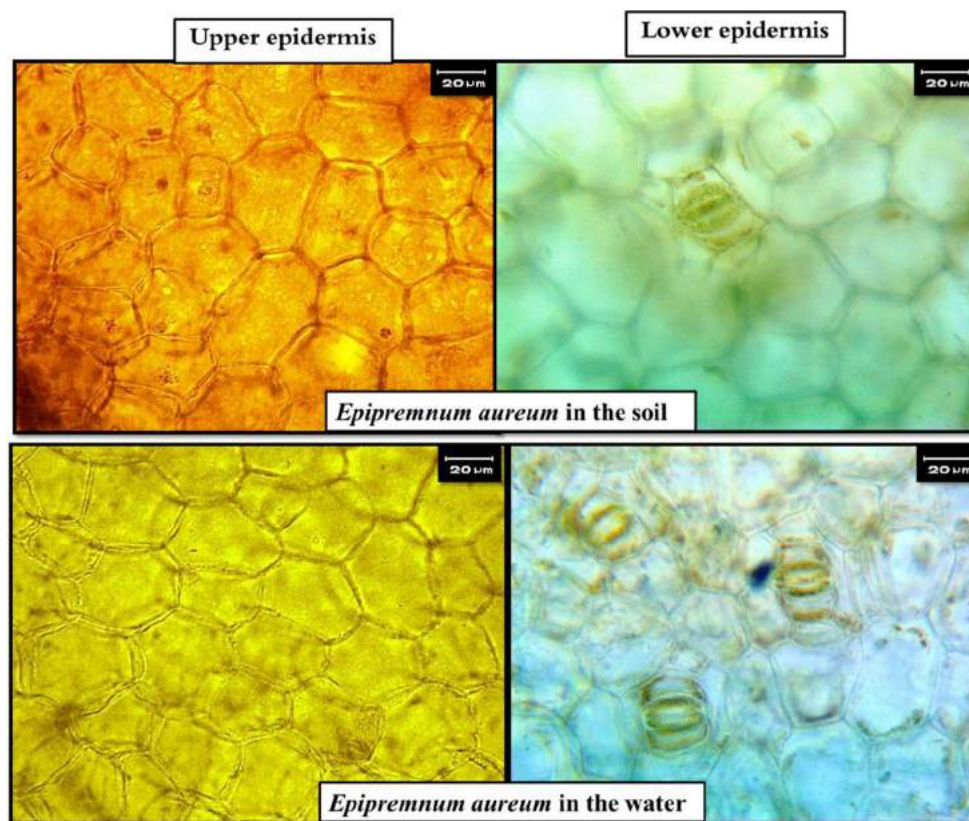




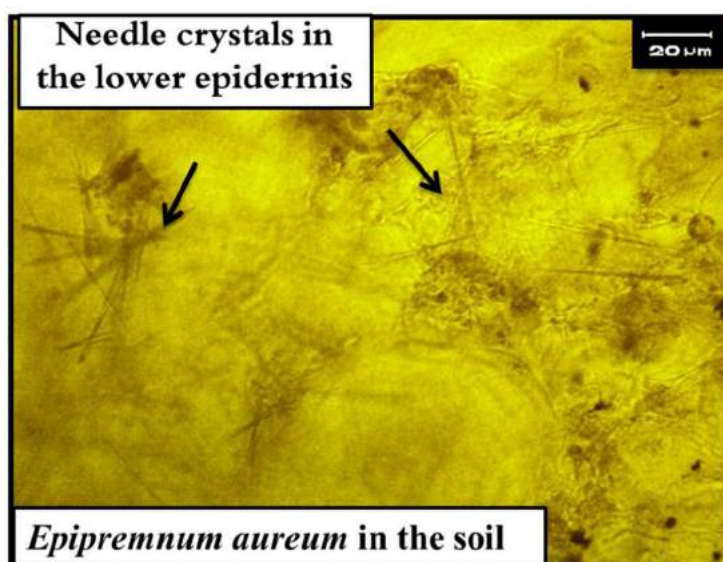
Shape 3: Stem cross-section of the species *Epipremnum aureum* in soil.



Shape 4: Stem cross-section of the species *Epipremnum aureum* in soilless.

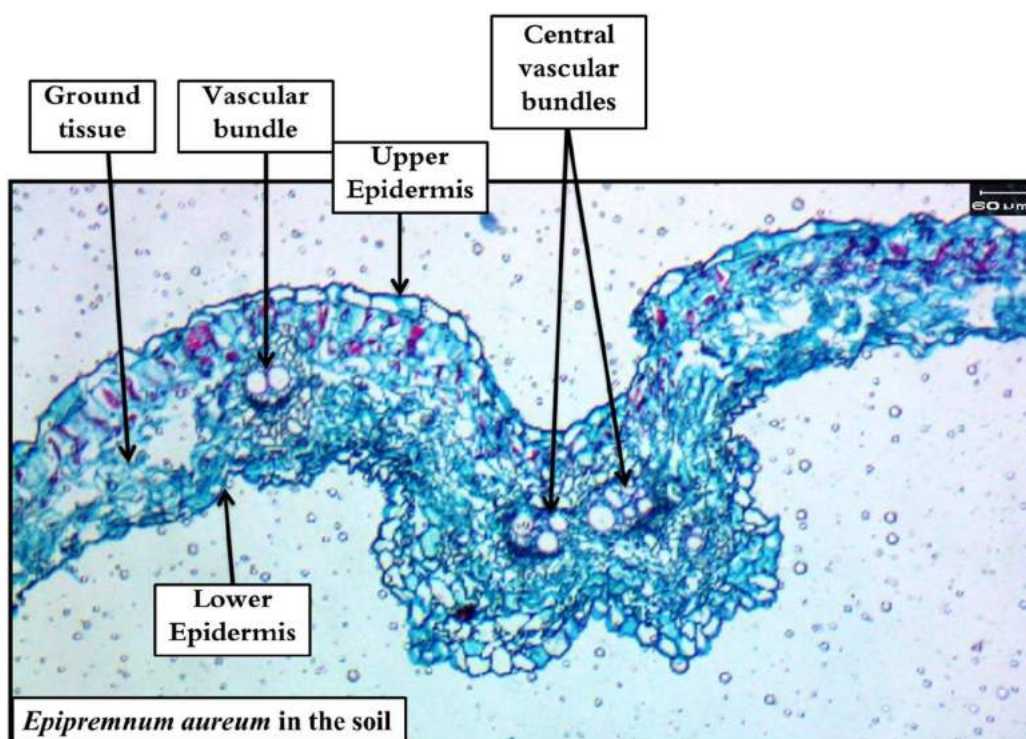


Shape 5: characters of epidermis in the species *Epipremnum aureum* in soil & water.

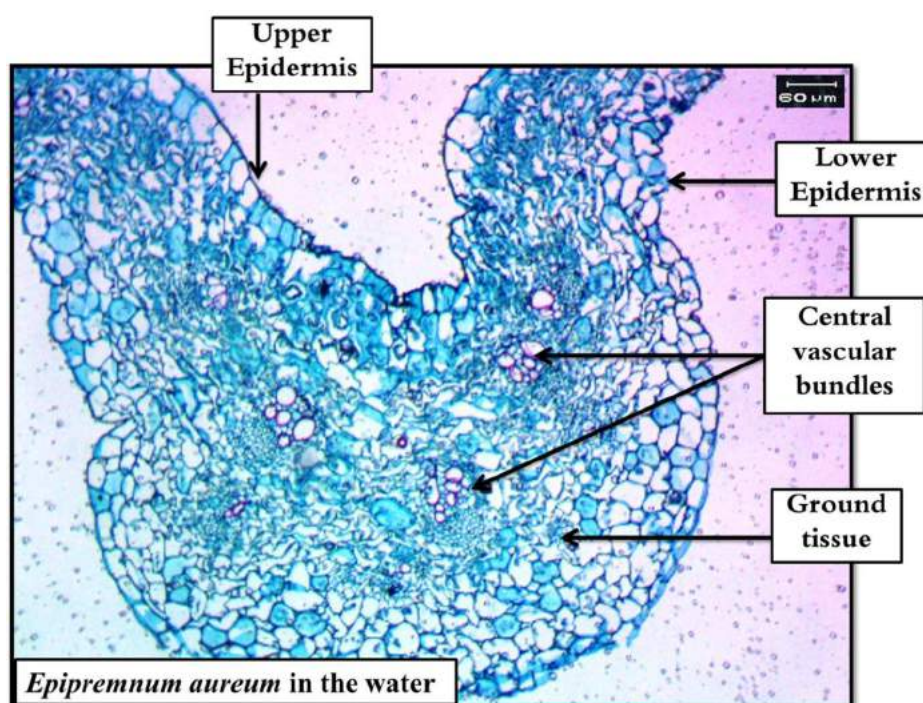


Shape 6: characters of the needle crystals in the epidermis in the species *Epipremnum aureum* in soil.





Shape 7: Transactional -section of the leaf in the species *Epipremnum aureum* in soil.



Shape 8: Transactional -section of the leaf in the species *Epipremnum aureum* in soilless.



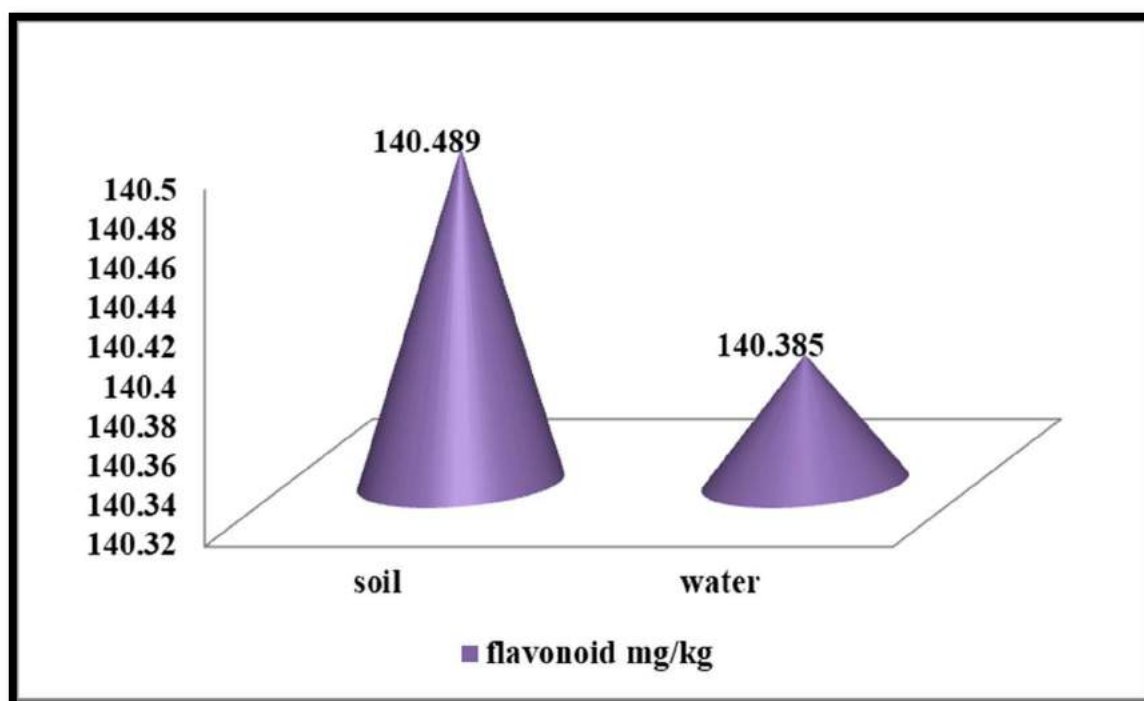


Chart 1: appeared the total flavonoids in the species

## References

1. Meshram, S. and Anju, N. (2014). Molecular and physiological role of *Epipremnum aureum*. International Journal of Green Pharmacy. 8 (2): 73-76.
2. Hung, Q.; Sun, C.; Kittur, H.; Jin, F.; Xie, C.; Ying-Hsuan, J.; Farooqahmed, S.; Richard J. and Gule, L. (2016). Gibberellin deficiency is responsible for shy-flowering nature of *Epipremnum aureum*. Scientific Reports. 6: 28-59.
3. Qu, L.; Chen, J.; Henny, R. J.; Huang, Y.; Caldwell, R. D. and Robinson, C. A.(2002).Thidiazuron promotes adventitious shoot regeneration from pothos (*Epipremnum aureum*) leaf and petiole explants. In Vitro Cellular & Developmental Biology - Plant. 38 (3): 268–271.
4. Sawada, A. and Oyabu, T. (2008). Purification characteristics of pothos for airborne chemicals in growing conditions and its evaluation. Atmospheric Environment. 42 (3): 594–602.
5. Meshram, S. and Anju, N. (2014). Molecular and physiological role of *Epipremnum aureum*". International Journal of Green Pharmacy. 8 (2): 73-76.
6. De-Costa, W.; Hitanayake, H. and Dharmawardena, I. (2011). A Physiological Investigation into the Invasive Behavior of Some Plant Species in a Mid-Country Forest Reserve in Sri Lanka. JNSFSL. 29 (1&2):35–50.
7. Moodley, D.; Procheş, S. and Wilson, J. (2017). Assessing and managing the threat posed by *Epipremnum aureum* in South Africa. South African Journal of Botany. 109: 178–188.
8. Rosalind, T. H.; Dutta, B. K., and Paul, S. B. (2013). Evaluation of in vitro antioxidant activity, estimation of total phenolic and flavonoid content of leaf extract of eurya japonica thunb. AJPCR, 6(1):152-55.

9. Hossain, M. A.; AL-Raqmi, K. A.; AL-Mijizy, Z. H.; Weli, A. M. and Al-Riyami, Q. (2013). Study of total phenol, flavonoids contents and phytochemical screening of various leaves crude extracts of locally grown *Thymus vulgaris*, APJTB, 3(9):705-10.
10. Chetan, S. S.; Deepali, M. J.; Sushama, D. P.; Leena, J. P. and Vilasrao, J. K. (2011). Phytochemical screening and in vitro antimicrobial activity studies of *Epipremnum aureum* Linn. leaves extracts, Der Pharmacia Sinica, 2 (5):267-72.
11. Johanson, A. D. (1940). Plant Microtechnique .1st ed. Mc. Graw-Hill Book Company, New York and London, 523 PP.
12. Stace, C. A. (1965). The Signification of The Leaf Epidermis in The Taxonomy of The Combretaceae: 1–A general Review of Tribal Generic and Specific Characters. J. Linn. Soc. (Bot), 59: 229-252.
13. Thammathaworn A. (19961). Handbook by paraffin method. Department of biology, Faculty of science, Khon Kaen University, Thailand.
14. Palanisamy, P.; Jayakar, B.; Kumuthavalli, M. V.; Kumar, Y. and Kashi, S. (2012). Preliminary phytochemical evaluation of whole plant extract of *Dipteracanthus prostratus* nees, International research journal of pharmacy, 3(1): 150-53.
15. Reddy A.R.; K.V. Chiatanyaand M. vivekanandan (2004). Drought induced responses of photosynthesis and antioxidant metabolism in higher plants .J Plant Physiol 161:1189-1202.
16. Mohamed E.F.; G.F. Azza ; T.A.M. Osman and A.A. Eman ( 2012). Histo-Pathological Changes in Leaves Cells of Squash Plants infected with Squash leaf curl begomovirus (SqLCV) Report and Opinion 2;4:(5).
17. Olmos E.; M.J. Sanchez-Blanco; T .Fernandez and J.J. Alarcon (2007).Sub cellular effects of drought stress in *Rosmarinus officinalis*. Plant Biology 9:77-84
18. Guerfel M., O;Baccouri; D. Boujnah; W. Chaibiand Zarrouk M (2009). Impacts of water stress on gas exchange; water relations, chlorophyll content and leaf structure in the two main Tunisian olive (*Olea europaea* L.) Cultivars. SciHortic 119:257-263.
19. Santandrea G. ; C. Taniand A. Bennici (1998).Cytological and ultrastructural response of *Nicotianatabacum* L. roots to manganese stress .Plant Biosyst . 132:197-206.
20. Child R.D.; J.E. Summers; J .Babij ; J.W. Farrentand D.M. Bruce (2003). Increased resistance to pod chatter is associated with changes in the vascular structure in pods of a resynthesized *Brassica napus*line . J Exp Bot 54:1919-1930.
21. Weier T.E; C.Ralphstocking and M.G. Barbour Botany (1974): An introduction to plant biology:fifth edition;p.165-175.
22. Matsuda K. and A. Rayan (1990). Anatomy: A Key factor regulating plant tissue response to water stress. In:Kafternan F (ed.) Environment Injury to Plants, San Diego: Academic Press, P.290.
23. Shao H.B.; L.Y. Chu; C.A. Jaleeland C.X. Zhao (2008).Water deficit stress induced anatomical changes in higher plants. CR Biol 331:215-225.

## MLETA'S GORGE AS A REPRESENTATIVE FACE OF THE MUDFLOW WATERCOURSES OF GEORGIA

Maya KUPRAVISHVILI

*Doctor of Technical Sciences, Associate Professor  
Georgian Technical University, Faculty of Agricultural Sciences and Bio-systems  
Engineering  
Department of Agro-engineering, Tbilisi, Georgia  
<https://orcid.org/0000-0003-4761-3640>*

### Abstract

Protecting the natural environment, in particular land, from dangerous geological, meteorological and other negative natural phenomena is an urgent task of modern society.

The combined action of the geological, climatic, meteorological and diverse landscape features of the mountainous terrain of Georgia often creates favorable conditions for the occurrence of mudflow events in certain regions of the territory, which in turn lead to environmental degradation and shortening of the country's land cover.

Distribution of riverbeds along the watershed is a complex and multi-factor process, which largely depends on the mud-flow type. In this regard, a field experiment was carried out on a Mleta Gorge.

Experimental and theoretical studies have obtained correlation between the angles of internal friction of the particles of the same diameter but different shape - the more meaning of its correlation, the harder the particle moves on the water channel bottom. This correlation acquires the maximum value in the case of sand-gravel fraction, which led to its anomalous action. It has been ascertained, that the washing and sedimentation process of the water channel of the debris flow largely depends on the shape of its constituting particles.

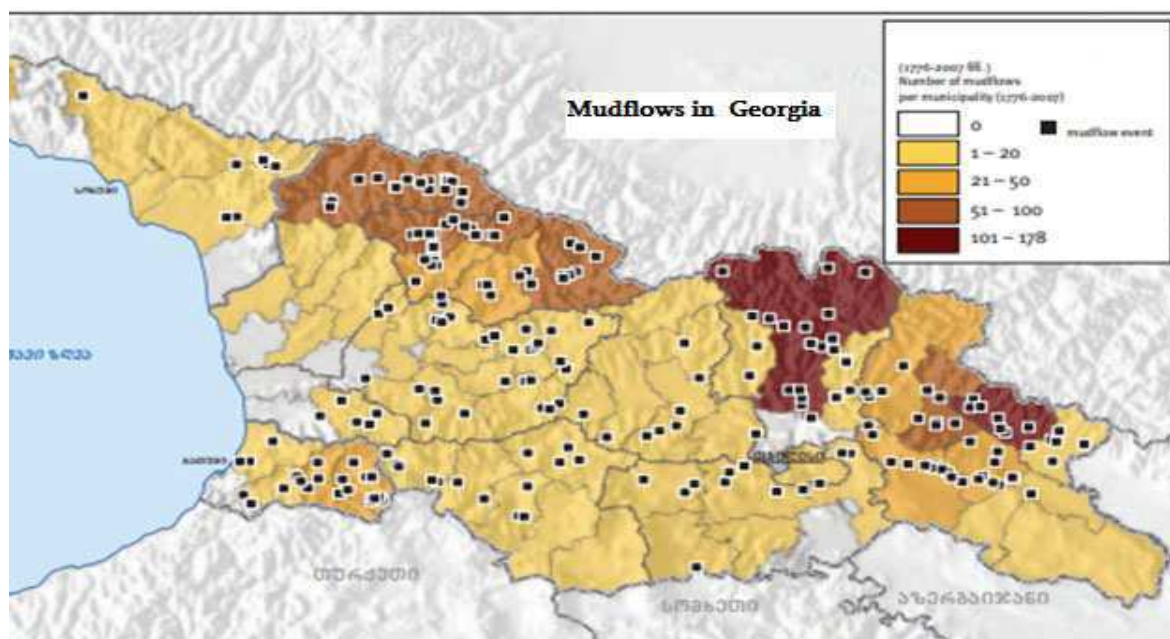
**Keywords:** correlation of internal friction angles of the particles; differential curves of granulometric composition; proluvium;

### INTRODUCTION

About a quarter of Georgia's territory is in the zone of intense mudflow. An important role in the formation of mudslides belongs to **temperature fluctuations**. The annual amount of radiation balance, with the exception of some regions, is positive, and it reaches 13-149 kcal / cm<sup>2</sup> at the controlled surface of the sun's rays in the afternoon. At an altitude of 2500 m above sea level, this value is 148-150 kcal/cm<sup>2</sup>. Among the climatic factors are snow cover, frequent fog, winds. For highland areas, the number of foggy days per year ranges from 45-85 on average, and the maximum wind speed reaches 45 m/sec. **From the lithological** point of view, a solid phase on mudflow generating ground is clayey-sandstones and sandstones, which are distinguished by different denotative resistance. **According to the vertical zoning**, the area of the territory of Georgia is divided into the following sequence: up to 500 m - 23.5%; 500-1000 m - 22.7%; 1000-1500 m - 17.4%; more than 2000 m - 19.8%.

Georgia is a highly representative region, with 20-25% of which are in the area of devastating action, depending on the type of mudflow genesis, the origin, the intensity

of the passage, and the volume of solid material on the cone. 79% of the recorded mudflows on the territory of Georgia belong to the Caspian Sea and 21% to the Black Sea basins.



Picture 1. Mud-flows in Georgia

## MATERIALS AND METHODS

In order to solve the problem, a field experiment was carried out according to the characteristics of the mudflows in one of the most representative ravine of the Mleta's Gorge, where the head, transit and accumulation zones (cone) of the mudflow are succinctly presented.



Picture 2. The Mleta's Gorge



The head zone of the Mleta's Gorge are represented by a canyon whose slopes cover  $50^{\circ}$  -  $60^{\circ}$  and decrease to  $45^{\circ}$  -  $20^{\circ}$ , the bed width from head to the end transit zone grows from 4- 5 m to 10- 15 m. Picture 2.

The accumulation zone (cone) is represented by an expanded cone up to  $60^{\circ}$ - $80^{\circ}$ , its surface is relatively curved and is represented by sand-gravel fractions below it.



**Picture 3. The accumulation zone (cone) of the Mleta's Gorge**

Based on the determination of the granulometric and mineralogical composition of the bedrock-forming particles, it was determined that the above-mentioned watercourse is characterized by turbulent mudflows.

The purpose of the experiment was to determine the distribution of the granulometric composition of the proluvium in the watercourse, taking into account the shape and size of the particles forming the bed.

To solve this problem, the particle size distribution of the proluvium was determined by the photoanalytical method at 11 sections 5-5 meters in the transit zone.



**Picture 4. Determine the distribution of the granulometric composition of the proluvium in the taranzit zone**

The granulometric composition of the mud -flow sediment along the transit zone is differentiated in **Picture 5, Picture 6, Picture 7, Figure 1, Figure 2, Figure 3.**





Picture 5. Proluvion on the before the middle of the transit zone

Pyramidal-shaped stones, with an average diameter  $d=0.10\div0.11$  m

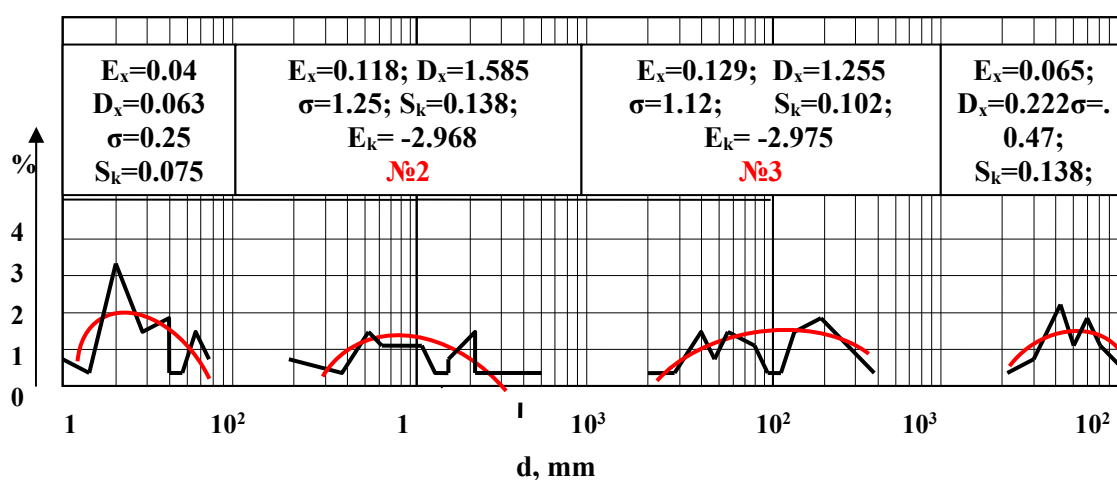


Figure 1. Differentiated curves of granulometric composition of bed-forming particles on the before the middle of the transit zone



Picture 6. Proluvion at the middle of the transit zone

The relatively small average diameter  $d = 0.032 \div 0.087$  m, pyramid-shaped stones.

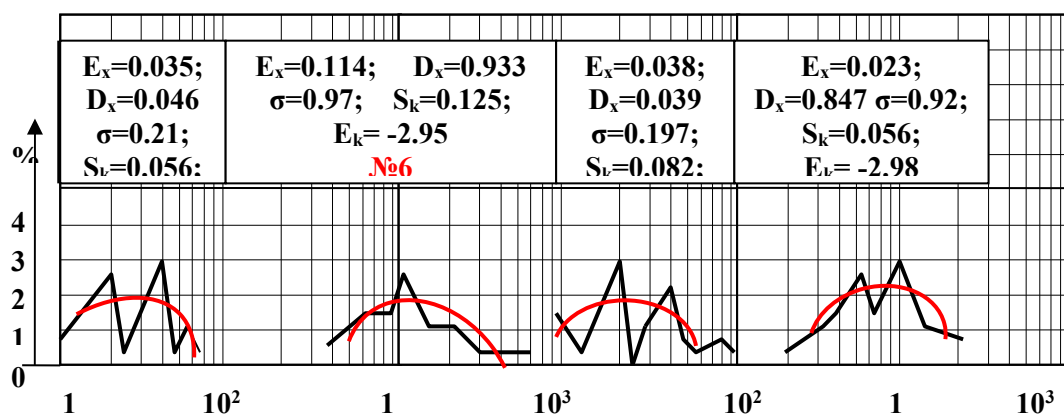
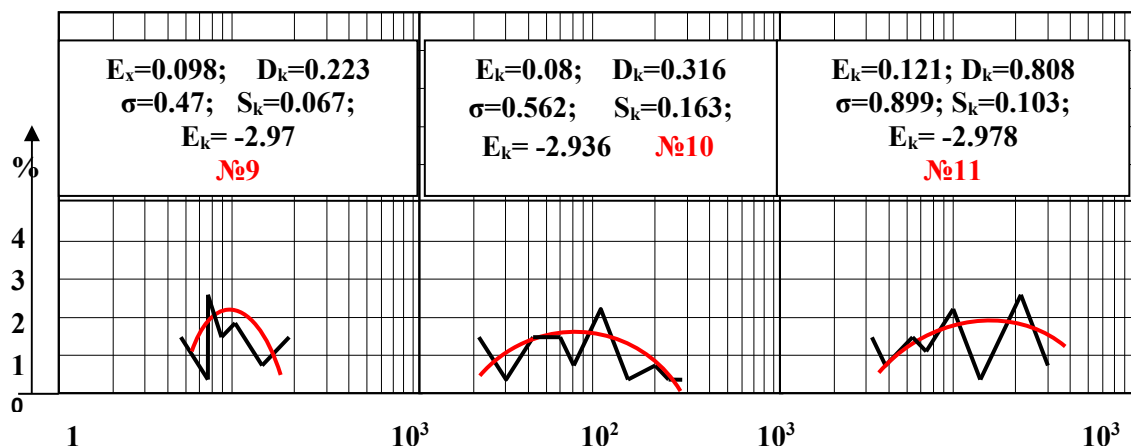


Figure 2 . Differentiated curves of granulometric composition of bed-forming particles at the middle of the transit zone



**Picture 7. Proluvion at the end of the transit zone Quite large average diameter  $d = 0.10 \div 0.121$  m stones, with relatively rounded cubic and prismatic surfaces.**



**Figure 3 . Differentiated curves of granulometric composition of bed-forming particles at the end of the transit zone**

Based on the mathematical statistics of the obtained data, the particles average diameter was determined: asymmetry and excess. The curves of granulometry composition are inscribed by the gamma distribution law. The curves describing the granulometric composition of the proluvion at the middle and end of the transit zone are relatively smooth, indicating particle homogeneity.

In order, to illustrate the variability of the granulometric composition, the integral curves of the granulometrical composition of the sedimentary mass deposited along the watercourse, are shown in Figure 4.

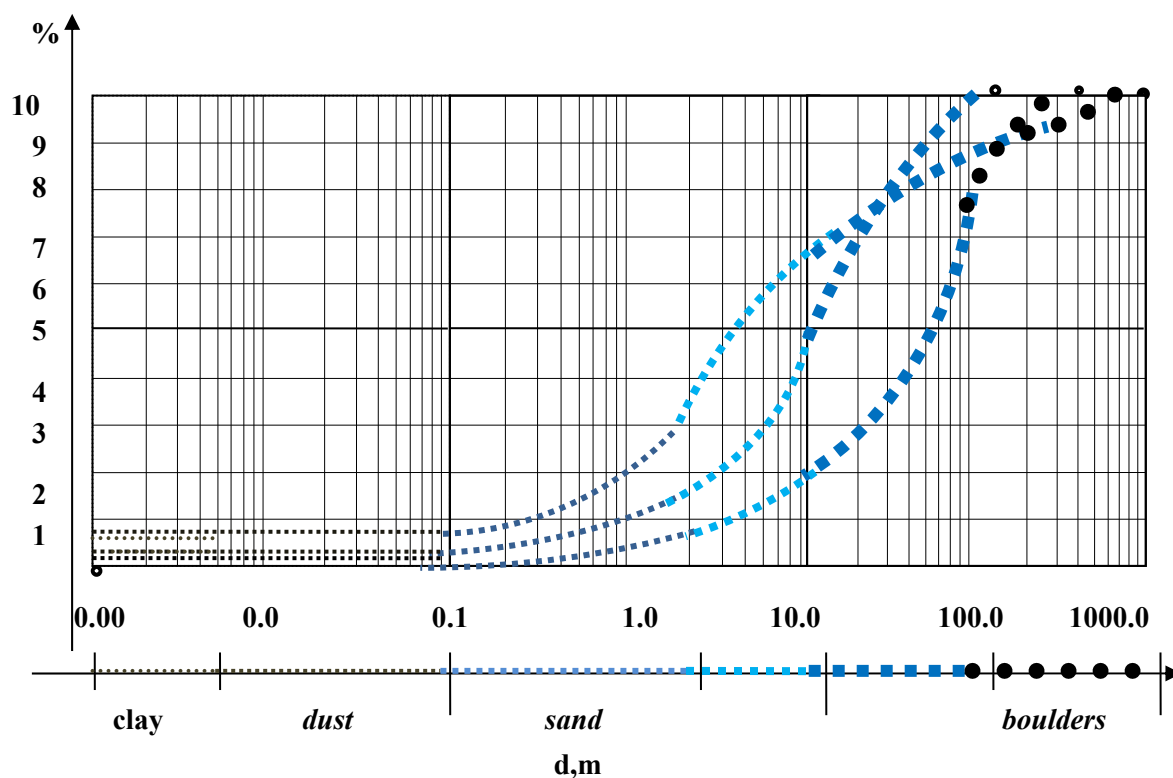


Figure 4. Integral curves of granulometric composition of mud-flow deposited in the transit zone

The analysis of the integral curves is given in the following table:

Table 1. Granulometric composition of proluvion In the transit zone of Mleti Gorge

Crossings of the transit zone	Percentage composition of fractions, %				
	Dust and clay-colloid <0.01 mm	Sand 0.01-2.0 mm	Gravel 2-10 mm	Stone 10-200 mm	Boulders 200< mm
before the middle	5	25	35	25	10
at the middle	5	10	30	55	—
at the end	3	5	15	70	7

It is noteworthy, that a gradual decrease in fractions of 2-10 mm and an increase in stones of 10-200 mm are observed in the sedimentary proluvium along the waterway. In view of the above, the sand-gravel fraction remained largely in the upper part of the transit, despite their small size, when large stones were moved extensively downstream, This process can be explained by the values of the **internal friction angles** of the particles proposed by D. Simon. The values of the internal friction angles for the particles of different shapes in the form of nomograms are shown in **Figure 5**.

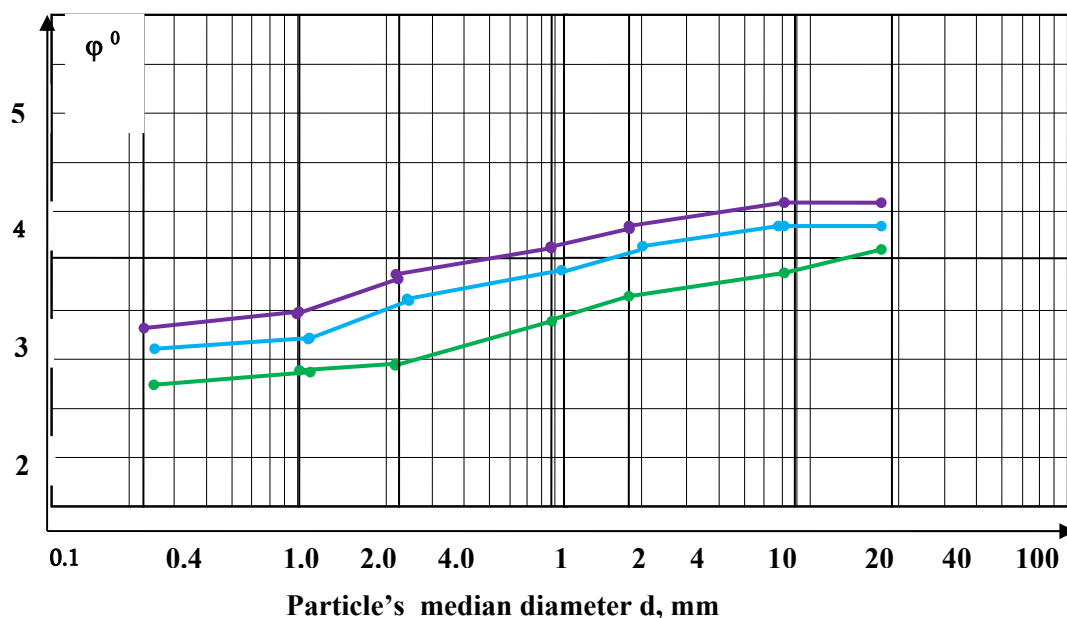


Figure 5. Nomograms of the dependence between the angles of the internal friction of the particles of different shape and the median diameter

The cornered, unrounded and rounded particles with the following diameters  $D_{\text{corner}} : D_{\text{unrounded}} : D_{\text{Round}} = 1 : 2,5 : 25$ , have the same internal friction angle; And the ratio of the internal friction angles of particles of the same diameter but of different shape (rounded, unrounded, corner), in relation to different diameters, determined by exponential dependency (Figure 6).

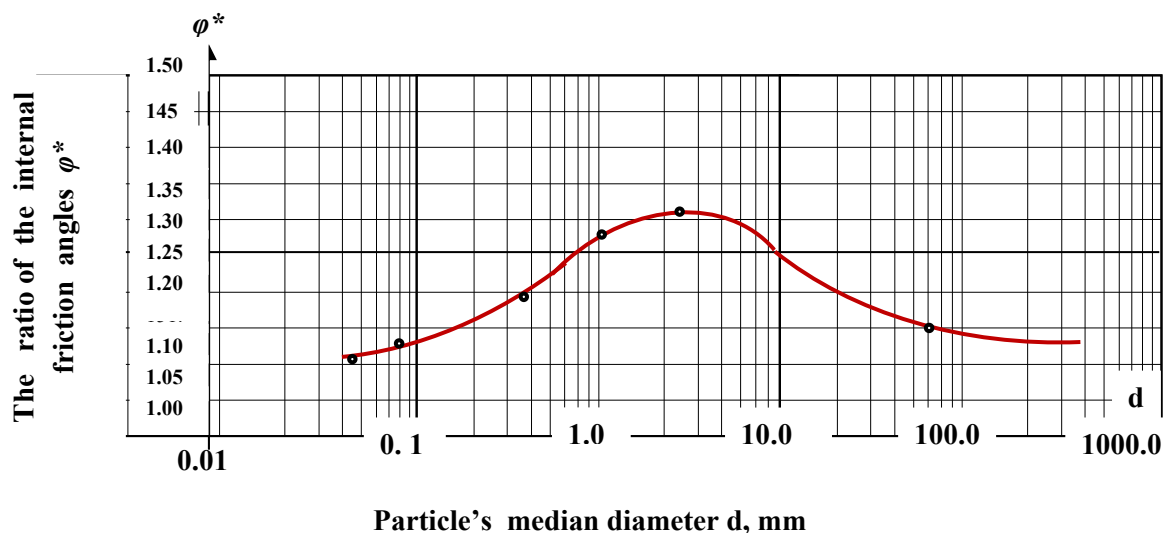


Figure 6. The dependence curve of  $\varphi^*(d) = f(d)$

As can be seen from the drawing, when  $D_{\text{cornered}} : D_{\text{unrounded}} : D_{\text{Round}} = 1 : 2,5 : 25$ , particles have same internal friction angle; This is diameter of particles with cornered, un-rounded and rounded shape. Ratio between the angles of the internal friction of particles of the same diameter, but cornered and rounded surface determined by exponential dependency.



In order to evaluate the stability of bedforms of different diameters and shapes, the relative friction angles of their inner fringes were analyzed, which was expressed by the following approach.

$$\varphi^*(d) = 1,23 \cdot e^{-(d-6)^2} \quad (1)$$

Where  $\varphi^*$  - the ratio between the angles of the internal friction of particles of the same diameter, but corner and rounded surface.

$$\varphi^* = \frac{\varphi^\Delta}{\varphi^0} \quad (2)$$

$d$  – particle's average median diameter (mm);

This function is maximal ( $\varphi^*=1,23$ ) in the case of sand-gravel fraction (2 mm), which led to the anormal action of the sand fraction, with a pronounced resistance; As for the large particles (10-200 mm) and the fine-grained fractions (0.01-2 mm), the relative values of their internal friction angles are the same; Therefore, their movement and stopping are conditioned not by form, but by size and weight.

## RESULTS

As a result of experiment conducted on the watercourse Mleti's Gorge, proluvion distribution was determined by the average particle diameter as follows: to the middle of the transit zone stopped stones and boulders with large diameters, with cornered and flat forms of the surface, in the middle of the transit zone stopped the fractions with smaller diameter and pyramidal forms, and at the end of the transit zone stopped large stones with rounded surfaces. Motion and sedimentation of proluvion particles significantly depends not only on the size (diameter), but also on their particle shapes. The table shows that the clay-colloidal fraction (particles with a diameter of less than 0.005 mm) was treated with the same percentage of content in both the transit zone and the cone (2-5% of the solid phase weight of the floodplain); The sand-gravel fraction remained 2 times more abundant in the transit zone compared to the mass deposited on the cone. Particles 10 to 200 mm in diameter were observed to be 2 times larger than the transit zone on the cone, which is due to the rounded shape of the surface of the fractions. Particles with a diameter of more than 100 mm, due to their rather large weight, stopped in the transit zone and were almost not marked on the cone.

## CONCLUSION

Have been established the influence of the particles shapes of the solid phase constituents of the mudflow mixture on the formation of the watercourse bed and the nature of their distribution in the transit and accumulation zone.

As a result of field observations, the boundary-dynamic equilibrium area of the watercourse has been established, where there is no intensive change in the morphometric characteristics of the bed over time. This allows us to select anti-mudflow events in this area, taking into account economic and environmental factors.

It has been ascertained, that the washing and sedimentation process of the riverbed of the debris flow largely depends on the shape of its constituting particles.

It is desirable to take the above into account when calculating the volumes of mudflow in the transit and accumulation zones, after which it will be possible to predict the environmental impact of the mudflows on the adjacent territory.

Generalization and consideration of the above-mentioned experimental and theoretical data will allow us to conveniently select the construction sites of effective mudflow control facilities in order to reduce the negative impact of mudflow events. Which is a prerequisite for protecting the fertile lands of the land from this dangerous exogenous event.

## REFERENCES

1. Egizarov I. 1959. To solving the problem of transporting unconnected sediments (any fraction) with influence of their concentration in the layer of the turbidity gradient Iz-vo./ AN. SS, 15: 115-126.
2. Egizarov I. 1963, Traffic heterogeneous sediment. Iz-vo AN. SSSR, seruia. texn. T-16, (12-3): .41-50.
3. Kupravishvili M. 2019. Correlation of internal friction angles of the particles with the same diameters. Georgia: Works of GTU, №4(514): 75-81. <https://doi.org/10.36073/1512-0996-2019-4-75-81>
4. Kupravishvili M. 2019, The distribution of channel formations (proluvium) along the watercourse. Georgia. Works of GTU, №4 (514): 66-74. <https://doi.org/10.36073/1512-0996-2019-4-66-74>.
5. Kupravishvili M. 2020, Why Mountains Cry. Germany, LAP LAMBERT Academic Publishing, 69 pp.
6. Sheko A.. 1988, Methods of studying and predicting of exogenous geological processes. Moskva, 215pp.
7. Simons D. 1977. Sediment transport technology. Collins..Water Resorces Public.Fort. 25-36
8. Takahashi T. 2007, Debris flow. London,UK, Taylor and Francis Group, 465 pp.
9. Ventcel E., Ovcharov L. 1983, Applied problems of probability theory. M. "Radio I sviaz". 414 pp.

## EFFECT OF MIXTURE FUNGAL INOCULANT ON NUTRITIONAL COMPOSITION OF SUNFLOWER MEAL BY WAY OF FERMENTATION

KARIŞIK KÜLTÜR FUNGAL İNOKULANTI İLE FERMANTASYONUN AYÇİÇEĞİ  
TOHUMU KÜSPESİNİN BESİN MADDE İÇERİĞİNE ETKİSİ

**Ramazan TOSUN<sup>1\*</sup>, Sulhattin YAŞAR<sup>2</sup>**

<sup>1</sup>*Iğdır University, Faculty of Agriculture Department of Animal Science, Iğdır, Turkey.  
ORCID iD: 0000-0002-8209-6362*

<sup>2</sup>*Karamanoglu Mehmetbey University, Faculty of Engineering, Department of Food  
Engineering, Karaman, Turkey.  
ORCID iD: 0000-0001-9334-1303*

### Özet

Bu çalışmada ayçiçeği tohumu küspesinin (ATK) *Aspergillus ficuum* (*A. ficuum*) + *Aspergillus niger* (*A. niger*) fungal kültür karışımı ile katı-faz fermantasyonu yöntemiyle besin madde, organik asit içeriğinin artırılması ve antibesinsel faktörlerin azaltılması amaçlanmıştır. Bu amaç doğrultusunda literatürdeki çalışmalardan da yararlanarak optimum fermantasyon koşulları (nem %80, sıcaklık 26 °C, karıştırma hızı 150 rpm, hava girişi 1.5 L/dakika ve pH 4.5-5.5) belirlenmiş ve ATK belirlenen fermantasyon koşulları altında herhangi bir mikroorganizma kültürü ilave edilmeden (kontrol) ve *A. ficuum* + *A. niger* karışımı ilave edilerek 72 saat fermantasyona tabi tutulmuştur. Fermantasyonlarda her 24 (0, 24, 48 ve 72 saat) saatte steril koşullar altında örnekler alınarak mikrobiyolojik ve kimyasal analizleri yapılmıştır. Örnekler düşük sıcaklıkta (40-50 °C) kurutulduktan sonra besin maddeleri, antibesinsel maddeler ve organik asit içerikleri tespit edilmiştir. Karışık fungal kültürü ile ATK fermantasyonu sonucunda ham kül ve ham yağ içeriği sırasıyla ortalama %42 ve %71 oranında azalmıştır. Ham protein içeriği fermantasyonun ilk 24 saatinde azalırken ilerleyen fermantasyon süresinde artmıştır. Fermantasyonda ham selüloz, ADF ve NDF önemli derecede azalmıştır. En fazla azalma ise fermantasyonun ilk 24 saatinde olmuştur. Fermantasyonun organik asit içeriklerine etkisi incelendiğinde ise asetik ve bütirik asit içeriğini azaltırken laktik asit içeriği önemli derecede artmıştır. Fermantasyonda tanin içeriği azalmış olup en fazla azalma fermantasyonun ilk 24 saatinde olmuştur. Diğer taraftan fitik asit fermantasyon süresince azalmıştır. Sonuç olarak, 72 saatlik fungal fermantasyonu ayçiçeği tohumu küspesinin besleyici değerinin artmasına ve özellikle de hayvan beslemede organik asit katkı maddesi olarak kullanılabileceği söylenebilir. Ancak bu sonuçların hayvan denemeleri ile de desteklenmesi gerekmektedir.

**Anahtar Kelimeler:** *Aspergillus ficuum*, *Aspergillus niger*, Ayçiçeği tohumu küspesi, Katı-faz fermantasyon

### Abstract

In this study, it was aimed to increase the nutrient and organic acid content and decrease the antinutritional factors by using solid-state fermentation method of sunflower meal (SFM) with *Aspergillus ficuum* (*A. ficuum*) + *Aspergillus niger* (*A. niger*) fungal culture mixture. For this purpose, optimum fermentation conditions were determined using the studies in the literature. An optimized set of fermentation parameters (80% moisture, 4.5-5.5 pH, 26 °C temperature, continuous aeration of 1.5 L min<sup>-1</sup> and agitation of 150 rpm) were used to ferment SFM samples with or without using mixed fungal inoculant for 72 h. Microbiological and chemical analyzes were made by taking samples under sterile conditions every 24 (0, 24, 48 and 72 hours) during fermentation. After drying the samples at low temperature (40-50 °C), nutrients, antinutritional substances and organic acid contents were determined. As a result of mixture fungal fermentation, crude ash and crude lipid content of SFM decreased by an average of 42% and 71%, respectively. Crude protein content decreased in the first 24 hours of fermentation and

increased in the further fermentation period. Crude fiber, ADF and NDF decreased significantly during fermentation, the greatest decrease was in the first 24 hours of fermentation. When the effect of fermentation on organic acid contents was examined, acetic and butyric acid contents decreased while lactic acid contents increased significantly. The tannin content decreased in fermentation and the greatest decrease was in the first 24 hours of fermentation. On the other hand, phytic acid decreased during fermentation. As a result, 72 hours of fungal fermentation increased the nutritive value of fermented SFM. It can be said that it can be used as an organic acid additive in animal nutrition, however, these results need to be supported by animal studies.

**Keywords:** *Aspergillus ficuum*, *Aspergillus niger*, sunflower meal, solid-state fermentation

## GİRİŞ

Ayçiçeği tohumu küspesi (ATK), hayvan beslemede soya fasulyesi küspesinden sonra en çok kullanılan bitkisel kökenli protein kaynağıdır. Ancak ATK'nın yüksek ham selüloz içeriği ve beslemeyi engelleyici bazı antibesinsel faktörleri (ABF) bünyesinde bulundurmasından dolayı hayvan beslemede özellikle de kanatlı hayvanların beslenmesinde kullanımı sınırlıdır (Sangsoponjit ve ark., 2017; Yaşar ve ark., 2018). ATK'nın kanatlılar için sınırlayıcı faktörlerini yok etmek veya en aza indirmek için enzim katılması, ısıtma işlemi uygulaması gibi birtakım metotlar uygulanmış, ancak bu yöntemler gerek yem maliyetinin artması gerekse istenilen etkinliği oluşturması açısından tatmin edici bulunmamıştır (Soltan ve ark., 2015). Bunun yerine diğer yöntemlere göre daha etkin ve ucuz yöntem olan katı faz fermantasyon (KFF) tekniği dikkat çekmektedir. KFF tekniği ile ATK ve kanola küspesi gibi yüksek selüloz ve ABF'ye sahip küspe ve yemlerin ABF içeriklerinin azaldığı ve yemlerin besin madde kalitesinin iyileştiğine dair çalışmalar mevcuttur (Ahmed ve ark., 2016; Yaşar ve Tosun, 2019).

KFF, katı ortamda suyun bulunmadığı veya çok az bulunduğu ortamda mikroorganizmaların doğal ortamındakine benzer büyüme ve faaliyet göstermesi olarak tanımlanabilir (Singhania ve ark., 2009). Bakteri, maya ve fungal kökenli mikroorganizmalar ile KFF'ye tabi tutulan ATK'nın besleme değerinin, organik asit içeriğinin, antioksidan ve enzim aktivitesinin arttığı, ham selüloz ve ABF gibi sınırlayıcı içeriklerin azaldığı bildirilmiştir (Soltan ve ark., 2015; Yaşar ve ark., 2018; Hassaan ve ark., 2018; Yaşar ve Tosun, 2019).

Bu çalışmanın amacı, modern bir biyoreaktör kullanarak fermantasyonda kullanılacak mikroorganizma kültürü için optimum şartlar (pH, karıştırma hızı, havalandırma ve nem içeriği) sağlanarak ayçiçeği tohumu küspesini *Aspergillus ficuum* (Reichert) Hennings, *anamorph* (ATCC® 66876™) + *Aspergillus niger* van Tieghem, *anamorph* (ATCC® 9029) ikili fungal kültürü ile 72 saat fermantasyona uğratmak ve fermantasyon sonucunda besin madde, organik asit ve antibesinsel faktörlerdeki değişimi tespit etmektir.

## MATERYAL ve METOT

Havada kuru formda (%90 kuru madde) olan ayçiçeği tohumu küspesinin (ATK) fermantasyon öncesi partiküller arasında uygun hava dolaşımı için 3 mm elekten geçirilerek öğütülmüştür. Öğütülen ATK 120 °C'de 15 dakika otoklavlanarak sterilizasyonu sağlanmıştır. DSMZ'den temin edilen *Aspergillus ficuum* (Reichert) Hennings, *anamorph* (ATCC® 66876™) (*A. ficuum*) ve *Aspergillus niger* van Tieghem, *anamorph* (ATCC® 9029) (*A. niger*) mikroorganizmaları DSMZ'nin önerdiği koşullarda çoğaltılarak fermantasyonda kullanılmak üzere depolanmıştır. Çalışma kapasitesi 2.5-3 litre olan LabforEtOH 5 (Infors Ltd., İsviçre) biyoreaktör, toplam hacim 2.5 L'yi geçmeyecek şekilde mikrobiyolojik kabin içinde katı ve sıvı ile doldurularak fermantasyon için istenilen koşullar sağlanıp katı faz fermantasyon

başlatılmıştır (Tablo 1). Fermantasyon süresi boyunca peristaltik pompaları sayesinde pH istenilen aralıkta tutulmuştur. Fermantasyonda pH'ı ideal aralıkta tutmak için asit ve baz tamponu olarak 0.1 M sodyum asetat (pH=1.5) ve 0.1 M sodyum bikarbonat (pH=9.75) kullanılmıştır. Aynı koşullar altında mikroorganizma kullanılmadan da ATK fermente edilmiştir (Tablo 1).

**Tablo 1.** Fermantasyon deneme deseni

Parametreler	Deneme I	Deneme II
<i>A. ficuum</i>	0	$2 \times 10^7$
+		
<i>A. niger</i> , spor g <sup>-1</sup>	0	$1 \times 10^7$
Substrat	Ayçiçeği tohumu küspesi	
pH	5.30	
Nem, %	80	
Sıcaklık, °C	26	
Hava, L dk <sup>-1</sup>	1.5	
Karıştırma, rpm	150	
Örnekleme aralığı (saat)	0, 24, 48 ve 72	

Biyoreaktör sisteminden çıkan hava yine filtrelerden geçtikten sonra portatif gaz ölçüm cihazı ile CO<sub>2</sub>, CH<sub>4</sub> ve H<sub>2</sub>S gazı ölçümlerine tabi tutulmuştur. Fermantasyon süreleri sonunda steril olarak alınan yaş örneklerde mikrobiyolojik analizler TS EN ISO 21527-1/2:2008, tarafından bildirilen koloni oluşturma birimi (kob.) metoduna göre yapılmıştır. Fermente ürünlerde organik asit (asetik, bütirik ve laktik asit) tayinleri Karabulut ve Canbolat (2005), tarafından bildirilen titrimetrik yöntem ile yapılmıştır. Fermente örneklerde besin madde analizleri AOAC (1990), tarafından bildirilen ve Karabulut ve Canbolat, (2005)'de ayrıntılı bir şekilde anlatılan metot protokollerine göre tespit edilmiştir. Metabolik enerji ve lignin ise hesap yolu tespit edilmiştir. Metabolik enerji (ME) değerlerinin hesabında Janssen (1989), tarafından formülden yararlanılmıştır. Tanin analizleri Chemesova ve Chizhikov (2004), fitik asit içeriği ise spektrofotometrik olarak Raheja ve ark. (1973) tarafından bildirilen metoda göre tespit edilmiştir.

Fermantasyon sonucu elde edilen örneklerde kimyasal analizler yapılmış ve kimyasal analiz sonucu elde edilen veriler General Linear Model (GLM) kullanılarak varyans analizine (2 yem x 4 inkübasyon zamanı x 3 örnek) tabi tutulmuştur. Analiz sonucunun önemli bulunması durumunda grup ortalamaları arasındaki farklılıklar ise Duncan Çoklu Karşılaştırma Testi ile belirlenmiştir.

## BULGULAR

Tüm fermantasyonlarda sıcaklık değerlerinde herhangi bir değişim söz konusu olmamış, biyoreaktör fermantasyon süresi boyunca sıcaklığı değerini sabit tutarak başarılı bir fermantasyon olması sağlanmıştır. ATK'nın mikroorganizma kullanılmadan (kontrol) yürütülen fermantasyon çalışmasında pH ve CO<sub>2</sub> değerinde istatistiksel bir değişim söz konusu olmamıştır (P>0.05). ATK'nın *A. ficuum*+*A. niger* kombine mikroorganizma inokulantları kullanılarak gerçekleştirilen fermantasyonda özellikle 48 ve 72 saatlerde pH'da yükselme gözlenmiştir (P<0.05). Bununla birlikte CO<sub>2</sub> düzeyi, özellikle 48 saatlik fermantasyonda %50'e kadar artmıştır. Diğer 24 ve 72 saatlik sürelerde %1 düzeyinde CO<sub>2</sub> çıkışı tespit edilmiştir. ATK'nın fungal kombini ile fermantasyonunda mikrobiyal gelişim yaklaşık 4 log gibi yüksek bir artış göstermiştir (Tablo 2) (P<0.05).

**Tablo 2.** Fermantasyonda pH, CO<sub>2</sub> ve mikrobiyal gelişimde gözlenen değişim

Deneme	Parametre	0. Saat	24 Saat	48 Saat	72 Saat
Deneme I	CO <sub>2</sub> , %	0±0.10	0±0.10	0±0.10	0±0.10
	pH	5.30±0.03	5.25±0.05	5.30±0.04	5.30±0.05
	Toplam fungal gelişim, spor g <sup>-1</sup>	0.00±0.00	0.0±0.00	0.0±0.00	0.0±0.00



<b>Deneme II</b>	CO <sub>2</sub> , %			0±0.10 <sup>c</sup>	1±0.10 <sup>b</sup>	50±0.10 <sup>a</sup>	1±0.10 <sup>b</sup>
	pH			5.30±0.01 <sup>c</sup>	5.10±0.01 <sup>d</sup>	6.49±0.03 <sup>a</sup>	5.80±0.40 <sup>b</sup>
	Toplam fungal gelişim, spor g <sup>-1</sup>			6x10 <sup>6</sup> ±0.03 <sup>c</sup>	9.86x10 <sup>9</sup> ±0.06 <sup>b</sup>	2x10 <sup>10</sup> ±0.04 <sup>a</sup>	2x10 <sup>10</sup> ±0.02 <sup>a</sup>

ATK'nın deneme I'deki koşullar altında fermente edildiğinde besin madde içeriklerindeki değişim istatistiksel olarak önemsizdir ( $P>0.05$ ) (Tablo 3). Ancak deneme II'deki koşullar altında ATK fermente edildiğinde besin madde içeriği fermantasyondan önemli derecede etkilenmiş ve bu değişimler istatistiksel olarak önemli ( $P<0.05$ ) olduğu tespit edilmiştir (Tablo 3).

ATK'nın *A. ficuum*+*A. niger* kombine fungal kültürleri ile fermantasyona tabi tutulduğunda ham kül (HK) içeriği (%6.55'den %3.85'e kadar) önemli derecede azalmıştır ( $P<0.05$ ). Ham protein (HP) içeriği ise fermantasyonun 24 ve 48 saatlerinde önemli derecede azalmasına rağmen fermantasyonun ilerleyen saatlerinde arttığı tespit edilmiştir ( $P<0.05$ ). ATK'nın ham yağ (HY) içeriği fungal mikroorganizmalar ile yürütülen fermantasyondan etkilenmiş ve fermantasyon süresi boyunca azalarak %0.28 oranından %0.08 oranına kadar düşmüştür ( $P<0.05$ ). *A. ficuum*+*A. niger* ile ATK fermente edildiğinde ham selüloz (HS), ADF, NDF ve lignin içeriklerinin önemli derecede azalırken toplam redükte şeker (TRŞ) ve metabolik enerji (ME) içerikleri artmıştır ( $P<0.05$ ).

**Tablo 3.** ATK'nın fermantasyonu sonucunda besin madde içeriğinde meydana gelen değişim

Parametre	Deneme	0. saat	24. saat	48. saat	72. saat
HK, %	I	6.55±0.08	6.30±0.44	6.35±0.20	6.45±0.15
	II	6.55±0.08 <sup>a</sup>	2.35±0.44 <sup>b</sup>	3.06±0.89 <sup>b</sup>	3.85±0.25 <sup>b</sup>
HP, %	I	35.25±0.14	35.15 ±0.15	35.20 ±0.14	35.22±0.11
	II	35.25±0.14 <sup>b</sup>	32.63±0.41 <sup>c</sup>	33.25±0.26 <sup>c</sup>	36.54±0.47 <sup>a</sup>
HY, %	I	0.28±0.01	0.30±0.03	0.28±0.03	0.27±0.02
	II	0.28±0.01 <sup>a</sup>	0.21±0.03 <sup>b</sup>	0.18±0.03 <sup>b</sup>	0.08±0.03 <sup>c</sup>
HS, %	I	25.26±1.80	24.71±0.40	25.04±0.23	25.27±0.25
	II	25.26±1.80 <sup>a</sup>	14.68±0.77 <sup>c</sup>	13.95±0.16 <sup>c</sup>	20.68±0.24 <sup>b</sup>
ADF, %	I	34.05±0.97	34.00±0.25	34.08±0.42	34.21±0.32
	II	34.05±0.97 <sup>a</sup>	29.46±0.12 <sup>c</sup>	31.49±0.22 <sup>b</sup>	28.53±0.99 <sup>c</sup>
NDF, %	I	52.12±1.03	52.12±0.25	52.14±0.24	52.50±0.25
	II	52.12±1.03 <sup>a</sup>	45.70±0.67 <sup>c</sup>	49.70±0.06 <sup>b</sup>	49.21±0.75 <sup>b</sup>
Lignin, %	I	8.79	8.63	8.62	8.63
	II	8.79	14.78	17.54	7.85
TRŞ, %	I	13.75±1.81	13.73±0.15	13.70±0.22	13.98±0.45
	II	13.75±1.81 <sup>d</sup>	34.7±0.04 <sup>a</sup>	30.43±0.03 <sup>b</sup>	24.93±0.12 <sup>c</sup>
ME, kkal/kg KM	I	1757	1777	1765	1758
	II	1757	2305	2189	2134

HK: ham kül, HP: ham protein, HY: ham yağ, HS: ham selüloz, TRŞ: toplam redükte şeker, ME: metabolik enerji, KM: kuru madde.

ATK'nın mikroorganizma kullanılmadan (deneme I) yürütülen fermantasyon çalışmasında organik asit içeriklerinde rakamsal bir değişim söz konusu olmuş olsa da istatistiksel olarak önemsizdir ( $P>0.05$ ) (Tablo 4). Ancak ATK'nın *A. ficuum* + *A. niger* ile yürütülen fermantasyon çalışmasında ise organik asit içeriklerinde önemli değişiklikler olmuştur ( $P<0.05$ ) (Tablo 4). Asetik asit (AA) içeriği fermantasyon sonunda %46 oranında azalmıştır. Bütirik asit (BA) içeriği ise %100 oranında azaldığı tespit edilmiştir. Laktik asit (LA) içeriği ise çok önemli derecede artmış, en fazla artış ise fermantasyonun ilk 24 saatinde %426 olmuştur. Toplam organik asit (TOA) içeriği ise laktik asit içeriğinden dolayı fermantasyonun ilk 24 saatinde artmış ancak bu artış fermantasyonun ilerleyen saatlerinde asetik asit ve bütirik asit oranlarındaki azalmalardan dolayı azalmıştır.

**Tablo 4.** Yürütülen fermantasyonlarda organik asit içeriklerindeki değişim

Deneme	Saat	AA, %	BA, %	LA, %	TOA, %
Deneme I (Kontrol)	0	2.10±0.59	1.17±0.66	0.95±1.30	4.23±1.40
	24	2.00±0.59	1.15 ±0.25	0.90±0.45	4.05±0.40
	48	2.05±0.24	1.20 ±0.17	0.98±0.20	4.23±0.44
	72	2.01±0.10	1.12±0.15	0.97±0.25	4.12±0.25
Deneme II ( <i>A. ficuum</i> + <i>A. niger</i> )	0	2.10±0.59 <sup>b</sup>	1.17±0.66 <sup>a</sup>	0.95±1.30 <sup>c</sup>	4.23±1.40 <sup>b</sup>
	24	3.26±0.26 <sup>a</sup>	0.00±0.00 <sup>b</sup>	5.12±0.42 <sup>a</sup>	8.38±0.39 <sup>a</sup>
	48	0.91±0.12 <sup>c</sup>	0.00±0.00 <sup>b</sup>	3.99±0.10 <sup>b</sup>	5.90±0.13 <sup>b</sup>
	72	1.13±0.15 <sup>bc</sup>	0.00±0.00 <sup>b</sup>	4.80±0.21 <sup>a</sup>	5.93±0.14 <sup>b</sup>

AA: asetik asit; BA: bütirik asit; LA: laktik asit; TOA: toplam organik asit

ATK'nın mikroorganizma kullanılmadan (deneme I) yürütülen fermantasyonda antibesinsel faktörlerde (ABF) istatistiksel olarak önemli bir değişim olmamıştır ( $P>0.05$ ). ATK'nın *A. ficuum*+*A. niger* (deneme II) ile fermantasyonu sonucunda ABF'de önemli değişimler saptanmıştır ( $P<0.05$ ) (Tablo 5).

**Tablo 5.** ATK'nın fermantasyon sonucunda ABF'de meydana gelen değişim

Deneme	ABF	0	24	48	72
Deneme I (Kontrol)	Tannin, %	3.18±0.52	3.10±0.54	3.05±0.40	3.10±0.35
	Fitik asit, µg/g	0.76±0.03	0.70 ±0.05	0.71±0.03	0.71±0.04
Deneme II ( <i>A. ficuum</i> + <i>A. niger</i> )	Tannin, %	3.18±0.52 <sup>a</sup>	0.83±0.03 <sup>d</sup>	1.26±0.06 <sup>c</sup>	2.38±0.03 <sup>b</sup>
	Fitik asit, µg/g	0.76±0.03 <sup>a</sup>	0.47±0.02 <sup>b</sup>	0.28±0.03 <sup>c</sup>	0.15±0.01 <sup>d</sup>

## TARTIŞMA

Altop ve ark. (2019) yaptığı çalışmada ATK'nın *A. niger* ile fermantasyonunda HK içeriği yaklaşık %34 oranında arttığını bildirmiştir. Ancak bu çalışmada Altop ve ark. (2019) bulduğu sonucun aksine HK içeriği %41 oranında azalmıştır. Bunun sebebi olarak tekli fungal yerine ikili fungal mikroorganizma kullanılması halinde mikroorganizmaların mineral madde gereksinimlerinin fazla olmasından veya fermantasyon koşullarından kaynaklandığı düşünülmektedir. ATK'nın bakteri, maya ve fungallarla fermantasyonu sonucunda HP içeriğinin %25-36 oranlarında arttığı bildirilmiştir (Soltan ve ark., 2015; Yaşar ve ark., 2018; Altop ve ark., 2019). Bu çalışmada da HP içeriğindeki değişim literatürdeki sonuçlar ile benzerlik göstermektedir. ATK'nın *Trichoderma reesei* (Yaşar ve Tosun, 2019) ile fermantasyonu sonucunda HY içeriği %21 oranında; *Aspergillus niger* (Alttop ve ark., 2019) ile fermantasyonunda ise %41 oranında arttığı belirtilmiştir. Bu çalışmada da önceki çalışmalardan elde edilen sonuçlara benzer şekilde HY içeriğinin %71 oranında artmıştır. ATK'nın mikrobiyal fermantasyonu sonucunda HS, ADF, NDF ve lignin içeriklerinin azaldığı bildirilmiştir (Soltan ve ark., 2015; Yaşar ve ark., 2018). Bu çalışmada da HS, ADF, NDF ve lignin içeriklerindeki değişimler önceki çalışmalardan elde edilen sonuçlarla paralellik göstermektedir. Karakurt ve ark. (2019) yaptığı ATK'nın *Bacillus subtilis* ile fermantasyon çalışmasında TRŞ içeriğinin değişmediği, Yaşar ve Tosun, (2019) yürüttüğü çalışmada ise arttığını belirtmişlerdir. Bu çalışmada elde edilen sonuçlar ise Yaşar ve Tosun, (2019) sonuçları ile benzerlik göstermektedir.

ATK'nın mikrobiyal fermantasyon sonucunda organik asitlerde önemli değişimlerin elde edildiği bildirilmiştir (Yaşar ve ark., 2018; Yaşar ve Tosun, 2019; Karakurt ve ark., 2019). Bu fermantasyon çalışması sonucunda da ATK'nın organik asitler içeriğindeki değişimler önceki çalışmalardan elde edilen sonuçlarla benzerdir.

Katı faz fermantasyonu sonucunda ATK'nın ABF içeriklerinin önemli derecede azaldığını bildirilmiştir (Soltan ve ark., 2015; Yaşar ve ark., 2018; Karakurt ve ark., 2019; Yaşar ve Tosun, 2019). Bu çalışmada da ATK'nın fungal kombini ile fermantasyona uğratıldığında literatürdeki sonuçlarla büyük uyum göstermektedir.

**SONUÇ**

Ayçiçeği tohumu küspesinin *A. ficuum* + *A. niger* kullanılarak yürütülen fermantasyon çalışmasında ATK'nın ham selüloz, ADF, NDF, lignin ve antibesinsel faktör içeriklerinde önemli derecede azalma olduğu, ham protein, toplam redükte şeker, metabolik enerji ve özellikle laktik asit bakımından zenginleştiği, elde edilen bu yeni fermente ürünün hayvan beslemede fonksiyonel bir ürün olarak özellikle laktik asit bakımından kullanılma olanağı yüksek olacağı sonucuna varılmıştır.

**Bilgilendirme:** Bu araştırma TÜBİTAK VHAG 1001 tarafından desteklenmiştir (Proje No: 124O629).

**KAYNAKLAR**

1. Ahmed A, Zulkifli I, Farjam AS, Abdullah N, Liang JB, Awad EA 2016. Effect of solid state fermentation on nutrient content and ileal amino acids digestibility of canola meal in broiler chickens. Italian Journal of Animal Science, 13: 410-414.
2. Altop A, Güngör E, Erener G 2019. Improvement of Nutritional Quality of Some Oilseed Meals Through Solid-State Fermentation Using *Aspergillus niger*. Turkish Journal of Agriculture - Food Science and Technology, 7(9): 1411-1414.
3. AOAC (Association of Official Analytical Chemists), 1990. Official Methods of Analysis. 18th ed., Washington DC.USA.
4. Chemesova II, Chizhikov DV 2004. Determination of tannin content in rhizomes of *Comarum palustre* L. and its tincture by spectrophotometric method. Rastitel'nye Resursy, 40(3): 122-130.
5. Hassaan MS, Soltan MA, Mohammady EY, Elashry MA, El-Haroun ER, Davies SJ 2018. Growth and physiological responses of Nile tilapia. *Oreochromis niloticus* fed dietary fermented sunflower meal inoculated with *Saccharomyces cerevisiae* and *Bacillus subtilis*. Aquaculture, 495: 592-601.
6. Janssen WMMA 1989. European Table of Energy Values for Poultry Feedstuffs. Spelderholt Institute for Poultry Research and Information Services.
7. Karabulut A, Canbolat Ö 2005. Yem Değerlendirme ve Analiz Yöntemleri. Uludağ Üniversitesi Yayınları, Bursa Yayın No:2.05.048.0424, ISBN 975-6149-07-8.
8. Karakurt Y, Güvercin D, Önder S, Çelik C, Tosun R, Baran B, Yaşar S 2019. Chemical, enzymatic, and antioxidant enrichments of full-fat soybean and sunflower meal by *Bacillus subtilis* (ATCC® 6633™) fermentation using a solid-state bioreactor. Turkish Journal of Veterinary and Animal Sciences, 43: 82-93.
9. Raheja RK, Kaur C, Singh A, Batia IS 1973. New colorimetric method for the quantitative of phospholipids without aid digestion. Journal of Lipid Research, 14:695.
10. Sangsoponjit S, Suphalucksana W, Srikijsakemwat K 2017. Effect of feeding sunflower meal on the performance and carcass characteristics of broiler chickens. Chemical Engineering Transactions, Vol. 58, Doi: 10.3303/Cet1758141
11. Singhaniaa RR, Patel AK, Soccolc CR, Pandey A 2009. Recent advances in solid-state fermentation. Biochemical Engineering Journal, 44: 13-18.
12. Soltan MA, Hassaan MS, Abdella MS, El-Syaad GA, El-Ashry MA 2015. Yeast fermented sunflower meal as a replacer for fish meal in the diet of Nile tilapia. *Oreochromis niloticus*. Egyptian Journal of Aquatic Biology and Fisheries, 19: 65-72.
13. Yaşar S, Tosun R 2019. *Trichoderma reesei* simmons anamorph (ATCC® 26921) ile Fermente Edilmiş Ayçiçeği Küspesinin Fonsiyonel Yem Olarak Değerlendirilmesi. Mas 5. Uluslararası Matematik-Mühendislik-Fen ve Sağlık Bilimleri Kongresi. 2-5 Mayıs. Erzurum.

14. Yaşar S, Uysal C, Tosun R 2018. Nutritional fortification of sunflower meal by *Bacillus subtilis* ATCC PTA-6737 fermentation. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Veterinary medicine, 75:1-6.

## NEUROTOXIC EFFECTS CAUSED BY SODIUM NITRITE IN ZEBRAFISH EMBRYOS/LARVAE (*DANIO RERIO*)

ZEBRA BALIĞI EMBRİYOLARINDA/LARVALARINDA (*DANIO RERIO*) SODYUM NİTRİTİN NEDEN OLDUĞU NÖROTOKSİK ETKİLER

Mine KÖKTÜRK<sup>1\*</sup>, Fikret ALTINDAĞ<sup>2</sup>, Güneş ÖZHAN<sup>3,4</sup>, Arzu ODUNKIRAN<sup>5</sup>

*Iğdir University, College of Applied Sciences, Department of Organic Agriculture Management, Iğdir, Turkey, ORCID:0000-0003-4722-256X*

<sup>2</sup>*Van Yüzüncü Yıl University, Medical School, Department of Histology and Embryology, Van, Turkey, ORCID:0000-0002-4074-5168*

<sup>3</sup>*Dokuz Eylül University Health Campus, Izmir Biomedicine and Genome Center, Izmir, Turkey*

<sup>4</sup>*Izmir International Biomedicine and Genome Institute, Dokuz Eylül University, Izmir, Turkey, ORCID:0000-0002-4806-5917*

<sup>5</sup>*Iğdir University, Iğdir Vocational School of Higher Education, Department of Hotel, Restaurant and Catering Services, Iğdir, Turkey, ORCID: 0000-0002-6455-8594, e-mail:*

### Abstract

Organisms are exposed to nitrite in various ways, from water sources, as a food additive-preservative and color source. In this study, we evaluated the effect of exposure to sodium nitrite ( $\text{NaNO}_2$ ), a widely used food additive, on important parameters (survival rate, hatching rate, malformations) for toxicological assessments in zebrafish embryo/larvae. We also investigated brain histopathological changes by exposing zebrafish embryos to different doses of sodium nitrite. Embryos were divided into five groups: one control group and four sodium nitrite-treated group (10, 100, 500 and 1000 mg/L) (30 embryos per group). The survival rate was significantly reduced at the highest concentration (1000 mg/L, 58%) compared to the other groups. When the effect of sodium nitrite on larval hatching rates was evaluated, it was observed that it delayed larval hatching at high concentrations (500 and 1000 mg/L). Similarly, morphological deformations were detected at high rates, especially at high doses (500 and 1000 mg/L), and malformations such as pericardial edema, curved body axis, tail malformation, microphthalmia were detected in embryos/larvae. The most observed malformation is pericardial edema with a rate of 83%. In histological examinations, necrotic cells were observed in the brain tissues of zebrafish larvae at 96 hours exposed to nitrite at concentrations of 500 and 1000 mg/L. Our results showed that sodium nitrite, which is used as an additive in the food industry, has neurotoxic effects in addition to the toxic effects reported in previous studies.

**Keywords:** Zebrafish; sodium nitrite; brain histopathology; hatching rate; malformations

### Özet

Canlılar, nitritlere su kaynaklarından, gıda için katkı-koruyucu ve renk kaynağı olarak kullanımı ile çeşitli şekillerde maruz kalırlar. Bu çalışmada, yaygın kullanılan bir gıda katkı maddesi olan sodyum nitrite ( $\text{NaNO}_2$ ) maruz kalmanın zebra balığı embriyo/larvalarında toksikolojik değerlendirmeler için önemli parametreler (hayatta kalma, kuluçkadan çıkış oranı, malformasyonlar) üzerindeki etkisini değerlendirdik. Zebra balığı embriyolarını farklı



dozlarda sodyum nitrite maruz bırakarak beyin histopatolojik değişikliklerini de araştırdık. Embriyolar beş gruba ayrıldı: bir kontrol grubu ve dört sodyum nitrit ile tedavi edilen grup (10, 100, 500 ve 1000 mg/L) (grup başına 30 embriyo). Hayatta kalma oranı, diğer gruplara kıyasla en yüksek konsantrasyonda (1000 mg/L, %58) önemli ölçüde azaldı. Sodyum nitritin larva çıkış oranlarına etkisi değerlendirildiğinde yüksek konsantrasyonlarda (500 ve 1000 mg/L) larva çıkışını geciktirdiği görülmüştür. Benzer şekilde özellikle yüksek dozlarda (500 ve 1000 mg/L) yüksek oranlarda morfolojik deformasyonlar saptanmış ve embriyolarda/larvalarda perikardiyal ödem, eğri gövde eksen, kuyruk malformasyonu, mikoftalmi gibi malformasyonlar tespit edilmiştir. En fazla gözlemlenen malformasyon % 83 oranı ile perikardiyal ödemdir. Zebra balığı larvalarında 96.saatte beyin histolojik incelemelerinde 500 ve 1000 mg/L konsantrasyonlarda nekrotik hücreler gözlemlenmiştir. Sonuçlarımız gıda endüstrisinde kullanılan bu katkı maddesinin daha önceki çalışmalarda da bildirilen toksik etkilerine ek olarak nörotoksik etkilerinin de olduğunu göstermiştir.

**Anahtar kelimeler:** Zebra balığı; Sodyum nitrit; beyin histopatolojisi; larva çıkış oranı; malformasyonlar

## GİRİŞ

Nitritler gıda endüstrisinde renk sabitleyici, hayvansal kaynaklı gıdalarda işlenmiş et, balık ve peyniri stabilize etmek için katkı maddesi olarak kullanılabilir (Myers et al., 2016; EFSA, 2017). Ayrıca sodyum nitrit ( $\text{NaNO}_2$ ), boya sentezi, kauçuk kimyasalları ve nitroso bileşiklerinin üretiminde kullanılmaktadır. Buna ek olarak  $\text{NaNO}_2$ , bir bağırsak gevşetici, bir vazodilatör ve bir bronşiyal dilatör, hatta siyanür zehirlenmesi için bir panzehir olarak insan ve veterinerlik tıbbına uygulanmıştır (National Toxicology Program, 2001; Ansari et al., 2017). Avrupa Birliği Komisyonu No1129/2011 yönetmeliğe göre, gıda işleme sırasında gıda katkı maddesi olarak et ve peynire eklenebilecek maksimum nitrit miktarı 150 mg/kg olarak belirlenmiştir (EFSA 2010; Karwowska and Kononiuk, 2020). Avrupa Komisyonu'nun eski Gıda Bilimsel Komitesi (SCF) ve Ortak FAO / WHO Gıda Katkı Maddeleri Uzman Komitesi'ne (JECFA) göre, nitritler için geçerli kabul edilebilir günlük alım miktarı (ADI) vücut ağırlığının kilogramı başına 0,06 ve 0,07 miligramdır (SCF 1997; EFSA 2017). Ancak WHO'ya (2007) göre, insanlar genellikle günde 1,2 ila 3,0 mg nitrit tüketmektedir. Yapılan araştırmalar farklı yaş gruplarındaki çocuklarda yaklaşık % 12'sinin nitritin günlük alım sınırının (ADI) aşıldığı tespit edilmiştir (Larsson et al., 2011; Elias et al., 2020). Avrupa Su Çerçeve Direktifi nehirlerdeki maksimum nitrit konsantrasyonunun 0,01 ile 0,03mg  $\text{NO}_2^-/\text{L}$  arasında ve içme suyundaki 0,5 mg  $\text{NO}_2^-/\text{L}$  olduğunu beyan etmesine rağmen, nitrit konsantrasyonunun birçok ekosistemde düzenleyici sınırları aştığı bildirilmiştir (Raimonet et al., 2017). Dünya genelinde birçok bölge de, ABD Çevre Koruma Ajansı tarafından belirlenen 1 ppm nitrit ve 10 ppm nitrat kabul edilebilir sınırlarını aşan içme suyunda büyük ölçüde nitrat/nitrit içeriği olduğu tespit edilmiştir (WHO, 2011; Lawniczak et al., 2016).

Diyet ve tükürük nitratları kısmen nitritlere indirgenir ve ardından nitrat-nitrit-NO yolunda biyolojik olarak aktif nitrojen oksitleri (fizyolojik fonksiyonları yerine getirmek için) indirir. Diyet nitratlarının yaklaşık% 5-7'si ve tükürük nitratlarının% 20'si komensal bakteriler tarafından ağız boşluğunda nitritlere indirgenir (Doel et al., 2005; Hyde et al., 2014; Bryan and Ivy, 2015). Nitrite maruz kalmak, met-hemoglobin oluşumuna neden olabilmektedir. Met-hemoglobin normal oksijen dağıtımını engeller ve yüksek met-hemoglobin konsantrasyonları, oksijeni dokulara taşıma kapasitesinin azalması anlamına gelir ve potansiyel olarak hipoksiye neden olur (Mensinga et al., 2003; van den Brand et al., 2020). Nitritler asidik ortamlarda veya oksidatif stres koşulları altında, bir dizi reaktif nitrojen türüne (RNS) dönüştürülebilmektedir (D'Ischia et al., 2011). Reaktif oksijen / nitrojen formlarının içeriğindeki artışın bir sonucu olarak oksidatif / nitrozatif stres, birçok akut ve kronik

hastalığın belirgin bir özelliği olarak kabul edilmektedir (Dalle-Donne et al., 2006; Dilek et al., 2017; Ge et al., 2019; Bandoowala and Sengupta, 2020). ROS, üreme sırasında interferon aracılı endokrin disfonksiyonda vazgeçilmez bir rol oynamaktadır. Biraz artan ROS seviyeleri, oosit olgunlaşmasını ve embriyonik gelişimi bozabilir (Van Blerkom, 2011).  $\text{NaNO}_2$  ile tedavi edilen farelerde ROS seviyelerindeki artış, başarısız oosit ve embriyonik gelişime yol açmıştır. Kanıtlar, oositlerin ROS'a maruz kalmasının mitokondriyal hasara yol açtığını ve embriyonik gelişmeleri engellediğini göstermiştir (Komatsu et al., 2014; Ge et al., 2019). Nitrit, apoptoz, homeostaz, anjiyogenez, eritropoez ve hücre proliferasyonu ve farklılaşmasında değişikliklere neden olan hipoksiye neden olmaktadır (Al-Rasheed et al., 2017). Sodyum nitrit uygulaması, enflamasyon, hipoksi, iskemi, oksidatif stres ve bozulmuş metabolik enerjinin düzensizliğine neden olmakta ve bu da nihayetinde beyin hasarı dahil olmak üzere organ hasarını şiddetlendirmektedir (El-Sheikh and Khalil, 2011; Salama et al., 2013; Aita and Mohammed, 2014).

Suda taşınan nitrit ( $\text{NO}_2^-$ ), tatlı su balıklarının kanına, aktif brankial klorür alım mekanizmasında yer alan solungaç klorür/bikarbonat değiştirici yoluyla girer ve bu nitrit girişi, bir dizi fizyolojik rahatsızlığa yol açabilir (Eddy and Williams, 1987; Jensen, 2003). Sodyum nitrit farklı konsantrasyonları 96 saat boyunca 20-25 günlük zebra balığı larvalarına ve 2-3 aylık zebra balıklarına maruz bırakılmış olup  $\text{LC}_{50}$  değerleri 20-25 günlük larvalarda  $386,00 \pm 29,75$  mg/L ve 2-3 aylık balıklarda ise  $242,41 \pm 13,67$  mg/L olarak belirlenmiştir (Voslářová et al., 2006). Zebra balığı embriyolarında sodyum nitrit uygulaması sonrası 96. saatte  $\text{LC}_{50}$  değeri 411 mg/L olduğu bildirilmiştir (Simmons et al., 2012). Nitrat ve nitrite maruz kalma, hafif anksiyojenik benzeri davranışa yol açabildiği ve zebra balıklarında beyin metabolomik profilini değiştirdiği de tespit edilmiştir (García-Jaramillo et al., 2020). Farklı olarak nitritin fizyolojik ve terapötik seviyeleri (10  $\mu\text{M}$ ), zebra balıklarında ampütasyon (bir uzvun kesilmesi) ve düşük sıcaklıkların neden olduğu bir yaralanma sonrasında kalbe trombosit, nötrofil ve makrofaj alımını artırarak, kardiyomiyosit proliferasyonunun ve anjiyogenezin hızlanmasına neden olduğu bildirilmiştir (Rochon et al., 2020).

Zebra balıklarının küçük boyutu, tüm vücut metabolomik profillemesinin değerlendirilmesine izin vermesinin yanında bakımının diğer model canlılara göre daha kolay ve ucuz olması, embriyonik gelişiminin kısa olması, insanlar ve memeliler ile yüksek genetik homolojiye sahip olmaları toksikolojik, gelişim biyolojisi ve moleküler çalışmalarda yaygın olarak kullanılmalarını sağlamaktadır (Palstra et al., 2010; Howe et al., 2013; Palstra et al., 2014; Bugel et al., 2014; Simmonds et al., 2019).

Sodyum nitrit gıda katkı maddelerindeki kullanımı ile direkt insanlara ve kimya endüstrisindeki kullanımı ile ekosistem için tehlike oluşturmaktadır. Özellikle çocuklarda oluşturduğu olumsuz etkiler embriyo için oluşturabileceği etkilerin ne denli büyük olabileceğini akla getirmektedir. Biz çalışmamız sodyum nitratın model olarak zebra balığı embriyolarındaki gelişimsel toksisitesi ve nörotoksitesini belirlemek için yapılmıştır.

## MATERYAL VE YÖNTEM

### Kimyasallar

Sodyum nitrit ( $\text{NaNO}_2$ ) ve çalışmada kullanılan diğer kimyasallar Sigma-Aldrich firmasından satın alındı.

### Zebra balığı bakım ve etik beyanı

Yetişkin vahşi tip zebra balığı, İzmir Biyotıp ve Genom Merkezi Zebra Balığı Tesisinde yaklaşık 28 °C'de 14 saat aydınlık/10 saat karanlık döngüsü ile tutuldu. Zebra balıkları standart prosedürlere göre yetiştirildi (Westerfield, 1995). Balıklar günde iki kez sabah pul yem ve öğleden sonra artemia ile yemlendi. Çalışmada kullanılan zebra balığı larvaları 5 günlükten küçüktü. Bu nedenle, çalışma herhangi bir lisans gerektirmez (86/609/EEC Direktifi ve AB Direktifi, 2010/63/EU).

### Sodyum Nitritin Embriyo ve Larvalara Uygulanması

Çalışmamızda kullanılan nitrit dozları önceki çalışmalardan seçilmiştir (Voslářová et al., 2006; Simmons et al., 2012; García-Jaramillo et al., 2020). Çalışma 4 tekrarlı yarı statik teste göre planlanmıştır (Ensibi et al., 2014). Sodyum nitritten ( $\text{NaNO}_2$ ) diğer farklı konsantrasyonlar hazırlanması için distile su ile 2000 mg/L nitrit stok çözeltisi hazırlandı. Bu stok çözeltisinden, zebra balığı embriyo ve larvaları için uygun yaşam ortamı olan E3 solüsyonu (0,17 mM KCl, 0,33 mM  $\text{MgSO}_4$ , 5 mM NaCl, 0,33 mM  $\text{CaCl}_2$ ) ile uygulama grupları 10, 100, 500 ve 1000 mg/L nitrit konsantrasyonları hazırlandı. Akşam saatlerinde erkek ve dişi zebra balığı anaçları, şeffaf plastik bir ayırıcıyla ayrılmış çiftleşme tanklarına yerleştirildi. Sabah saat 9:00'da, zebra balıklarının çiftleşip yumurtlamasına izin vermek için ayırıcı kaldırıldı. Yumurtalar, E3 ortamı içeren Petri kaplarına alındı ve deneyin ilk gününde, rastgele seçilen yumurtalar, döllenmeden 4 saat sonra (hpf) farklı sodyum nitrit konsantrasyonlarına maruz bırakıldı. Her grup için 30 embriyo kullanıldı. Her gruptaki konsantrasyonlar 24 saatte bir yenilendi. Tüm deney grupları 28.5 °C'de inkübe edildi.

### Hayatta kalma oranı, Kuluçkadan çıkış oranı ve Malformasyon oranı

Tüm grupların embriyoları ve larvaları, sodyum nitrit uygulamasından sonra 24, 48, 72 ve 96. saatlerde bir stereomikroskop (SC50 Olympus kameralı SZX10 Olympus mikroskobu) altında hayatta kalma durumu ve malformasyonları görüntüledi. Zebra balığı larvaları normalde döllenmeden (hpf) 48 saat sonra yumurtadan çıkmaktadır. Sodyum nitritin farklı konsantrasyonlarının larvaların yumurtadan çıkması üzerindeki etkisi gözlemlenmiş ve 48-96 saat aralığında ölçülmüştür (Köktürk et al., 2021).

### Beyin Histopatolojik inceleme

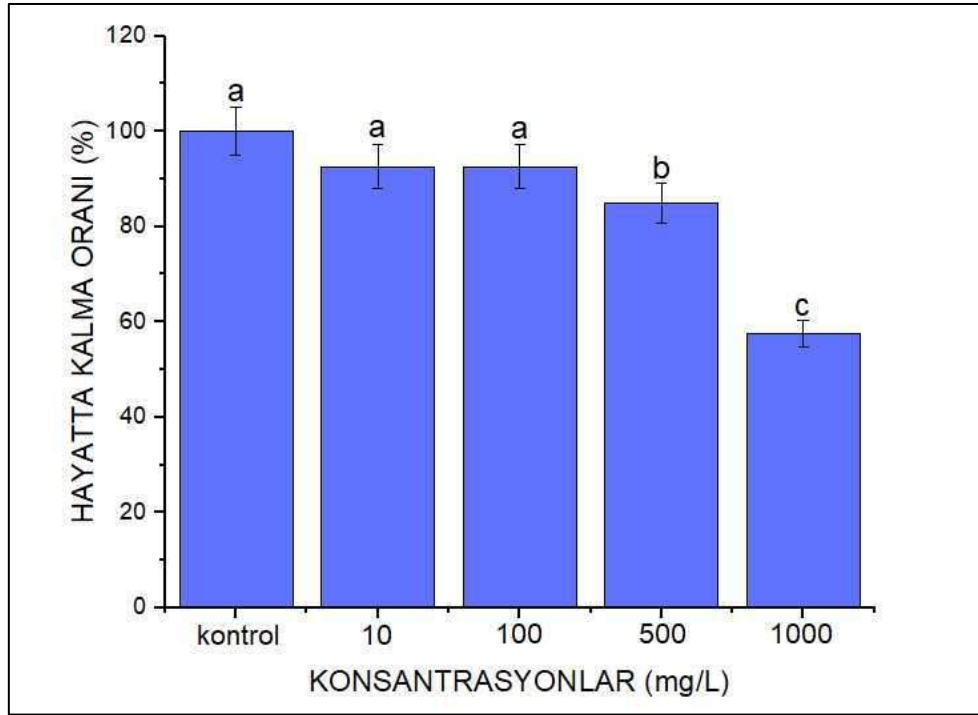
Larvalar, 96.saatte literatürlerde belirtilen prosedürlerde küçük değişikliklerden sonra histolojik incelemelerde kullanılmıştır (Hallare et al., 2005; Hill et al., 2002; Sabaliauskas et al., 2006). Histopatolojik değerlendirme için embriyolar %10'luk tamponlu formalin solüsyonu içerisinde fikse edildi. Rutin histolojik doku takip aşamalarından geçirildikten sonra parafine gömüldü. Mikrotomda 4µm kalınlığında kesitler alındı. Alınan kesitler Hematoksilen-Eozin (HE) boyası ile boyandıktan sonra ışık mikroskobu ile incelendi (Olympus BX53, Japan). Histolojik değerlendirme semikantitatif olarak yapıldı. Değerlendirmede mikroskobik olarak lezyon sayısına göre; normal: - (hiç lezyon ok), hafif: + (1-4 lezyon), orta: ++ (5-8 lezyon), şiddetli: +++ (9 ve üstü lezyon) şeklinde yapıldı. (Topal et al., 2017).

### İstatistik

Tüm veriler ortalama  $\pm$  standart hata (SEM) olarak gösterildi ve SPSS 17 programı ile tek yönlü varyans analizi yapıldı ve ardından Tukey post hoc testi yapıldı ve  $p < 0,05$  istatistiksel olarak anlamlı kabul edildi.

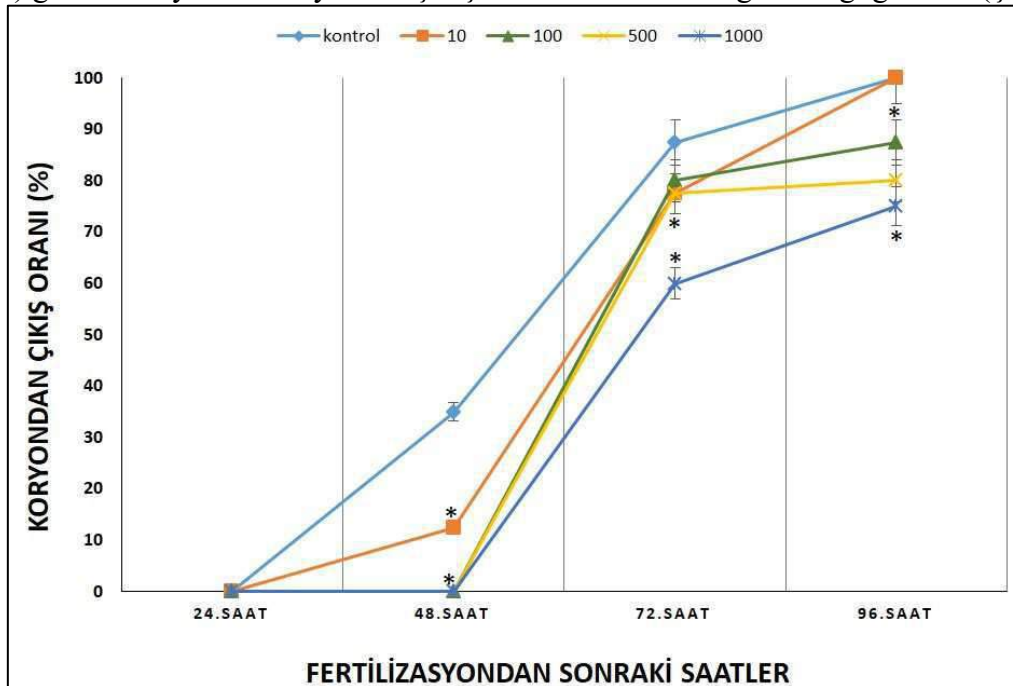
### BULGULAR VE TARTIŞMA

Zebra balığı embriyoları sodyum nitrite maruz kaldığında doz artışına (10, 100, 500 ve 1000 mg/L) bağlı olarak yaşama oranı azalmıştır (Şekil 1). Kontrol ile karşılaştırıldığında özellikle 500 ve 1000 mg/L konsantrasyonlarında yaşama oranı anlamlı olarak azalmıştır (Şekil 1,  $p < 0.05$ ). Ancak 10 mg/L ve 100 mg/L grupları arasında yaşama oranında anlamlı bir farklılık tespit edilmemiştir (Şekil 1,  $p > 0.05$ ). Yaşama oranında en fazla azalma % 58 olarak 1000 mg/L dozundaki uygulama gruplarında belirlenmiştir (Şekil 1).



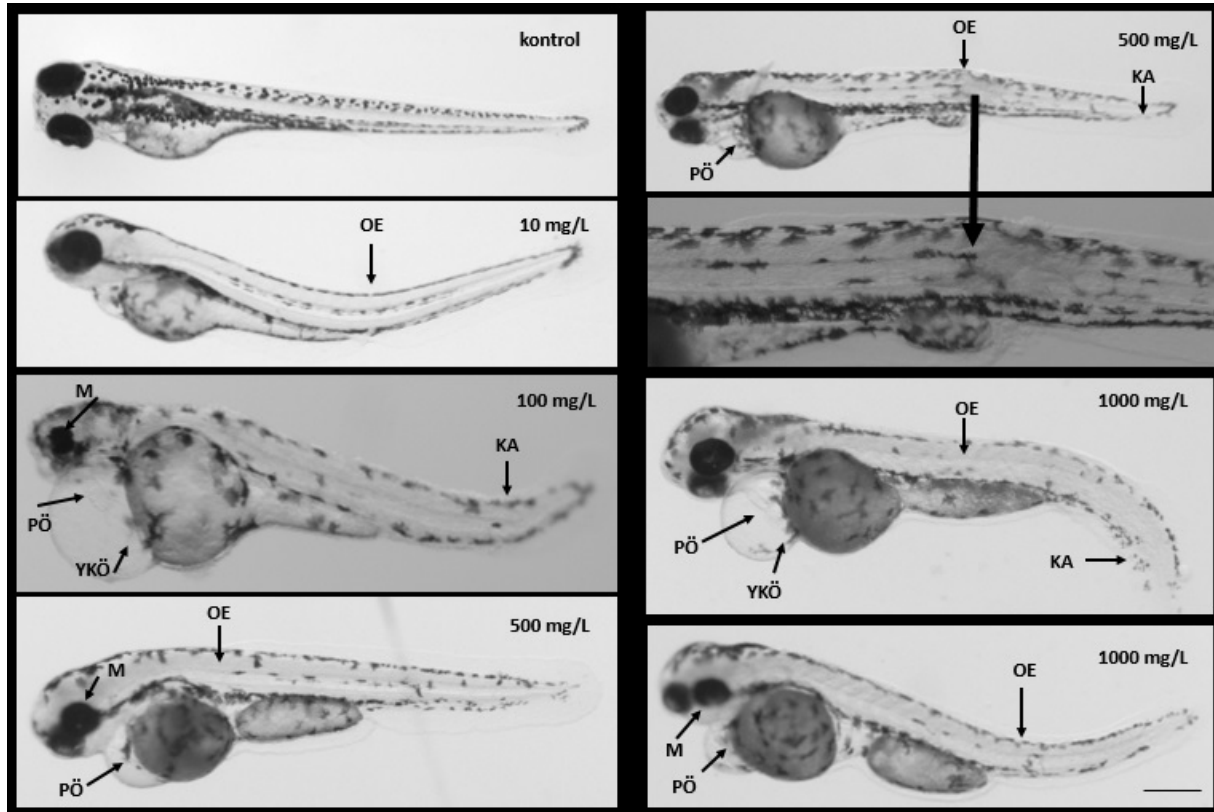
**Şekil 1.** 96 saat boyunca sodyum nitrite maruz kaldıktan sonra zebra balığı embriyo ve larvalarında hayatta kalma oranı. Farklı harfler gruplar arasında önemli farklılıkları gösterir ( $p < 0.05$ ) ve her bir değer ortalama  $\pm$  SEM'dir.

Şekil 2'de gösterildiği gibi, 72.saat ve 96.saatlerde kontrol grubu ve 10 mg/L grupları arasında koryondan çıkış oranlarında anlamlı bir farklılık bulunmadı (Şekil 2,  $p > 0.05$ ). Bununla birlikte, Sodyum nitrit uygulandığı farklı konsantrasyonların tümünde, 48.saatteki koryondan çıkış oranları kontrol grubu ile kıyaslandığında gecikmeye neden olduğu bulundu (Şekil 2,  $p < 0.05$ ). Ayrıca 1000 mg/L uygulama grubunda diğer gruplara (10, 100 ve 500 mg / L) (96.saat) göre embriyoların koryondan çıkışlarının daha fazla engellendiği görüldü (Şekil 2).



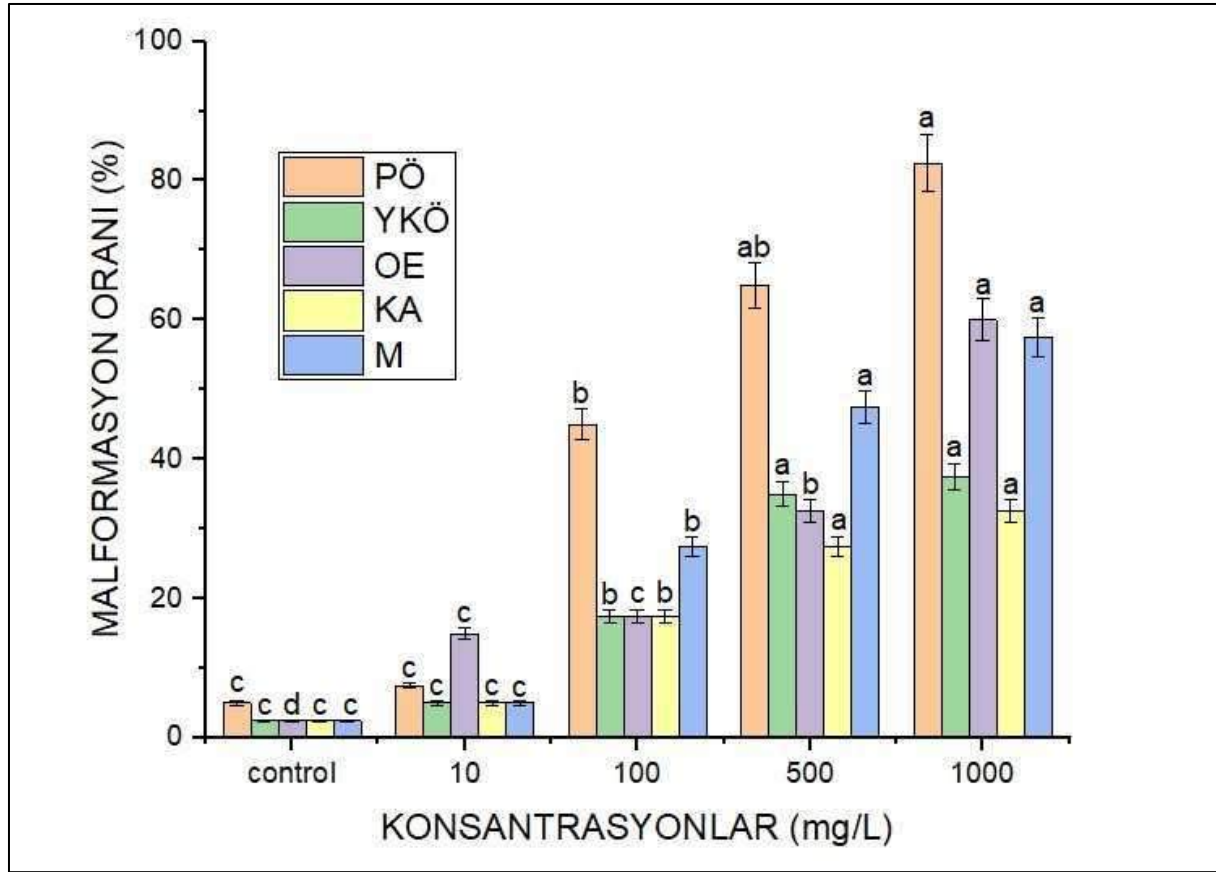
**Şekil 2.** 96 saat boyunca sodyum nitrite maruz kaldıktan sonra zebra balığı embriyo ve larvalarında koryondan çıkış oranı. \*p <0.05; Kontrol grubu ile diğer uygulama grupları arasında önemli farklılıkları gösterir.

Zebra balığı embriyoları sodyum nitritin farklı dozlarına maruz kaldığında yolk sac edema, pericardial edema, curved body axis, tail malformation ve microphthalmia gibi malformasyonlara neden olduğu gözlemlenmiştir (Şekil 3). En fazla görülen morfolojik anormallik perikardiyal ödem olup 1000 mg/L doz uygulama grubunda % 83 olarak belirlenmiştir (Şekil 4). Kontrol grubu ile karşılaştırıldığında 500 ve 1000 mg/L dozlarındaki tüm malformasyon oranlarında anlamlı bir farklılık tespit edilmiştir (Şekil 4, p < 0.05) Ancak 10 ve 100 mg/L uygulamaları kontrol ile karşılaştırıldığında curved body axis de anlamlı farklılık olmadığı görülmüştür (Şekil 4, p >0.05). Yine 500 ve 1000 mg/L grupları arasında bazı morfolojik bozukluklarda (yolk sac edema ve microphthalmia) anlamlı bir farklılık olmadığı belirlenmiştir (Şekil 4, p >0.05). Çalışmamızda 500 mg/L uygulama grubundaki embriyoların % 68 oranında perikardiyal ödem ve % 48 mikroftalmi gibi malformasyonların olduğu görülmüş olup benzer şekilde bir çalışmada zebra balığı embriyoları sodyum nitrite maruz bırakıldığında embriyoların % 50'sinin 436 mg/L konsantasyonunda etkilendiği bildirilmiştir (Lahnsteiner, 2008). Zebra balığı embriyolarında 10 mg/L uygulama gruplarımızda % 8 oranında perikardiyal ödem görülmüş ve oranın diğer gruplardan (100, 500 ve 1000 mg/L) az olması durumu, düşük dozlarda nitritin nitrik oksit (NO) sinyali yoluyla bağışıklık tepkisini modüle ederek rejenerasyonu artırdığı, trombositlerin, nötrofillerin ve makrofajların daha hızlı toplanması kardiyomiyosit proliferasyonunu, anjiyogenezi ve kalp onarımını hızlandırdığı şeklinde açıklanabilir (Rochon et al., 2020).



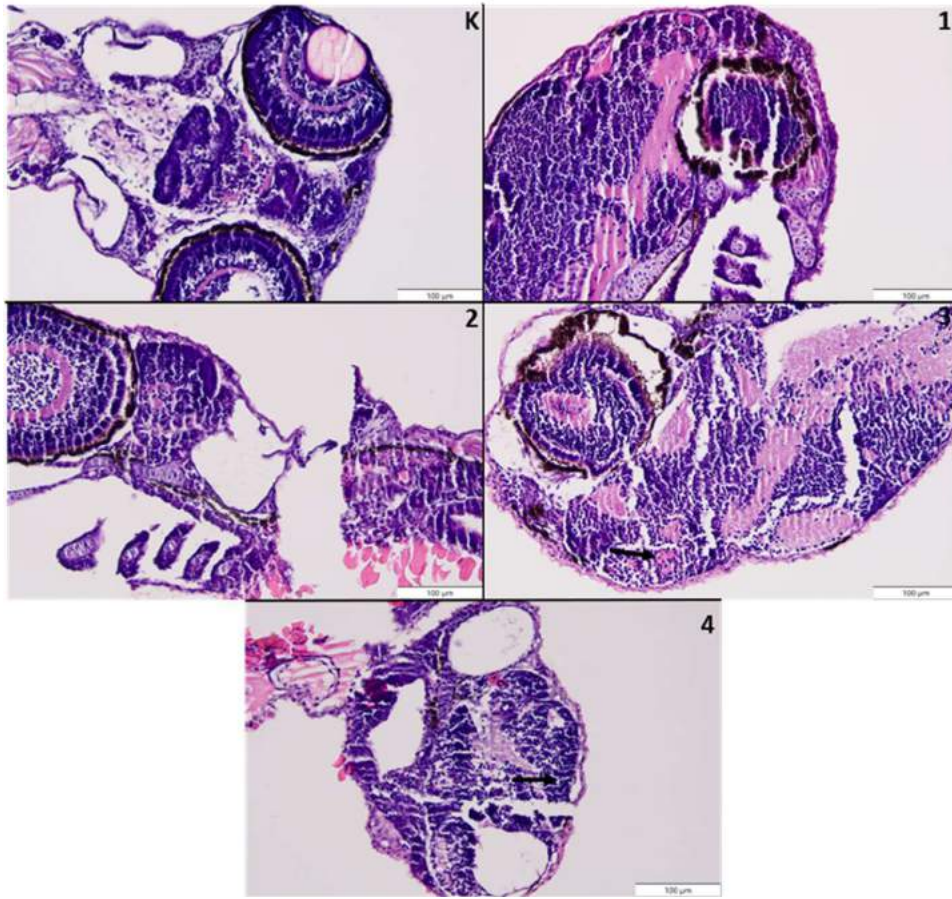
**Şekil 3.** 96 saat boyunca sodyum nitrite maruz kaldıktan sonra embriyoların mikroskopik görüntüleri. YKÖ: yumurta kesesi ödemi; PÖ: perikardiyal ödem; OE: omurga eğriliği; KA: kuyruk anormallliği, M: mikroftalmi (küçük göz). Bar: 500 µm.





**Şekil 4.** 96 saat boyunca sodyum nitrite maruz kaldıktan sonra embriyo ve larvalarda gözlenen malformasyonların yüzdesi. YKÖ: yumurta kesesi ödemi; PÖ: perikardiyal ödem; OE: omurga eğriliği; KA: kuyruk anormalliği, M: mikrofthalmi (küçük göz). Farklı harfler gruplar arasında önemli farklılıkları gösterir ( $p < 0.05$ ) ve her bir değer ortalama  $\pm$  SEM'dir.

Zebra balığı embriyolarının histopatolojik değerlendirmesinde, kontrol, 10 ve 100 mg/L uygulama grupları normal histolojik yapıda olduğu belirlenirken yüksek konsantrasyon (500 ve 1000 mg/L) uygulama gruplarında beyin dokusunda nekrotik hücrelere rastlandı (Şekil 5). Nitrit, nitrik oksit için önemli bir damar içi depodur. Nitritin aktif nitrik okside dönüşümü, en çok ihtiyaç duyulan yerde kan akışını artırmak için esas olarak hipoksik koşullar altında gerçekleşmektedir (Huang et al., 2005). Nitrit kullanımı, bu nedenle, kalp durması, iskemik inme veya subaraknoid kanama gibi serebral hipoksiye neden olan durumlarda beyin hasarını azaltmak için geniş çapta değerlendirilmektedir (Kitaura et al., 2007; Garry et al., 2015; Franko et al., 2019). Çalışmamızda zebra balığı embriyolarında 10 ve 100 mg/L konsantrasyonlarında beyin dokularında herhangi bir hasarın tespit edilmemiş olması nitritin belli bir dozdaki koruyucu etkisinin olduğunu destekleyebilir. Ancak önceki çalışmalarda 19.5 mg/L nitrite uygulanan zebra balığı yetişkinlerinde bir çok parametre değişmezken hafif anksiyojenik benzeri davranış ve beyin metabolomundaki değişiklikler olduğu bildirilmiştir (García-Jaramillo et al., 2020). Nitrit nöronal hücrelere önemli ölçüde zarar veren reaktif oksijen türlerinin oluşumunu tetiklemektedir (Ansari et al., 2015). Çalışmamızda yüksek konsantrasyon (500 ve 1000 mg/L) nitrit uygulanan zebra balığı larvalarında beyin dokularındaki nekrotik hücrelerin oluşması reaktif oksijen radikallerinin artışının etkisinin olabileceğini düşündürmüştür.



**Şekil 5.** Zebra balığı embriyo/larvalarına sodyum nitrit maruziyetinden sonra 96. saatteki beyin mikroskopik görüntüleri. Kontrol, 1: 10 mg/L ve 2: 100 mg/L nolu gruplar normal histolojik yapıda, 3: 500 mg/L ve 4: 1000 mg/L nolu gruplarda nekrotik hücreler gözlemlendi. H-E. 400x.

### SONUÇ

Bu çalışmada yaygın kullanılan bir gıda katkı maddesi olan sodyum nitritin zebra balığı embriyoları ve larvalarındaki nörotoksik etkileri belirlenmiştir. Sodyum nitritin özellikle yüksek konsantrasyondaki uygulama gruplarında zebra balığı embriyolarında çeşitli malformasyonlar gözlemlenmiş ve yine larvaların kuluçkadan çıkabilme başarısının da etkilendiği gözlemlenmiştir. Beyin histopatolojik inceleme sonucunda ise beynin farklı bölgelerinde yüksek konsantrasyonlarda nekrotik hücreler tespit edilmiştir. Sonuç olarak gıda endüstrisinde kullanılan bu katkı maddesinin daha önceki çalışmalarda da bildirilen toksik etkilerine ek olarak nörotoksik etkilerinin de olduğu belirlenmiştir. Bu durumda sodyum nitritin gıda endüstrisindeki kullanım miktarının daha az düzeylerde tutulması ya da bu katkı maddesine alternatif olabilecek zararsız katkı maddeleri kullanılması gerekmektedir.

### KAYNAKLAR

- Aita NAA, Mohammed FF 2014. Effect of marjoram oil on the clinicopathological, cytogenetic and histopathological alterations induced by sodium nitrite toxicity in rats. *Global Vet*, 12, 606-616.
- Al-Rasheed NM, Fadda LM, Attia HA, Ali HM, Al-Rasheed NM 2017. Quercetin inhibits sodium nitrite-induced inflammation and apoptosis in different rats organs by suppressing Bax, HIF1- $\alpha$ , TGF- $\beta$ , Smad-2, and AKT pathways. *Journal of Biochemical and Molecular Toxicology*, 31(5), e21883.

- Ansari FA, Ali SN, Mahmood R 2015. Sodium nitrite-induced oxidative stress causes membrane damage, protein oxidation, lipid peroxidation and alters major metabolic pathways in human erythrocytes. *Toxicology in Vitro*, 29(7), 1878-1886.
- Ansari FA, Ali SN, Arif H, Khan AA, Mahmood R 2017. Acute oral dose of sodium nitrite induces redox imbalance, DNA damage, metabolic and histological changes in rat intestine. *PLoS One*, 12(4), e0175196.
- Bandookwala M, Sengupta P 2020. 3-Nitrotyrosine: A versatile oxidative stress biomarker for major neurodegenerative diseases. *International Journal of Neuroscience*, 1-16.
- Bryan NS, Ivy JL 2015. Inorganic nitrite and nitrate: evidence to support consideration as dietary nutrients. *Nutrition Research*, 35(8), 643-654.
- Bugel SM, Tanguay RL, Planchart A 2014. Zebrafish: a marvel of high-throughput biology for 21st century toxicology. *Current environmental health reports*, 1(4), 341-352.
- D'Ischia M, Napolitano A, Manini P, Panzella L 2011. Secondary targets of nitrite-derived reactive nitrogen species: nitrosation/nitration pathways, antioxidant defense mechanisms and toxicological implications. *Chemical research in toxicology*, 24(12), 2071-2092.
- Dalle-Donne I, Rossi R, Colombo R, Giustarini D, Milzani A 2006. Biomarkers of oxidative damage in human disease. *Clinical chemistry*, 52(4), 601-623.
- Dilek F, Ozceker D, Ozkaya E, Guler EM, Yazici M, Tamay Z, Kocyigit A, Guler N. 2017. Elevated Nitrosative Stress in Children with Chronic Spontaneous Urticaria. *International Archives of Allergy and Immunology*, 172(1), 33-39.
- Doel JJ, Benjamin N, Hector MP, Rogers M, Allaker RP. 2005. Evaluation of bacterial nitrate reduction in the human oral cavity. *European journal of oral sciences*, 113(1), 14-19.
- Eddy FB, Williams EM 1987. Nitrite and freshwater fish. *Chemistry and Ecology*, 3(1), 1-38.
- EFSA Panel on Food Additives and Nutrient Sources added to Food (ANS), Mortensen, A., Aguilar F, Crebelli R, Di Domenico A, Dusemund B,...Lambré C. 2017. Re-evaluation of potassium nitrite (E 249) and sodium nitrite (E 250) as food additives. *Efsa journal*, 15(6), e04786.
- EFSA Panel on Food Additives and Nutrient Sources added to Food (ANS). 2010. Statement on nitrites in meat products. *EFSA Journal*, 8(5), 1538. <https://doi.org/10.2903/j.efsa.2010.1538> [wiley.com/doi/pdf/10.2903/j.efsa.2010.1538](http://wiley.com/doi/pdf/10.2903/j.efsa.2010.1538).
- Elias A, Jalakas S, Roasto M, Reinik M, Nurk E, Kaart T, Tuvike A, Meremäe K, Nelis K, Elias T. 2020. Nitrite and nitrate content in meat products and estimated nitrite intake by the Estonian children. *Food Additives & Contaminants: Part A*, 1-9.
- El-Sheikh NM, Khalil FA 2011. L-Arginine and L-glutamine as immunonutrients and modulating agents for oxidative stress and toxicity induced by sodium nitrite in rats. *Food and Chemical Toxicology*, 49(4), 758-762.
- Ensibi C, Hernández-Moreno D, Míguez Santiyán MP, Daly Yahya MN, Rodríguez FS, Pérez-López M 2014. Effects of carbofuran and deltamethrin on acetylcholinesterase activity in brain and muscle of the common carp. *Environmental toxicology*, 29(4), 386-393.
- Franko E, Ezra M, Crockett DC, Joly O, Pattinson K 2019. Effect of nitrite on the electroencephalographic activity in the healthy brain. *Nitric Oxide*, 90, 47-54.
- García-Jaramillo M, Beaver LM, Truong L, Axton ER, Keller RM, Prater MC, Magnusson KR, Tanguay RL, Stevens JF, Hord, N. G. (2020). Nitrate and nitrite exposure leads to mild anxiogenic-like behavior and alters brain metabolomic profile in zebrafish. *PloS one*, 15(12), e0240070.
- Garry PS, Ezra M, Rowland MJ, Westbrook J, Pattinson KTS 2015. The role of the nitric oxide pathway in brain injury and its treatment—from bench to bedside. *Experimental neurology*, 263, 235-243.

- Ge L, Han Z, Gao YQ, Zhou CJ, Wang DH, Ma YZ, Liang CG 2019. Sodium nitrite negatively affects reproductive ability and offspring survival in female mice. *Toxicology*, 427, 152284.
- Hallare AV, Schirling M, Luckenbach T, Köhler HR, Triebkorn R 2005. Combined effects of temperature and cadmium on developmental parameters and biomarker responses in zebrafish (*Danio rerio*) embryos. *Journal of Thermal Biology*, 30(1), 7-17.
- Hill AJ, Howard CV, Cossins AR 2002. Efficient embedding technique for preparing small specimens for stereological volume estimation: Zebrafish larvae. *Journal of microscopy*, 206(3), 179-181.
- Howe K, Clark MD, Torroja CF, Torrance J, Berthelot C, Muffato M, ...McLaren S 2013. The zebrafish reference genome sequence and its relationship to the human genome. *Nature*, 496(7446), 498-503.
- Huang Z, Shiva S, Kim-Shapiro DB, Patel RP, Ringwood LA, Irby CE, Huang KT, Ho C, Hogg N, Schechter AN, Gladwin MT 2005. Enzymatic function of hemoglobin as a nitrite reductase that produces NO under allosteric control. *The Journal of clinical investigation*, 115(8), 2099-2107.
- Hyde ER, Andrade F, Vaksman Z, Parthasarathy K, Jiang H, Parthasarathy DK, Torregrossa AC, Tribble G, Kaplan HB, Petrosino JF, Bryan NS 2014. Metagenomic analysis of nitrate-reducing bacteria in the oral cavity: implications for nitric oxide homeostasis. *PLoS One*, 9(3), e88645.
- Jensen FB 2003. Nitrite disrupts multiple physiological functions in aquatic animals. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology*, 135(1), 9-24.
- Karwowska M, Kononiuk A 2020. Nitrates/nitrites in food—Risk for nitrosative stress and benefits. *Antioxidants*, 9(3), 241.
- Kitaura H, Uozumi N, Tohmi M, Yamazaki M, Sakimura K, Kudoh M, Shimizu T, Shibuki K 2007. Roles of nitric oxide as a vasodilator in neurovascular coupling of mouse somatosensory cortex. *Neuroscience research*, 59(2), 160-171.
- Komatsu K, Iwase A, Mawatari M, Wang J, Yamashita M, Kikkawa F 2014. Mitochondrial membrane potential in 2-cell stage embryos correlates with the success of preimplantation development. *Reproduction*, 147(5), 627-638.
- Köktürk M, Altındağ F, Ozhan G, Çalimli MH, Nas MS 2021. Textile dyes Maxilon blue 5G and Reactive blue 203 induce acute toxicity and DNA damage during embryonic development of *Danio rerio*. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology*, 242, 108947.
- Lahnsteiner F 2008. The sensitivity and reproducibility of the zebrafish (*Danio rerio*) embryo test for the screening of waste water quality and for testing the toxicity of chemicals. *Alternatives to Laboratory Animals*, 36(3), 299-311.
- Larsson K, Darnerud PO, Ilbäck NG, Merino L 2011. Estimated dietary intake of nitrite and nitrate in Swedish children. *Food Additives and Contaminants*, 28(5), 659-666.
- Lawniczak AE, Zbierska J, Nowak B, Achtenberg K, Grześkowiak A, Kanas K 2016. Impact of agriculture and land use on nitrate contamination in groundwater and running waters in central-west Poland. *Environmental monitoring and assessment*, 188(3), 172.
- Mensinga TT, Speijers GJ, Meulenbelt J 2003. Health implications of exposure to environmental nitrogenous compounds. *Toxicological reviews*, 22(1), 41-51.
- Myers MI, Sebranek JG, Dickson JS, Shaw AM, Tarte R, Adams KR, Neibuhr S 2016. Implications of decreased nitrite concentrations on *Clostridium perfringens* outgrowth during cooling of ready-to-eat meats. *Journal of food protection*, 79(1), 153-156.



- National Toxicology Program. 2001. Toxicology and carcinogenesis studies of sodium nitrite (CAS NO. 7632-00-0) in F344/N rats and B6C3F1 mice (drinking water studies). National Toxicology Program technical report series, 495, 7.
- Palstra AP, Rovira M, Rizo-Roca D, Torrella JR, Spaink HP, Planas JV 2014. Swimming-induced exercise promotes hypertrophy and vascularization of fast skeletal muscle fibres and activation of myogenic and angiogenic transcriptional programs in adult zebrafish. *BMC genomics*, 15(1), 1136.
- Palstra AP, Tudorache C, Rovira M, Brittijn SA, Burgerhout E, Van den Thillart GE, Spaink HP, Planas JV 2010. Establishing zebrafish as a novel exercise model: swimming economy, swimming-enhanced growth and muscle growth marker gene expression. *PLoS One*, 5(12), e14483.
- Raimonet M, Cazier T, Rocher V, Laverman AM 2017. Nitrifying kinetics and the persistence of nitrite in the Seine River, France. *Journal of environmental quality*, 46(3), 585-595.
- Rochon ER, Missinato MA, Xue J, Tejero J, Tsang M, Gladwin MT, Corti P 2020. Nitrite improves heart regeneration in zebrafish. *Antioxidants & redox signaling*, 32(6), 363-377.
- Sabaliauskas NA, Foutz CA, Mest JR, Budgeon LR, Sidor AT, Gershenson JA, Joshi SB, Cheng KC 2006. High-throughput zebrafish histology. *Methods*, 39(3), 246-254.
- Salama MF, Abbas A, Darweish MM, El-Hawwary AA, Al-Gayyar MM 2013. Hepatoprotective effects of cod liver oil against sodium nitrite toxicity in rats. *Pharmaceutical biology*, 51(11), 1435-1443.
- Scientific Committee for Food (SCF) 1997. Opinions of the scientific committee for food on: nitrates and nitrite 1-33.
- Simmonds AI, Miln C, Seebacher F 2019. Zebrafish (*Danio rerio*) as a model for sprint exercise training. *Zebrafish*, 16(1), 1-7.
- Simmons AE, Karimi I, Talwar M, Simmons TW 2012. Effects of nitrite on development of embryos and early larval stages of the zebrafish (*Danio rerio*). *Zebrafish*, 9(4), 200-206.
- Topal A, Atamanalp M, Oruç E, Erol HS 2017. Physiological and biochemical effects of nickel on rainbow trout (*Oncorhynchus mykiss*) tissues: assessment of nuclear factor kappa B activation, oxidative stress and histopathological changes. *Chemosphere*, 166, 445-452.
- Van Blerkom J 2011. Mitochondrial function in the human oocyte and embryo and their role in developmental competence. *Mitochondrion*, 11(5), 797-813.
- van den Brand AD, Beukers M, Niekerk M, van Donkersgoed G, van der Aa M, van de Ven B, Bulder A, van der Voet H, Sprong CR 2020. Assessment of the combined nitrate and nitrite exposure from food and drinking water: application of uncertainty around the nitrate to nitrite conversion factor. *Food Additives & Contaminants: Part A*, 37(4), 568-582.
- Voslářová E, Pištěková V, Svobodova Z 2006. Nitrite toxicity to *Danio rerio*: effects of fish age and chloride concentrations. *Acta Veterinaria Brno*, 75(1), 107-113.
- Westerfield M 1995. The zebrafish book: a guide for the laboratory use of zebrafish (*Brachydanio rerio*). University of Oregon press.
- WHO, 2007. World Health Organization. Nitrate and Nitrite in Drinking Water Development of WHO Guidelines for Drinking Water Quality; World Health Organization: Geneva, Switzerland, pp. 1–21.
- WHO, 2011. nitrite in drinking-water background document for development of WHO guidelines for drinking-water quality. Geneva: World Health Organization (WHO/SDE/WSH/07.01/16/Rev/1).



# STUDY ON THE EFFECT OF THE HIGH-PRESSURE PUMP'S CAM-PROFILE ON FUEL INJECTION PARAMETERS AND DIESEL ENGINE POWER OF THE FISHING VESSEL

Ho Duc Tuan<sup>1st</sup>, Mai Duc Nghia<sup>2nd</sup>

*1<sup>st</sup> Faculty of Transportation Engineering, Nha Trang University, Nha Trang City, VietNam*

*2<sup>nd</sup> Faculty of Mechanical Engineering, Air Force Officer's college, Nha Trang City, VietNam*

## Abstract

The high-pressure pump cam profile directly affects the supply histories and fuel injection parameters, especially the injection pressure history in the high-pressure pipeline, thereby affecting the engine's power. Therefore, when the engine is running, it is possible to measure pressure in the high-pressure pipeline ( $p_{hpp}$ ) to diagnose the technical state of the fuel injection system, which will soon prevent potential problems. In this paper, the research's results by simulating cam-profile corrosion to injection parameters using AVL Boost/Hydsim software and experiment on a 4CHE Yanmar diesel engine used as the main engine of a fishing boat presented. The results show that when the cam-profile is worn to 16%, the high-pressure pipe's pressure and the engine power reduced by approximately 18%, 7.4%, respectively.

**Keywords:** *Cam profile; pressure performance in the high pressure pipe; high pressure pump; power; fuel injection system; diesel engine of fishing vessel.*

## 1. INTRODUCTION

For diesel engines, the high-pressure pump cam profile of the fuel system affects the injection parameters, especially the pressure evolution in the high-pressure pipeline. When the pressure in the high-pressure pipeline decreases, it will reduce the fuel injection pressure at the injector, directly influencing the combustion mixture and fuel combustion, thereby affecting the engine's power [1, 2]. Therefore, it is possible to measure the pressure history in the high-pressure pipeline to diagnose the power and technical state of the fuel injection system, which will soon prevent potential engine problems. An equivalent pipeline replacement method mounted pressure sensor will measure the pressure history in the high-pressure pipeline (pressure history in the high-pressure pipeline will reflect the fuel injection pressure and the injector lift stroke at the injector). In this study, the 4CHE Yanmar engine, the main diesel engine of the fishing vessels in the South Central region of Vietnam [5], was used to evaluate the corrosion of the high-pressure pump's cam profile to injection parameters by simulating them on the AVL Boost/Hydsim software. On that basis, the experiment was carried out by measuring pressure in high-pressure pipelines and measuring engine power in different cam profiles. Table 1 presents the technical parameters of 4 CHE Yanmar diesel engine [7], and Table 2 presents simulation and experimental modes, Table 3 presents cam profile parameters (standard profile).

**Table 1.** The Specifications of the 4CHE Yanmar engine

Name of parameters	Units	Values
Engine type		4CHE
Number of cylinders		4
Bore x stroke	mm	105×125
Power/speed	kW/rpm	52.22/2300
Compression ratio		16.4:1

Fuel system	High pressure pump	Bosch type
	Diameter of injection hole (mm)	4 x 0,32 x 140 <sup>0</sup>
	Injection timing	18 <sup>0</sup> BTDC
	Injection pressure	215 bar

**Table 2.** Simulation and experiment mode

Experimental conditions	Values	Notes
Engine speed	1.400 rpm	According to the Japanese diesel engine test cycle [6]
Load conditions	0, 20%, 40%, 60%, 80%	According to the Japanese diesel engine test cycle [6]
NO.1 Cam Profile	The cam profile parameters in the manufacturer's initial state (Table 3)	Simulation with increased corrosion from the initial state (%): 2; 4; 6; 8; 10; 12; 14; 16; 18; 20
NO.2 Cam Profile		Used on average: 5.000h
NO.3 Cam Profile		Used on average: 10.000h

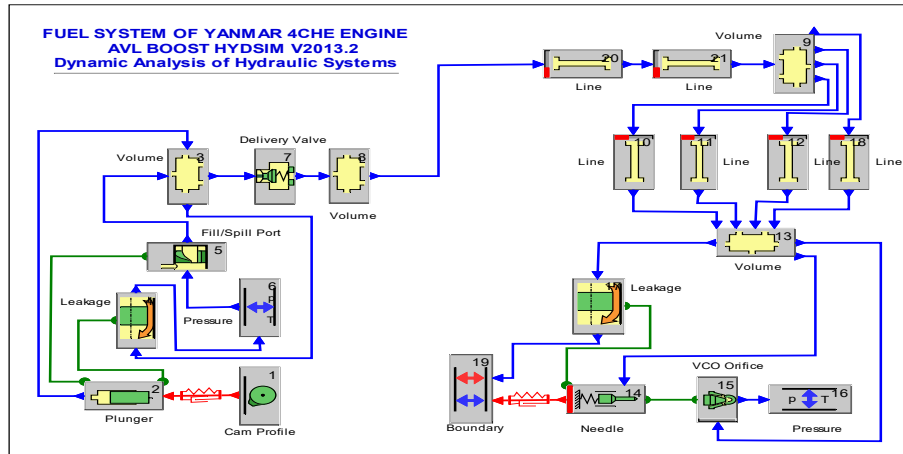
**Table 3.** The cam profile parameters in standard state

Cam angle, $\varphi$ ( <sup>0</sup> crank angle)	Cam lift, mm	Cam angle, $\varphi$ ( <sup>0</sup> crank angle)	Cam lift, mm
0	0	85	6.537
5	0.093	90	6.810
10	0.364	95	6.981
15	0.536	100	7.032
20	0.914	105	6.889
25	1.379	110	6.111
30	1.723	115	4.791
35	2.222	120	3.566
40	2.594	125	2.599
45	3.045	130	1.695
50	3.429	135	1.013
55	3.909	140	0.561
60	4.442	145	0.250
65	4.948	150	0.058
70	5.355	155	0
75	5.855	160	0
80	6.178	165	0

## 2. RESEARCH CONTENT

### 2.1. Simulation study using AVL Boost/Hysim software

- AVL Boost/Hydsim is a dynamic analysis software for hydraulic and hydromechanical systems, built based on the theory of dynamics and fluid oscillations of multi-element systems. In internal combustion engines, HydSim is used to simulate hydraulic systems such as fuel systems, lubrication systems, hydraulic transmission systems. But mainly, the software is used to simulate the fuel injection system [4, 8]. On this basis, we have built a simulation model of the 4CHE Yanmar diesel's fuel injection system, as shown in Figure 1.



**Figure 1.** A simulation model of the 4CHE-Yanmar diesel engine's fuel injection system

- The basis of the calculation process's the fuel system elements is shown by the equations of conservation's flow dynamics in the pipeline:

Continuity Equation:

$$\frac{\partial \rho}{\partial t} = -\frac{\partial(\rho \cdot u)}{\partial x} - \rho \cdot u \cdot \frac{1}{A} \cdot \frac{dA}{dx} \quad (1)$$

Equation of conservation of momentum:

$$\frac{\partial(\rho \cdot u)}{\partial t} = -\frac{\partial(\rho \cdot u^2 + p)}{\partial x} - \rho \cdot u^2 \cdot \frac{1}{A} \cdot \frac{\partial A}{\partial x} - \frac{F_R}{V} \quad (2)$$

Energy equation:

$$\frac{\partial E}{\partial t} = -\frac{\partial[u \cdot (E + p)]}{\partial x} - u \cdot (E + p) \cdot \frac{1}{A} \cdot \frac{dA}{dx} + \frac{q_w}{V} \quad (3)$$

Where:  $\rho$ - specific weight,  $\text{kg} \cdot \text{m}^{-3}$ ;  $u$ - fluid flow rate,  $\text{m} \cdot \text{s}^{-1}$ ;  $x$ - coordinates,  $\text{m}$ ;  $A$ - pipe cross-sectional area,  $\text{m}^2$ ;  $t$ -time,  $\text{s}$ ;  $p$ - static pressure,  $\text{Pa}$ ;  $F_R$ - friction force,  $\text{N}$ ;  $E$ - energy composition of the fluid ( $E = \rho \cdot \bar{c}_v \cdot T + \frac{1}{2} F_R \cdot \rho \cdot u^2$ ),  $\text{Kj/Kg}$ ;  $c_v$ - isothermal specific heat,  $\text{Kj/Kg K}$ ;  $T$ -temperature,  $\text{K}$ ;  $q_w$ - heat transfer to the wall,  $\text{w/m}^2$ .

The friction force with the wall can be determined from the friction coefficient of a pipe diameter  $D$  as  $\lambda_f$ :

$$F_R / V = (\lambda_f / 2D) \cdot \rho \cdot u \cdot |u| \quad (4)$$

Using the Reynolds equation, the heat transfer to the pipe wall has the volume from the frictional force and the temperature difference between the wall and the fluid flow:

$$q_w / V = (\lambda_f / 2D) \cdot \rho \cdot |u| \cdot c_p \cdot (T_w - T) \quad (5)$$

The fluid flow rates at the inlet and outlet are calculated from the flow equations through the isentropic slit taking into account the flow factor, which is determined at a steady state. Mass flow can be obtained from the energy equation for steady flow through the narrow gap [3]:

$$dm / dt = A_{\text{eff}} \cdot p_{\text{in}} \cdot \sqrt{2\psi / R_o \cdot T_{\text{in}}} \quad (6)$$

Where:  $dm / dt$  - the fluid flow rates,  $\text{g/s}$ ;  $A_{\text{eff}}$  - the flow cross-sectional area,  $\text{m}^2$ ;  $p_{\text{in}}$  - inlet pressure,  $\text{Pa}$ ;  $T_{\text{in}}$  - temperature in front of the entrance,  $^{\circ}\text{K}$ ;  $R_o$  - gas constant,  $-\text{}$ ;  $\psi$  - the pressure function depends on the properties of the fluid and the pressure ratio;  $c_p$  - isostatic pressure specific heat,  $\text{Kj/Kg}$ ;  $T_w$  - pipe wall temperature,  $\text{K}$ ;  $T$  - flow fluid temperature,  $^{\circ}\text{K}$ .

- Fuel injection speed: That is influenced by many factors of the system and injector. If the structure and fuel properties are not considered, the injection pressure is decisive to the large and

small amount of fuel out of the injector. In addition, parameters that directly affect the fuel injection rate can be divided into two groups [6]:

+ The external flow parameters (specific gravity, Weber number) controls the interaction between the fuel jet and the invironment (in-cylinder pressure):

$$\text{Weber number of liquid phase: } w_{el} = v_l^2 d_{hole} \rho / \sigma \quad (7)$$

+ The internal flow parameters (Reynolds number,  $l_{hole}/d_{hole}$  ratio,  $C_d$  coefficients) control the interaction between the fuel jet and the injector:

$$\text{Reynolds number of liquid phase: } R_{el} = v_l d_{hole} \rho / \mu \quad (8)$$

$$v_l = n(p_{in} - p_{out}) \cdot \sqrt{\frac{1}{\frac{1}{Cd_{nsh}^2 \cdot A_{nsh}^2} + \frac{1}{Cd_{hole}^2 \cdot A_{hole}^2}}} \cdot \sqrt{\frac{2}{\rho} |\Delta p|} \quad (9)$$

$$\dot{m}_{inj} = A_{hole} \cdot v_l \cdot \rho \quad (10)$$

Where:  $\Delta p = p_{in} - p_{out}$ , differential pressure, Pa;  $v_l$  – injection rate,  $m^3/s$ ;  $n$ – engine speed, rpm;  $Cd_{hole}$ –flow discharge coefficient in the spray hole;  $A_{nsh}$  – total narrowest flow area before nozzle spray holes,  $m^2$ ;  $\sigma$  – surface tension of the fuel;  $Cd_{nsh}$  – flow discharge coefficient in the area before the nozzlespray hole;  $A_{holes}$  – open cross-sectional flow areas of sprayholes,  $m^2$ ;  $p_{in}$  and  $p_{out}$  – pressures on input and output, Pa;  $\rho$  – fluid density,  $kg/m^3$ ;  $\dot{m}$  – mass injection rate,  $mg/ms$ ;  $\mu$ – fuel viscosity,  $mm^2/s$ .

## 2.2. Experimental Research

- Experimental research is carried out on Yanmar 4CHE high-speed diesel engine, mechanical fuel injection, Dynamite 13 hydraulic brake connection, power, torque, speed meter, fuel cost meter, and other devices. Experimental layout as shown in Figure 2, the engine specifications are shown in Table 1.

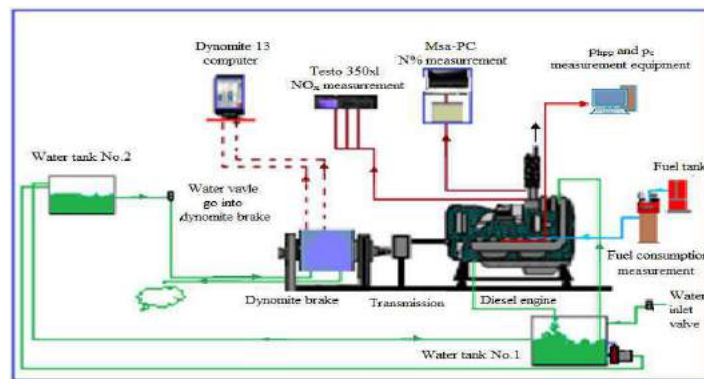


Figure 2. Experimental setup

- A Dynamite 13 hydraulic brake of LAND SEA Firm- USA, with computer connection, used to load and power measure. In which the working fluid in the brake is water. Loading the engine is done through the torque adjustment in the hydraulic brake ( $M_b$ ):

$$M_b = G_w \cdot C \cdot (T_{in} - T_{out}) \quad (Nm) \quad (11)$$

The engine torque ( $M_e$ ) will be equal to the sum of the torque calculated on the dynamometer and the torque in the hydraulic brake:

$$M_e = M_b + pl \quad (Nm) \quad (12)$$

Actual engine working power ( $N_e$ ) is determined:

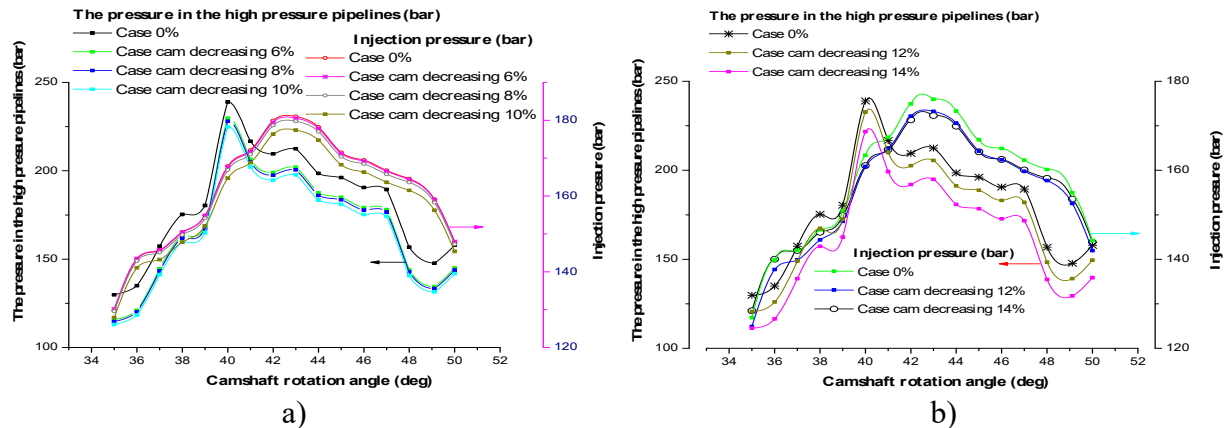
$$N_e = n \cdot M_e / 9550 \quad (kW/h) \quad (13)$$

Where:  $G_w$  - amount of water required for the brake to work;  $C$  - the heat rate of water;  $T_{in}$ ,  $T_{out}$  - inlet and outlet temperature at brake;  $p$  - dynamometer;  $l$  - swing arm length;  $n$  - engine speed.

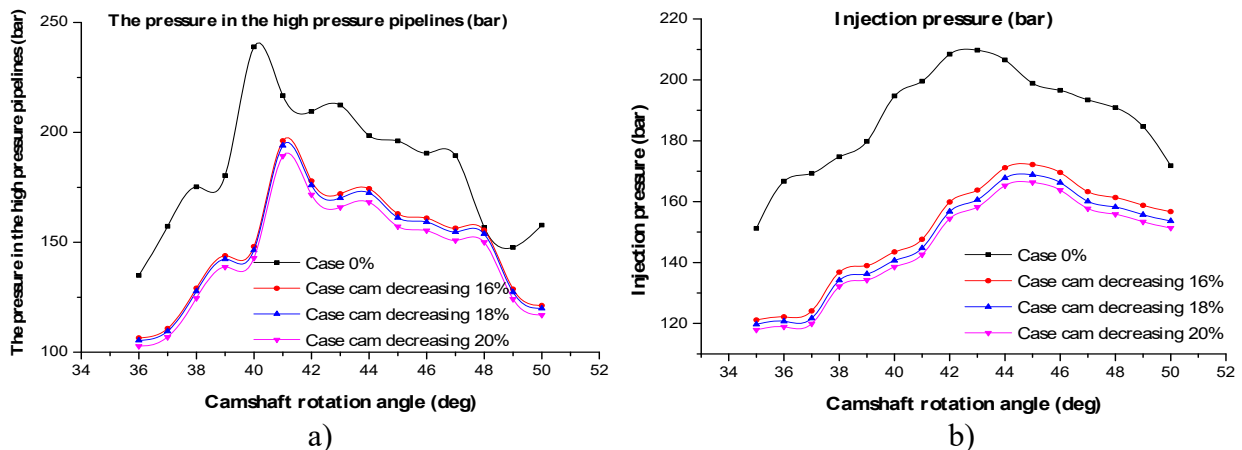
### 3. RESEARCH RESULTS AND DISCUSSION

#### 3.1. Simulation research results

From Table 1, Table 3 and the simulation assumptions as in Table 2, simulation research results of the influence of cam profile corrosion on injection parameters (pressure evolution in the high-pressure pipeline, fuel injection pressure at the injector) shown in Fig. 3. In which cam profile corrosion at 6%, 8%, 10% has little influence on injection parameters. In Figure 4, when cam profile corrosion decreases at 16%, 18%, 20%, the pressure history and injection pressure decrease from 18% to over 20% compared to the initial state. Which affects the process of combustion mixture formation, resulting in a reduction of engine power.



**Figure 3.** Cam profile corrosion 6%, 8%, 10% (a) and cam profile corrosion 12%, 14% (b) compared with standard condition

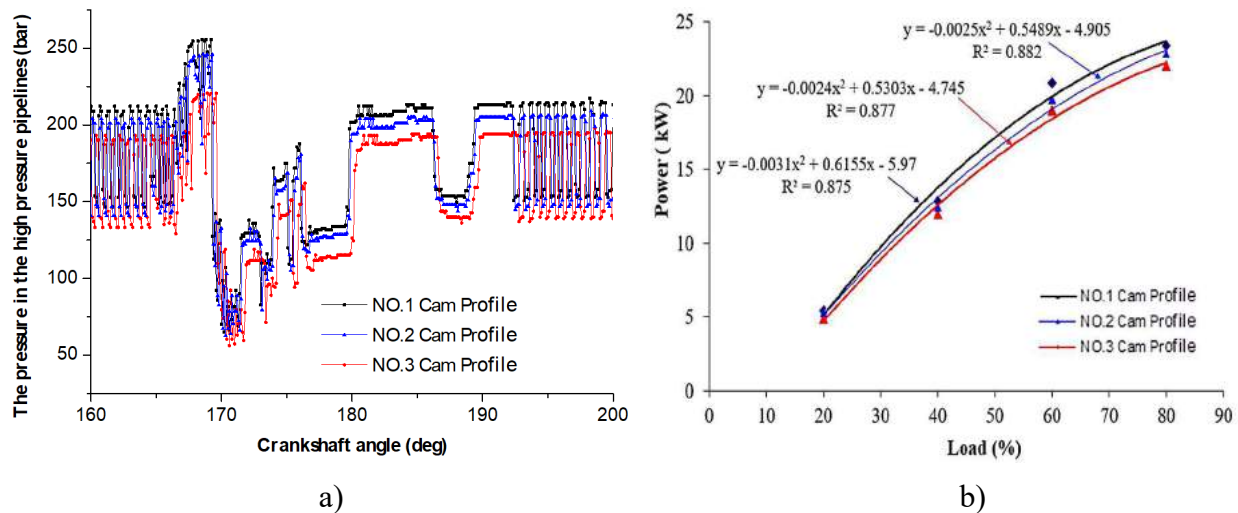


**Figure 4.** Effect of cam profile corrosion on  $p_{hpp}$  (a) and fuel injection pressure (b)

#### 3.2. Experimental research results

Based on the experimental layout shown in Figure 2, the test mode shown in Table 2, the measuring devices are calibrated to standard conditions. Next, Organize a test to measure the pressure history in the high-pressure pipeline, and the results are shown in Figure 5a. In which, in cam profile 02, the pressure drop in the high-pressure pipeline is not much. However, in the case of cam profile 03, the pressure in the high-pressure pipeline and the injection pressure decreased sharply, on average by 18% compared to the point of cam profile 01, which is the cause of a sharp decrease in power as shown in Figure 5b.





**Figure 5.** Effect of different cam profiles on  $p_{hpp}$  (a) and engine power characteristics at different cam profiles (b)

The Figure 5b shows the results of measuring engine power with 03 types of cam profiles with different use times, in which, when the pressure in the high-pressure pipe decreases slightly, the power decreases not much (cam profile 02) compared to in the standard state (cam profile 01), when the pressure in the high-pressure pipe drops sharply, the injection pressure at the nozzle decreases, causing the formation of the combustion mixture to take place incompletely, causing the engine power to decrease up to 7.4% as in the case of cam profile 03.

#### 4. CONCLUSIONS AND RECOMMENDATIONS

It can be seen from the simulation and experimental results that, when the cam profile is worn to 16%, the pressure change in the high-pressure pipe is reduced by about 18% and the engine power is reduced by 7.4% compared to standard conditions. On this basis, it is possible to use a pressure gauge in the high-pressure hose to diagnose the technical status of a diesel engine used as the main engine for fishing vessels preventing problems with the fuel injection system and other issues early. At the same time, take appropriate measures to maintain and repair the main diesel engine.

#### References

- [1] Carsten Baumgarten, Mixture Formation in Internal Combustion Engines, pp. 57-71, Springer - Verlag Berlin Heidelberg, 2006.
- [2] Kazimierz Lejda and Pawel Woschi, Internal Combustion Engines, pp. 32-45, Intech chapters published, 2012.
- [3] Kazimierz Lejda, Fuel Injection in Automotive Engineering, pp. 126-131, Intech chapters published, 2012.
- [4] Lukasz Grabowski, AVL Simulation Tools Practical Applications, pp. 78-86, Politechnika Lubelska Graz – Lublin, 2012.
- [5] Ho Duc Tuan, Tran Thanh Hai Tung, Mai Duc Nghia, "Experimental research influence of the pressure of the end compression stroke to power and specific fuel consumption of the main diesel engine of fishing vessels", Vietnam mechanical engineering journal, vol 7, pp 14-19, 2019.
- [6] K.Mollenhauer and H.Tschoeke, Handbook of Diesel Engines, pp. 216-260, Springer - Verlag Berlin Heidelberg, 2010.
- [7] Operation manual 4CHE, Yanmar Co.,ltd, 2013.
- [8] Users Guide, BOOST Hydsim v2013.

## HAFİFLETİLMİŞ VE DAYANIMI ARTTIRILMIŞ KATMANLI KOMPOZİT MİĞFER TASARIMI İÇİN TABAKA DİZİMLERİ ANALİZİ

### ANALYSIS OF LAYER ARRANGEMENTS FOR LIGHTENED AND STRENGTHENED LAYERED COMPOSITE HELMET DESIGN

**Burhan TEPEHAN<sup>1</sup>, İsmail Yasin SÜLÜ<sup>2</sup>**

<sup>1,2</sup> İnönü Üniversitesi, Makine Mühendisliği Bölümü, Malatya/TÜRKİYE  
0000-0003-0327-5272

#### Özet

Bu çalışmada, hafifletilmiş ve dayanımı arttırılmış katmanlı bir kompozit miğfer tabakasının arasına ilave edilen metal sac malzemesinin kompozit yapı üzerinde ki etkileri incelenmiştir. Üç boyutlu sonlu elemanlar yöntemi kullanılarak deformasyon ve gerilme analizleri yapılmıştır. Analizlerde kullanılan malzemeler, karbon fiber, cam fiber ve alüminyum alaşımıdır. Bağlayıcı malzeme olarak ise epoksi reçine kullanılmıştır. Nümerik analizler için ANSYS paket programı kullanılmıştır. Kompozit tabakada oluşan hasar yükleri çarpışma analiz sonuçlarına göre tespit edilmiştir. Kompozit tabaka üzerinde oluşan toplam deformasyon ve eşdeğer gerilmeler gözden geçirilmiştir. Sonuç olarak aradaki sac levhanın ve yapılan kompozit diziliminin etkileri araştırılmıştır.

**Anahtar kelimeler:** Sonlu elemanlar yöntemi, Kompozit malzemeler, Miğfer ,Gerilme analizi, Hasar analizi ,çarpışma analizi

#### Abstract

In this study, the effects of the metal sheet material added between a lightened and strength enhanced layered composite helmet layer on the composite structure are examined. Deformation and stress analyzes are carried out by using the three dimensional finite element method. In the analysis, the materials carbon fiber, glass fiber and aluminum alloy are used. As for the binding material, epoxy resin is used. ANSYS package program is used for numerical analysis. The damage ratio in the composite layer is determined according to results of the analysis of collision. The whole deformation and equivalent stresses on the composite layer are reviewed. As a result, the effects of the steel plate and the composite delamination in between them are analyzed.

**Keywords:** Finite element method, Composite parts,Helmet , Stress analysis, Failure analysis, explicit dynamic

#### Giriş

Kompozit malzemeler günümüzde birçok alanda sıkça kullanılmakta olan sanayisinin vazgeçilmez bir parçasıdır. Teknolojinin gelişmesiyle bu malzemelerde meydana gelene yenilikler gelişime paralel olarak artış göstermiştir. Gün geçtikçe yaygın kullanıma sahip olan bu malzemeler havacılık, uzay, otomotiv, savunma vb. sanayilerinin vazgeçilmez bir materyali haline gelmiştir. Sahip olduğu avantajlı özelliklerinden dolayı özellikle savunma sanayisinin de yaygın bir kullanıma sahiptir.

Savunma sanayinde kullanılmak amacıyla üretilen kompozit malzemelerden beklenen özellikler, yüksek mukavemet/yoğunluk oranı, şekillendirebilme, elektriksel özellikler, korozyona ve kimyasal etkilere karşı mukavemet, renklendirilebilme ve titreşim

sönümlendirmedi. Uçak, helikopter gibi askeri hava taşıtlarının kanat kuyruk elemanlarında ve iniş kalkış pistlerinde, egzoz flaplerinde, tank, panzer ve hava taşıtlarının zırhlarında, askeri taşımacılıkta kullanılan ağır vasıtalarda, vücut koruyucu hafif zırhlarda, kurşun geçirmez yeleklerde, silah gövdelerinde, sıvı zırhlarda, insansız hava araçlarında, otobüs, kamyon ve diğer askeri araç koltuklarında ve yanmaz askeri çadırlarda kompozit malzemeler tercih edilir (Eryıldız & Akdoğan Eker, 2015). Kompozitlerin yaygın kullanım alanlarından biride askeri miğferlerdir. Miğferlerin üretiminde birçok malzeme türü ve farklı üretim yöntemleri kullanarak gerçekleştirilmiştir. Askeri miğferler, sadece parçalanma direnci nedeniyle değil, aynı zamanda malzemenin, tek bir soğuk presleme işleminde kullanılan nispeten sık çanak şekillerine dönüştürülebilmesi için çelikten yapılmış. Fakat günümüzde çağdaş kasklar genellikle kompozit yapılardan yapılmaktadır. Bunu sebebi ise hafiflik konusunda çözümler sunması ve kafada gelişmiş entegrasyon ve stabilite sunan şekiller için daha fazla tasarım özgürlüğü sağlamasıdır. İlk kompozit miğferler 1960'ların sonunda, tipik olarak balistik naylon kullanılarak yapıldı. Kısa bir süre sonra aramid takviyeleri tanıtıldı ve sonunda askeri kasklarda en yaygın kullanılan malzeme haline geldi. Ultra yüksek moleküler ağırlıklı polietilenler (UHMWPE) uzun yıllardır balistik uygulamalarda kanıtlanmış olmasına rağmen, kask uygulamalarında aramidin yerini yeni yeni almaya başladılar. Yaklaşık son beş yılda, üretim süreçlerinin gelişmesi ve spesifikasyonların daha da zorlaşmasıyla, UHMWPE, en gelişmiş yüksek performanslı hafif balistik kasklarda kullanılan en yaygın malzeme haline geldi. Kasklarda kullanılan malzemeler genellikle bu işlevlerden birine veya daha fazlasına uyan, ancak diğer işlevlerle her zaman çatışan özelliklere sahiptir. Bunun bir örneği, UHMWPE malzemelerinin balistik ve parça tehditlerini ortadan kaldırmada mükemmel olması, ancak diğer malzemelerden daha fazla deforme olmasıyla arka yüz imzasının bir endişe haline gelmesidir (Giray & Bailey, 2019). Bu nedenle, en etkili kask yapıları, tüm gereksinimleri verimli bir şekilde karşılamak için tek bir malzeme kullanımına indirgenemez. Sonuç olarak, kask yapıları, bireysel müşteri gereksinimlerini karşılamak ve performansı optimize etmek için birçok farklı malzemeyi hibrit yapılarda birleştirir. Bu, kask için gerekli olan genel özellik aralığını karşılamak için balistik malzemeleri karbon veya cam gibi geleneksel yapısal kompozit malzemelerle birleştirmek anlamına gelebilir. Literatürdeki çalışmalardan biri olan (Bitlisli & Yazıcı, 2019) çalışmalarında “ UHMWPE, Aramid, Karbon, Hibrit ve Cam elyaflarından oluşan kumaş yapılar, ara yüzey malzemesi olarak seçilen PE film tabakaları ile basınç ve sıcaklık kontrolü özelliğine sahip bir pres kullanılarak, sıcaklık ve basıncın etkisiyle katmanlı yapı formunda birleştirilmiştir. Üretilen çok katmanlı kompozit plakalar ile balistik standartlara uygun deneyler gerçekleştirilmiştir ” yapmıştır.

Bu zamana kadar balistik dayanımı yeterli, hafif, ve ekonomik balistik miğfer malzemeleriyle ilgili çok sayıda çalışmalar gerçekleştirilmiştir. Ancak henüz ideal bir yapıda bir miğfer geliştirilememiştir. Bu kapsamda geliştirilen bu çalışmada, literatürdeki çalışmalardan farklı olarak hibrid kompozit yapısının arasına eklenecek metal levhanın eklenmesinin balistik dayanıma katkıları ayrıntılı olarak değerlendirilecektir. Karbon fiber kumaş ve cam fiberin farklı oryantasyon dizilimleri ele alınacak olup araya eklenecek metal malzemenin kalınlığındaki değişimin malzeme üzerindeki deformasyon ve gerilme değerleri üzerinde ki etkisinin ne olacağı irdelenecektir. Yapılan çalışma sonucunda, miğferler için kullanılacak balistik kompozit malzeme ile aynı seviye tehdit durumunda daha ince ve daha hafif yeni bir kompozit hibrid yapısı geliştirmek ve bundan sonra yapılacak çalışmalara hızlı ve uygun maliyetli üretim prosesi geliştirilmesine zemin hazırlamaktır. Genel olarak literatürde, Hibrid yapıda ki kompozit malzelerin arasına eklenen metal malzemenin etkisine dair çok sayıda çalışma bulunmamaktadır. Bu yapılacak çalışmanın yeni çalışmalara ilham kaynağı olabileceği ve farklı balistik malzemelerde buna benzer yapıların kullanılabileceği öngörülmektedir.

## Materyal ve Yöntem

Bu çalışmada, karbon, cam fiber ve alüminyum alaşımı kullanılmıştır. Balistik ürünlerde kullanılan malzemelerden biri karbon fiberlerdir. Bu malzemeler, yüksek özgül mukavemet, özgül sertlik, korozyon direnci, artan yorulma ömrü gibi mükemmel mekanik özellikleri nedeniyle birçok askeri ve sivil uygulamada artan şekilde kullanılmaktadır (Alarçin, 2020). Cam elyafı yüksek çekme mukavemeti, iyi kimyasal dayanım, elektriksel yalıtıkanlık ve ekonomiklik nedeniyle polimer matrisli kompozitlerde ideal takviye elemanı olarak kullanılır (İlhan & Feyzullahoğlu, 2019). Kompozit malzeme yapımında cam elyaflar ile birlikte matris malzemesi olarak kullanılan en yaygın reçineler polyster ve epoksi reçinesi türevleridir. Termoset polimerler sınıfına üye olan epoksi reçineler, gösterdikleri eşsiz kimyasal ve mekanik özellikler ile çok yönlü işlenme kabiliyetleri doğrultusunda kompozit malzemeler için en çok tercih edilen reçineler arasına girmişlerdir (Çakır & Berberoğlu, 2018). Tablo 1’de ise bu kumaşlara ait teknik özellikler verilmiştir.

**Tablo 1.** Deney numunelerinde kullanılan kumaşların teknik özellikleri (Dost Kimya, 2017)

	Karbon fiber kumaş	Cam fiber kumaş
<b>Yoğunluk</b>	1.8 gr /cm <sup>3</sup>	2.54 gr/cm <sup>3</sup>
<b>Young modülü</b>	220-240 GPa	70 GPa
<b>Germe dayanımı</b>	3450 – 4850 MPa	2200 MPa
<b>Kumaş kalınlığı</b>	0.4 mm	0.35
<b>Reçine tüketimi</b>	281 gr /m <sup>2</sup>	294 gr/m <sup>2</sup>
<b>Alansal ağırlık</b>	245 gr/m <sup>2</sup>	296 gr/m <sup>2</sup>

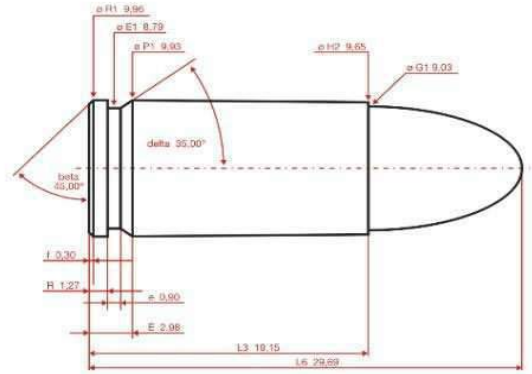
Yüksek dayanımlı çelikler koruyucu yapı malzemesi olarak seçilmeye birinci aday olmalarına rağmen, Al7075 ve Al7017 gibi mühendislik alüminyum alaşımları da mükemmel dayanım, düşük yoğunluk gibi özelliklerinden dolayı çekici bir zırh malzemesi adaydır (Camcı, Fındık , & Barlay Ergü, 2020). Çalışmada kullanılacak Al7075 –T6 için mukavemet değerleri Tablo- 1 ‘da ki gibidir.

**Tablo 2.** Al7075 –T6 için mukavemet değerleri (Seykoç Alüminyum, 2017)

Temper	Akma Mukavemeti (MPa)	Çekme Mukavemeti (Mpa)	Uzama ( %50)	Sertlik ( Brinel )
T6	460-505	530-570	10	140-160

Bu çalışmada bu malzemelerin hibrid yapıda bir araya getirilecektir. Hibrit kompozitler yüksek sertlik ve mukavemet sağlayabilir, darbe ve yorulma direncini artırabilir ve hafiflik avantajları

gibi kazanımlar verebilirler (Camcı, Fındık , & Barlay Ergü, 2020). Deneyler, balistik standartlara uygun olarak, 5 m mesafeden 8 gram ağırlığında çekirdeği olan 9x19 Parabellum FMJ (Full Metal Jacket) fişekler ile atışlar yapılmıştır (Mukasey & diğ., 2008). Şekil-2’de mermiye ait teknik resim verilmiştir.



Şekil 1. Deneyde kullanılan mermi özellikleri (Mukasey & diğ., 2008)

Bu çalışmada cam fiber ve karbon fiber kumaşlardan oluşturulacak bir hibrid tabaka arasına eklenecek bir sac levhanın kalınlığındaki değişimle deformasyon ve gerilme değerlerinde değişimi incelenmesi hedeflenmiştir. ANSYS aracılığıyla kompozit tabakalar ve balistik mermi modellenmiş ve analiz kısmına aktarılmıştır. Bu çalışmada 4 farklı oryantasyon dizilimi, 3 farklı sac kalınlığı belirlenerek toplamda 12 adet analiz yapılacaktır. Deformasyon değerleri ve gerilme değerleri göz önünde bulundurularak ideal sac kalınlığı ve kompozit dizilimi seçilecektir. Bu çalışma için 4 farklı oryantasyon dizilimi ve 3 farklı levha kalınlığı şekilde belirlenmiştir.

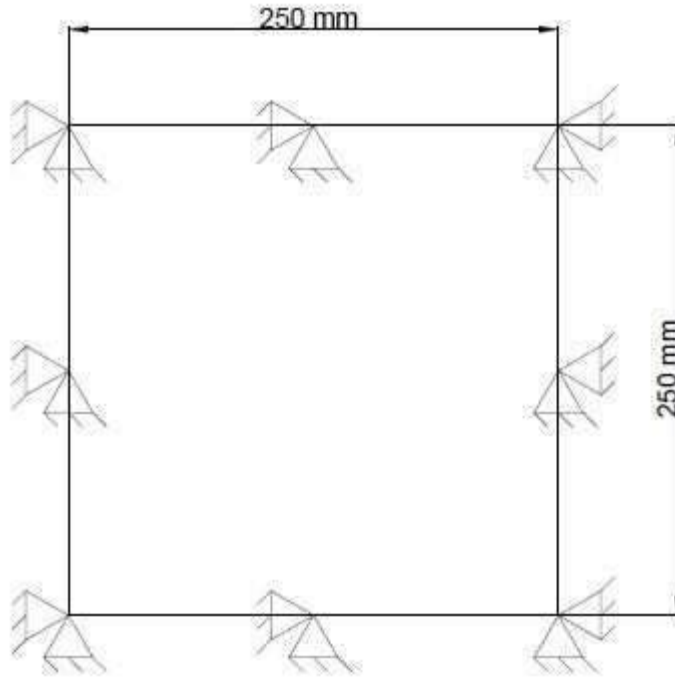
Tablo 3. Çalışmada kullanılacak malzeme dizilimi ve metal levha kalınlık oryantasyonları

	MALZEME & TABAKA DAĞILIMI						
	1. Tabaka	2. Tabaka	3. Tabaka	4. Tabaka	5. Tabaka	6. Tabaka	7. Tabaka
1. ORYANTASYON	KARBON FİBER	CAM FİBER	KARBON FİBER	SAC LEVHA 1 mm	KARBON FİBER	CAM FİBER	KARBON FİBER
	KARBON FİBER	CAM FİBER	KARBON FİBER	SAC LEVHA 3 mm	KARBON FİBER	CAM FİBER	KARBON FİBER
	KARBON FİBER	CAM FİBER	KARBON FİBER	SAC LEVHA 5 mm	KARBON FİBER	CAM FİBER	KARBON FİBER
2. ORYANTASYON	CAM FİBER	KARBON FİBER	CAM FİBER	SAC LEVHA 1 mm	CAM FİBER	KARBON FİBER	CAM FİBER
	CAM FİBER	KARBON FİBER	CAM FİBER	SAC LEVHA 3 mm	CAM FİBER	KARBON FİBER	CAM FİBER
	CAM FİBER	KARBON FİBER	CAM FİBER	SAC LEVHA 5 mm	CAM FİBER	KARBON FİBER	CAM FİBER
3. ORYANTASYON	CAM FİBER	KARBON FİBER	KARBON FİBER	SAC LEVHA 1 mm	KARBON FİBER	KARBON FİBER	CAM FİBER
	CAM FİBER	KARBON FİBER	KARBON FİBER	SAC LEVHA 3 mm	KARBON FİBER	KARBON FİBER	CAM FİBER
	CAM FİBER	KARBON FİBER	KARBON FİBER	SAC LEVHA 5 mm	KARBON FİBER	KARBON FİBER	CAM FİBER
4. ORYANTASYON	KARBON FİBER	CAM FİBER	CAM FİBER	SAC LEVHA 1 mm	CAM FİBER	CAM FİBER	KARBON FİBER
	KARBON FİBER	CAM FİBER	CAM FİBER	SAC LEVHA 3 mm	CAM FİBER	CAM FİBER	KARBON FİBER
	KARBON FİBER	CAM FİBER	CAM FİBER	SAC LEVHA 5 mm	CAM FİBER	CAM FİBER	KARBON FİBER

Bu çalışma, deneysel nümerik analizlerle yürütülmesi hedeflenmiştir. Nümerik çözümler ile temellendirilmiş sonlu elemanlar yöntemi temeli esas alınarak kullanılan ANSYS paket programı ile analiz yapılacaktır. Sonlu elemanlar yöntemi, çeşitli mühendislik problemlerine kabul edilebilir bir yaklaşımla çözüm arayan bir sayısal çözüm yöntemidir. Ele alınan



mühendislik probleminin çözüm bölgesi alt bölgelere ayrıştırılır ve her alt bölgede aranan fonksiyonun ifadesi polinom olacak şekilde seçilir. Belirli işlemler dâhilinde her alt bölgede polinom olarak kabul edilen çözümün katsayıları belirlenmeye çalışılır (Kibar & Öztürk, 2012). Sonlu elemanlar yöntemiyle analiz yapan çeşitli programlar da bulunmaktadır. ANSYS programının kullanılması, modellerin sorunsuz bir şekilde tasarlanması ve önem arz eden parametrelerin değerlendirilmesinde maliyetsiz bir araştırma imkanı sunmaktadır. Yaptığımız çalışmada planlanan miğfer tasarımı çalışmaları sağlıklı bir şekilde yürütülmesi için miğferi oluşturan tabaka üzerinde analiz yapılmıştır. Analizin bu şekilde yapılmasının temel sebebi miğferin karmaşık bir tasarım yapısına sahip olması ve insandan insana çeşitlilik göstermesi sebebiyle tabakalar halinde çalışma yürütülmüştür. Çalışmalar sonlu elemanlar temelli olan ANSYS 14.5 yapısal analiz programı kullanılarak yapılmıştır. Planlanan miğfer tasarımının analizlerinin kontrollü bir şekilde yürütülmesi için 250mmx250mmx15mm boyutlarında plakaların tasarımları yapılmıştır. Bu analizler sonlu elemanlar olarak yürütülmesi planlandığından mesh tipi olarak quadratik olarak kullanılacaktır. Element tipi olarak SOLİD 20 nodlu quadratik element dikkate alınacaktır. Bu element x, y, z yönlerinde hareket etme özelliğine sahiptir. Malzemenin bütünlüğü düşünüldüğünde oluşturulan levhanın dört köşe yüzeylerinin tüm yönlerde sabitlenmesi gerekmektedir. Bu sabitlenmesine ilişkin teknik resim Şekil 2 ‘ de ayrıntılı olarak verilmiştir.



**Şekil 2.** Levhanın dört köşeden sabitlenmesi

Yukarıda Şekil-2’de ki gibi 4 köşeden sabitlenen plakalar üzerine tabanca mermisi ile atış yapılmıştır. Çalışmalarda kullanılacak mermi türlerine göre boyutları tabanca için 9mm çapında bir tabanca Bu mermilerin hızları 9 mm çapında tabanca mermisi için 370 m/sn Mermi kovan malzemesi olarak pirinç seçilirken mermi çekirdeği olarak kurşun alınmıştır (MKEK Hafif ve Ağır Mühimmat Ailesi – Millisavunma.com, 2021). Bu tabakalar ve mermi ANSYS 14.5 üzerinden tasarlanıp analizleri yapılmıştır.

Bu Çalışma için üniversitemizde kullanılmakta olan Ansys 14.5 programı yardımıyla 12 farklı analiz gerçekleştirilmiştir. Her bir analizin çözülme süresi yaklaşık 12 saat sürmüştür. Bu analizler bütün

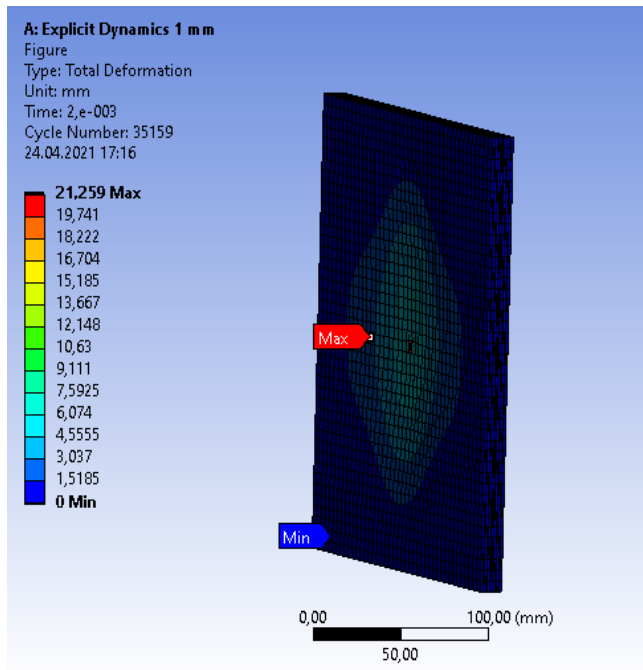
mukavemet değerleri bulunmuş olup bu çalışma için tabakada oluşan toplam deformasyon değeri ve maksimum gerilmeler verilmiştir.

## Bulgular

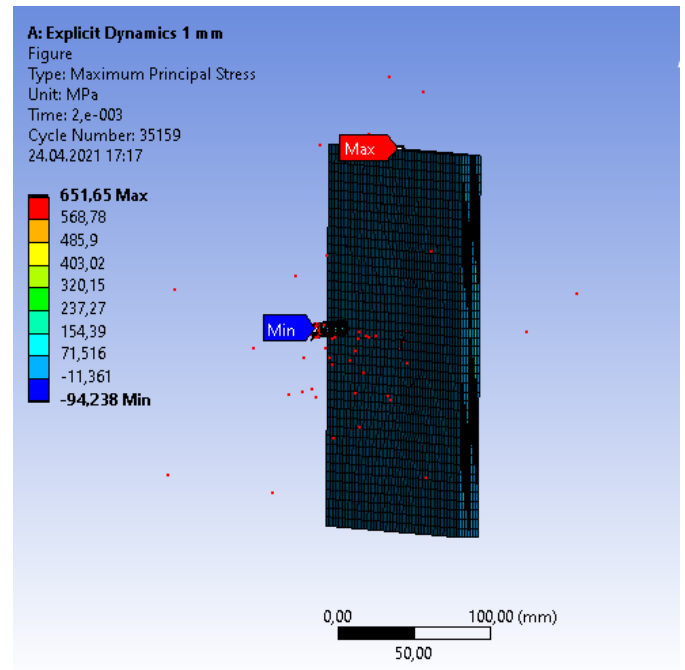
### 1. Oryantasyon

**Tablo 4. 1. Oryantasyon dizilimi**

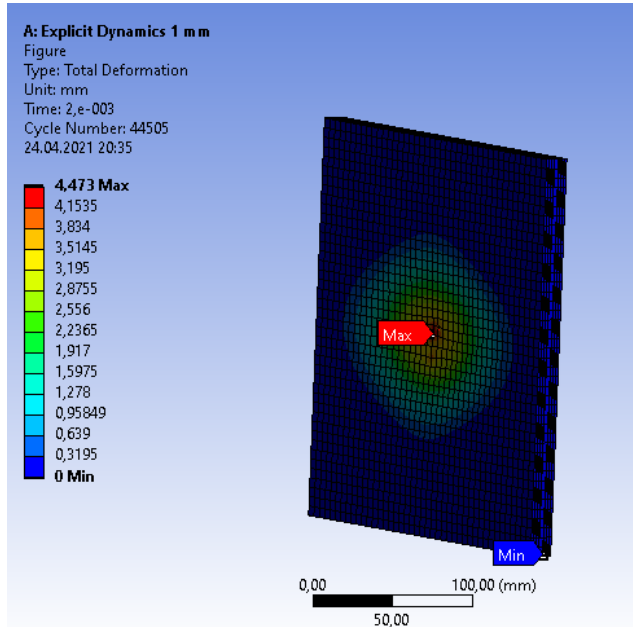
1.Tabaka	2.Tabaka	3.Tabaka	4.Tabaka	5.Tabaka	6.Tabaka	7.Tabaka
Karbon	Cam	Karbon	Aliminyum	Karbon	Cam	Karbon
fiber	fiber	fiber	alaşım	fiber	Fiber	fiber



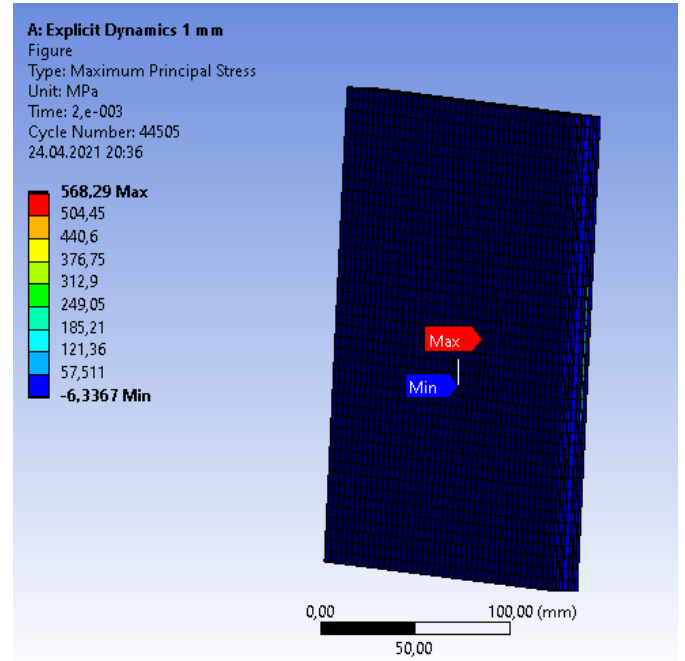
a) 1 mm kalınlığında ki sac levhada toplam deformasyon



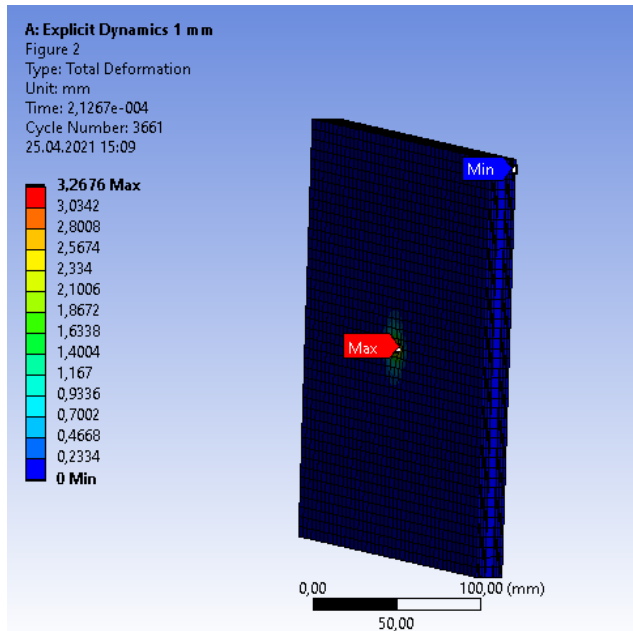
b) 1 mm kalınlığında ki sac levhada maksimum gerilme değeri



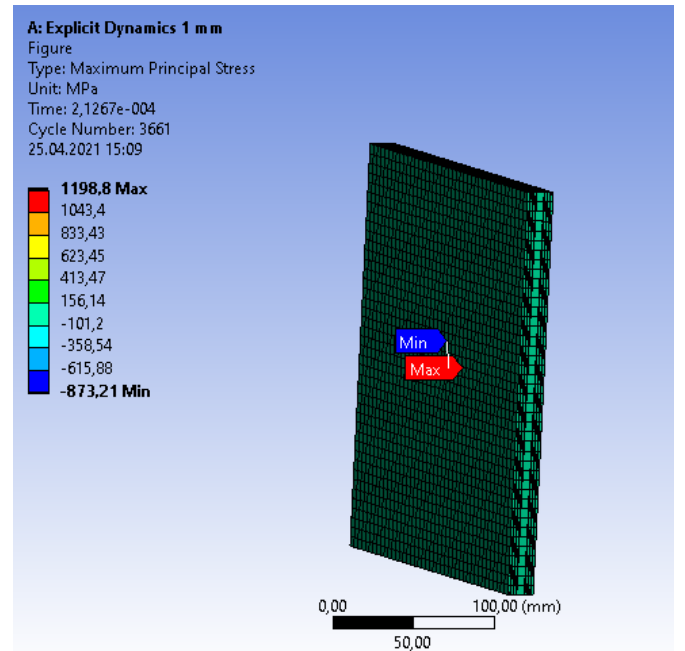
a) 3 mm kalınlığında ki sac levhada toplam deformasyon



b) 3 mm kalınlığında ki sac levhada maksimum gerilme değeri



a) 5 mm kalınlığında ki sac levhada toplam deformasyon



b) 5 mm kalınlığında ki sac levhada maksimum gerilme değeri

**Şekil 3.** 1. Oryantasyon için sırasıyla 1,3,5 mm kalınlığında tabakalardaki a) toplam deformasyon değerleri b) maksimum gerilme değerleri

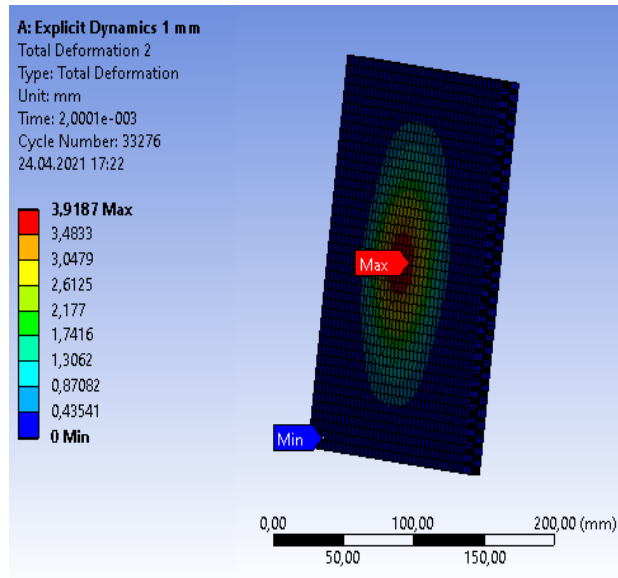
Bu deney sonucunda 1. Oryantasyon diziliminde ( karbon ,cam ,karbon,sac levha ,karbon ,cam , karbon ) elde edilen sonuçlara göre 1 mm kalınlığındaki levhada delinme meydana gelmiştir. Diğer dizilimlerde ( 3 ve 5 mm ) delinme görülmemiştir.Maksimum gerilmeler ise 1

mm sac levha kalınlığında üst orta bölümde meydana gelirken , 3 ve 5 mm sac levha kalınlığında arka yüzlerde oluşmuştur.

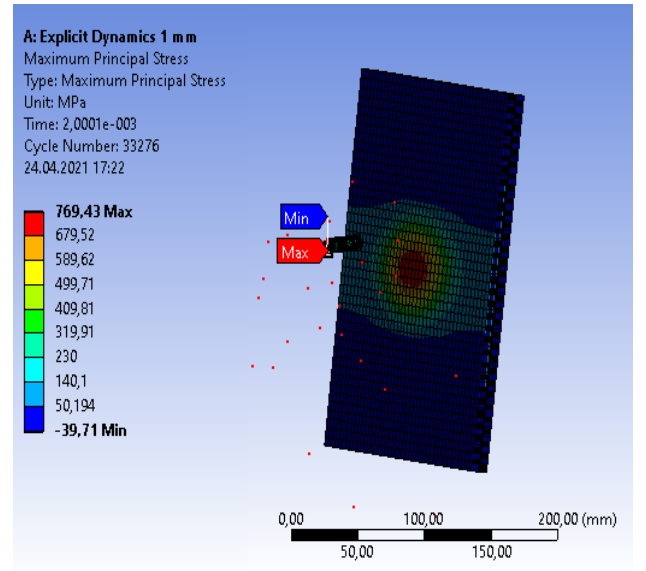
## 2. Oryantasyon

Tablo 5. 2. Oryantasyon dizilimi

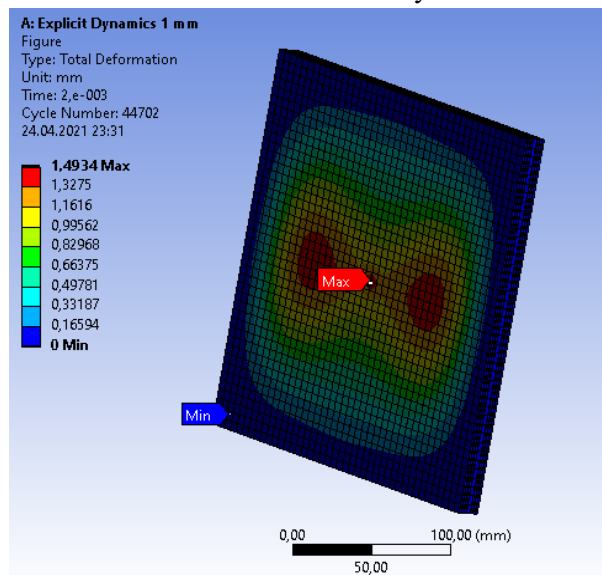
1.Tabaka	2.Tabaka	3.Tabaka	4.Tabaka	5.Tabaka	6.Tabaka	7.Tabaka
Cam	Karbon	Cam	Aliminyum	Cam	Karbon	Cam
fiber	fiber	fiber	alaşım	fiber	Fiber	fiber



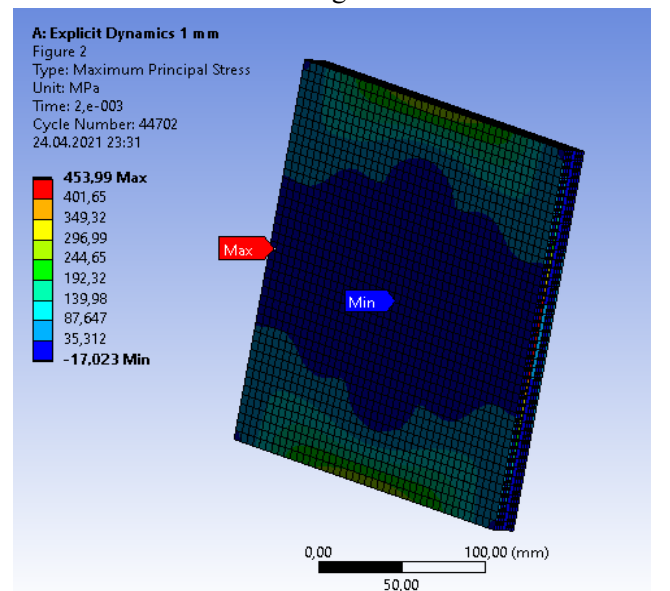
a) 1 mm kalınlığında ki sac levhada toplam deformasyon



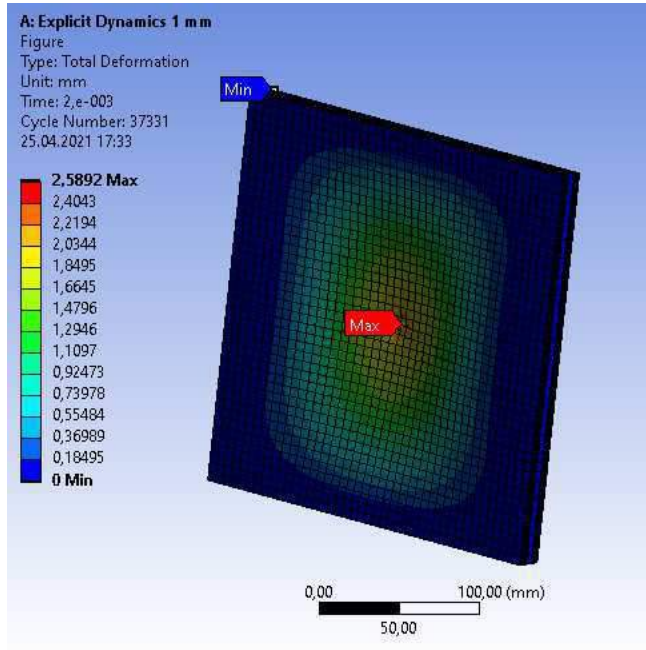
b) 1 mm kalınlığında ki sac levhada maksimum gerilme değeri



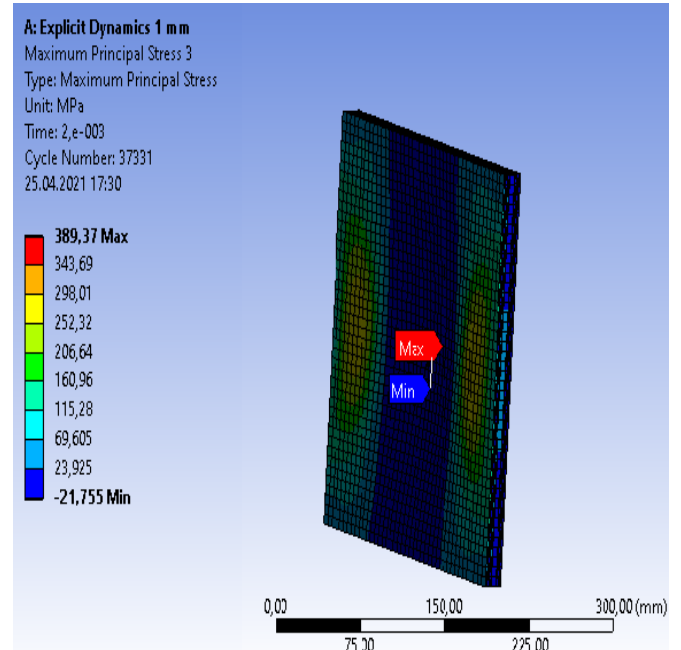
a) 3 mm kalınlığında ki sac levhada toplam deformasyon



b) 3 mm kalınlığında ki sac levhada maksimum gerilme değeri



a) 5 mm kalınlığında ki sac levhada toplam deformasyon



b) 5 mm kalınlığında ki sac levhada maksimum gerilme değeri

**Şekil 4.** 2. Oryantasyon için sırasıyla 1,3,5 mm kalınlığında tabakalardaki a) toplam deformasyon değerleri b) maksimum gerilme değerleri

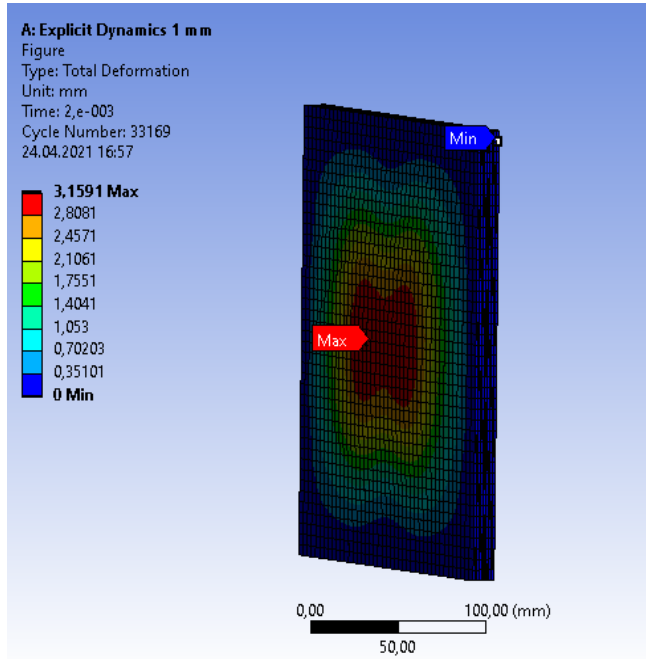
Bu deney sonucunda 2. Oryantasyon diziliminde (cam ,karbon,cam ,sac levha ,cam ,karbon ,cam ) elde edilen sonuçlara göre 1,3 ve 5 mm kalınlığında ki sac levhalarda delinme meydana gelmemiştir. Maksimum gerilmeler ise 3 farklı yerlerde meydana gelmiştir. Minimum toplam deformasyon 3 mm kalınlığında ki sac levha diziliminde meydana gelmiştir.

### 3. Oryantasyon

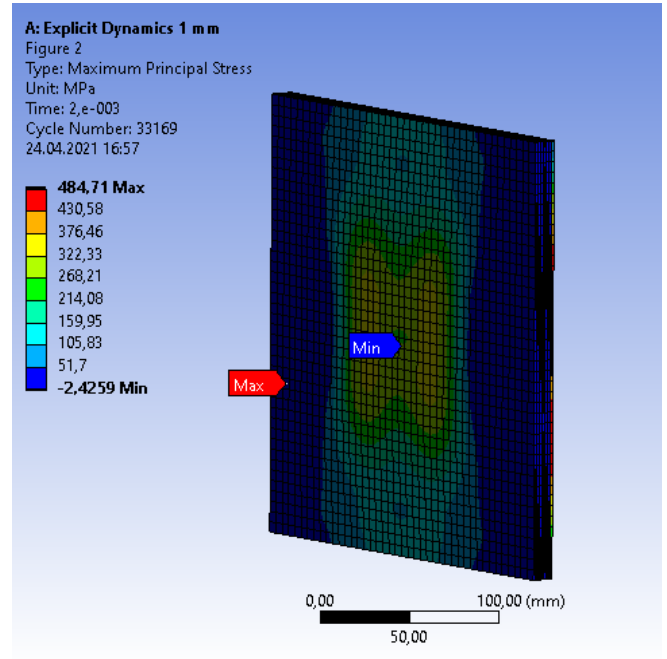
**Tablo 6. 3.** Oryantasyon dizilimi

1.Tabaka	2.Tabaka	3.Tabaka	4.Tabaka	5.Tabaka	6.Tabaka	7.Tabaka
Cam	Karbon	Karbon	Aliminyum	Karbon	Karbon	Cam
fiber	fiber	fiber	alaşım	fiber	Fiber	fiber

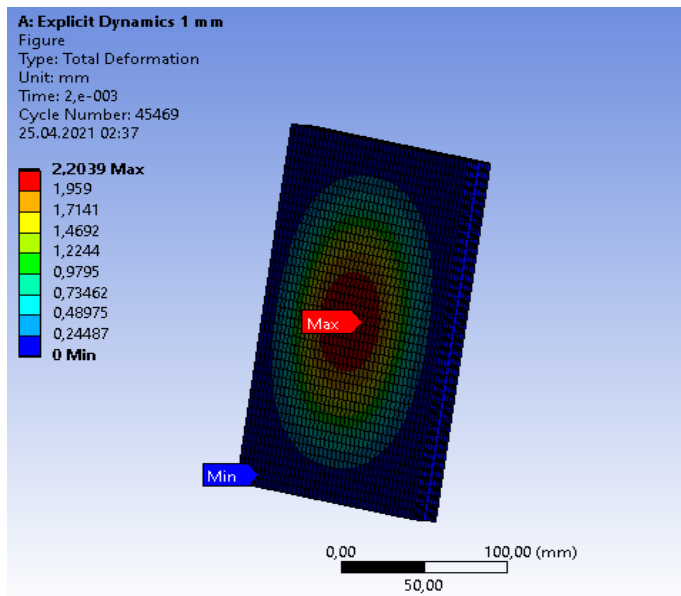




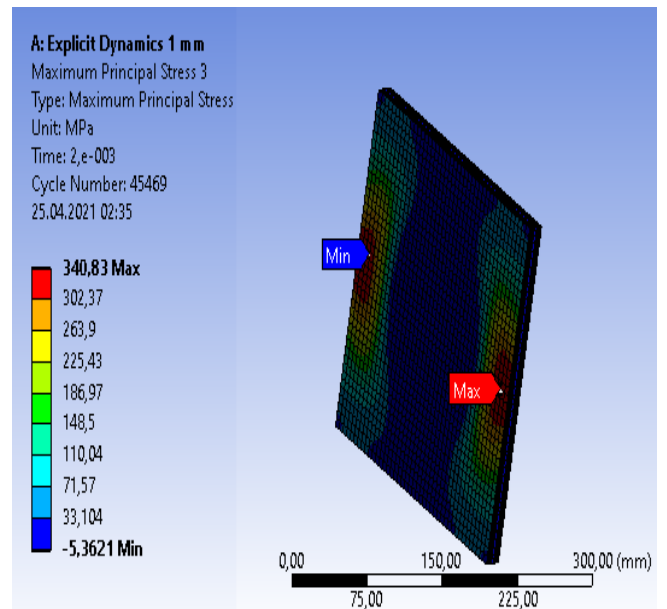
a) 1 mm kalınlığında ki sac levhada toplam deformasyon



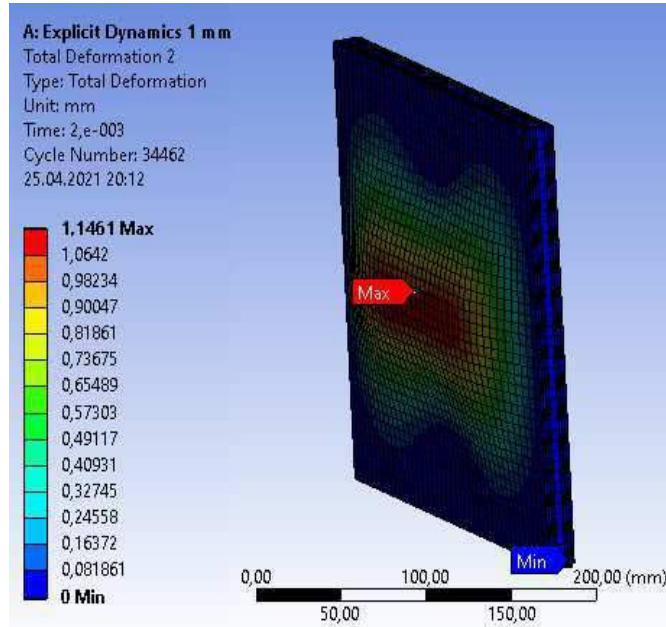
b) 1 mm kalınlığında ki sac levhada maksimum gerilme değeri



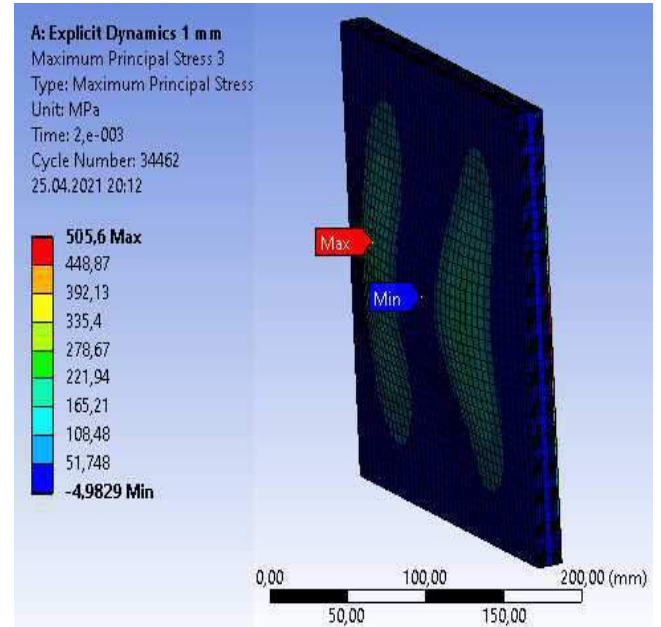
a) 3 mm kalınlığında ki sac levhada toplam deformasyon



b) 3 mm kalınlığında ki sac levhada maksimum gerilme değeri



a) 5 mm kalınlığında ki sac levhada toplam deformasyon



b) 5 mm kalınlığında ki sac levhada maksimum gerilme değeri

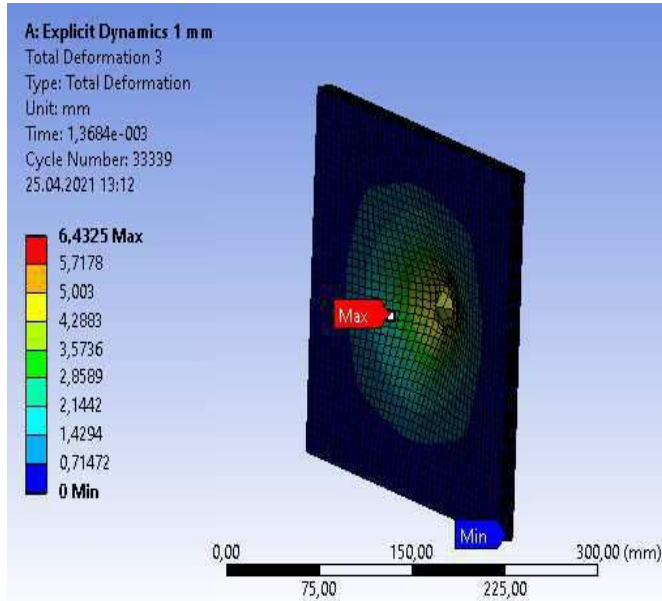
**Şekil 5.** 3. Oryantasyon için sırasıyla 1,3,5 mm kalınlığında tabakalardaki a) toplam deformasyon değerleri b) maksimum gerilme değerleri

Bu deney sonucunda 3. Oryantasyon diziliminde (cam ,karbon,karbon ,sac levha ,karbon,karbon ,cam ) elde edilen sonuçlara göre 1,3 ve 5 mm kalınlığında ki sac levhalarda delinme meydana gelmemiştir. Maksimum gerilmeler ise 3 farklı yerlerde meydana gelmiştir. Minimum toplam deformasyon 5 mm kalınlığında ki sac levha diziliminde meydana gelmiştir.

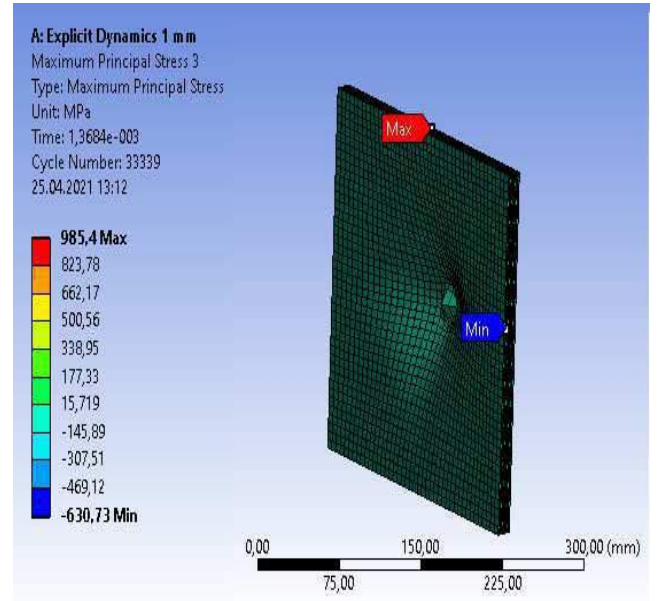
#### 4. Oryantasyon

**Tablo 7. 4.** Oryantasyon dizilimi

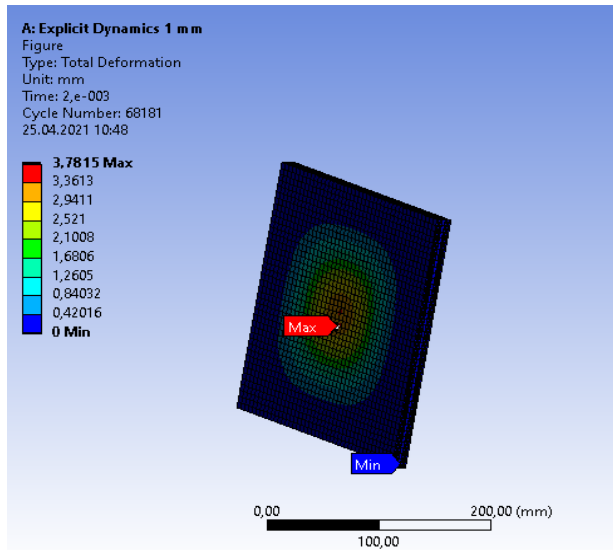
1.Tabaka	2.Tabaka	3.Tabaka	4.Tabaka	5.Tabaka	6.Tabaka	7.Tabaka
Karbon	Cam	Cam	Aliminyum	Cam	Cam	Karbon
fiber	fiber	fiber	alaşım	fiber	Fiber	fiber



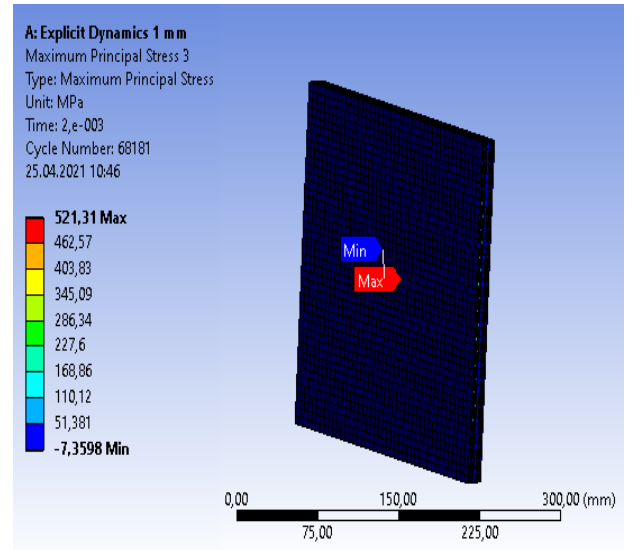
a) 1 mm kalınlığında ki sac levhada toplam deformasyon



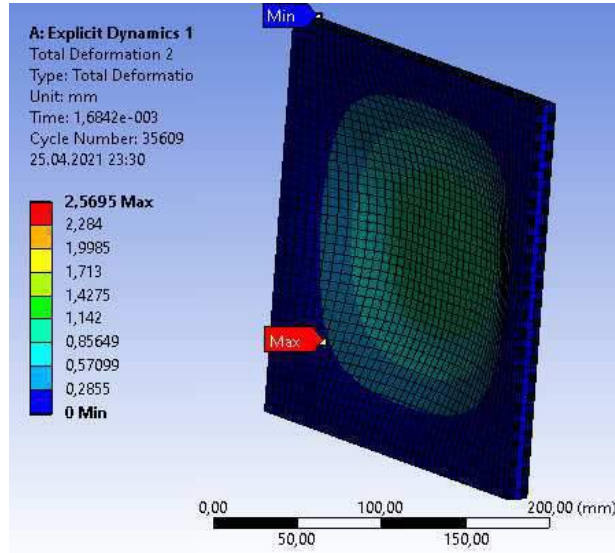
b) 1 mm kalınlığında ki sac levhada maksimum gerilme değeri



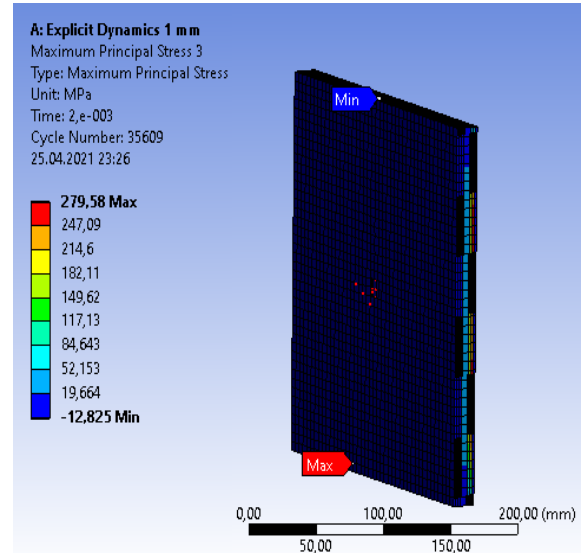
a) 3 mm kalınlığında ki sac levhada toplam deformasyon



b) 3 mm kalınlığında ki sac levhada maksimum gerilme değeri



a) 5 mm kalınlığında ki sac levhada toplam deformasyon



b) 5 mm kalınlığında ki sac levhada maksimum gerilme değeri

Şekil 6. 4. Oryantasyon için sırasıyla 1,3,5 mm kalınlığında tabakalardaki a) toplam deformasyon değerleri b) maksimum gerilme değerleri

Bu deney sonucunda 4. Oryantasyon diziliminde ( ,karbon,karbon,cam ,sac levha ,cam ,cam karbon) elde edilen sonuçlara göre 1,3 ve 5 mm kalınlığında ki sac levhalarda delinme meydana gelmemiştir. Maksimum gerilmeler ise 3 farklı yerlerde meydana gelmiştir. Minimum toplam deformasyon 5 mm kalınlığında ki sac levha diziliminde meydana gelmiştir.

#### Sonuçlar

Yapılan analizler sonucunda elde edilen değerler Tablo-3’de verilmiştir. Elde edilen sonuçlar ışığında maddeler halinde verilmiştir.

Tablo 8. Oryantasyonla deformasyon ve delinme durumları

	Deformasyon (mm )	Delinme durumu
<b>1.Oryantasyon (1 mm levha kalınlığı )</b>	21,259	Var
<b>(3 mm levha kalınlığı )</b>	4,473	Yok
<b>(5 mm levha kalınlığı )</b>	3,2676	Yok
<b>2.Oryantasyon (1 mm levha kalınlığı )</b>	3,9187	Yok
<b>(3 mm levha kalınlığı )</b>	1,4934	Yok
<b>(5 mm levha kalınlığı )</b>	2,5892	Yok
<b>3.Oryantasyon (1 mm levha kalınlığı )</b>	3,1591	Yok
<b>(3 mm levha kalınlığı )</b>	2,2039	Yok
<b>(5 mm levha kalınlığı )</b>	1,1461	Yok
<b>4.Oryantasyon (1 mm levha kalınlığı )</b>	6,4325	Yok
<b>(3 mm levha kalınlığı )</b>	3,7815	Yok
<b>(5 mm levha kalınlığı )</b>	2,5695	Yok

- Maksimum gerilme değeri 1198,8 MPa ile 1.Oryantasyon ( karbon ,cam ,karbon,sac levha ,karbon ,cam ,karbon ) 5 mm kalınlığında ki sac levhada meydana gelmiştir.

- Yapılan Analizlerden yalnızca 1. Oryantasyon ( karbon ,cam ,karbon,sac levha ,karbon ,cam ,karbon ) 1 mm kalınlığında ki sac levha diziliminde delinme oluşmuştur.
- 3. Oryantasyon ( cam ,karbon ,karbon ,sac levha ,karbon ,karbon ,cam ) 5 mm kalınlığında ki sac levha diziliminde 1,1461 mm ile minumum deformasyon miktarı oluşmuştur.

## KAYNAKLAR

- Alarçin, S. (2020). ULTRA YÜKSEK YOĞUNLUKLU POLİETİLEN VE KARBON FİBER HİBRİT KOMPOZİTLERİN BALİSTİK DAYANIMININ İNCELENMESİ. *Technological Applied Sciences*, 29-40.
- BAILEY, S., & GİRAY, M. (2019). DEVELOPMENTS IN LIGHTWEIGHT COMPOSITE BALLISTIC. *Güvenlik Bilimleri Dergisi*, 79-94.
- Bitlisli, B., & Yazıcı, M. (2019). ARAÇ ZIRHLAMADA KULLANILAN KOMPOZİT MALZEMELERİN BALİSTİK PERFORMANSLARININ İNCELENMESİ. *Uludağ Üniversitesi Mühendislik Fakültesi Dergisi*,.
- Camcı, E., Fındık, F., & Barlay Ergü, Ö. (2020). Metal Esaslı Sandviç Kompozitlerin Balistik Performansının İncelenmesi. *Düzce Üniversitesi Bilim ve Teknoloji Dergisi*, 1454-1469.
- Çakır, M., & Berberoğlu, B. (2018). E-Cam Elyaf Takviyeli Epoksi Matrisli Kompozit Malzemelerin ElyafOranındaki Artış İle Mekanik Özelliklerindeki Değişimlerin İncelenmesi. *El-Cezerî Fen ve Mühendislik Dergisi*, 734-740.
- Dost Kimya. (2017). dostkimya: <https://dostkimya.com/> adresinden alındı
- Eryıldız, E., & Akdoğan Eker, A. (2015). Savunma Sanayinde Kullanılan İleri Kompozit Malzemeler ve Uygulama Alanları. *International Journal of Engineering Research and Development*.
- Giray, M., & Bailey, S. (2019). DEVELOPMENTS IN LIGHTWEIGHT COMPOSITE BALLISTIC. *Güvenlik Bilimleri Dergisi*, 79-94.
- İlhan, R., & Feyzullahoğlu, E. (2019). Cam Elyaf Takviyeli Polyester (CTP) Kompozit Malzemelerde Kullanılan Doğal Elyaf ve Dolgu Maddeleri. *El-Cezerî Fen ve Mühendislik Dergisi*, 355-381.
- Kibar, H., & Öztürk, T. (2012). ANSYS Sonlu Eleman Yazılımının Tarımdaki Uygulamaları. *İğdır Üni. Fen Bilimleri Enst. Der.*, 65-74.
- MKEK Hafif ve Ağır Mühimmat Ailesi – *Millisavunma.com*. (2021). <http://www.millisavunma.com/mkek-hafif-ve-agir-muhimmat-ailesi/> adresinden alındı
- Mukasey, & diğ. (2008). Ballistic Resistance of Body Armor. *U.S. Department of Justice , Office of Justice Programs* .
- Seykoç Alüminyum. (2017). Seykoç Alüminyum: <https://www.seykoc.com.tr/icerik/7075?dil=tr> adresinden alındı



## DESIGN OF SMART FIRE EXTINGUISHING AMMUNITION

**Murat TOPTAŞ<sup>1\*</sup>, Mehmet YILMAZ<sup>2</sup>**

<sup>1</sup>Inonu University, Engineering Faculty, Department of Mechanical Engineering, Malatya, Turkey.

ORCID NO: 0000-0001-9368-5675

<sup>2</sup>Inonu University, Engineering Faculty, Department of Mechanical Engineering, Malatya, Turkey.

ORCID NO: 0000-0001-5025-1842

### Abstract

Fires, occurring in a variety of environments and of different sizes, continue to threaten the entire world. Today, due to its independence from geography and the possibility of observing the entire fire area from above, the aerial method of fire suppression provides more effective results for fires that occur in open areas than other methods. However, still the existed tools used today to fight fires from the air cannot have the expected effect in extinguishing fires. There are two main reasons for this. The first is the low effectiveness of the extinguishing agents used in extinguishing and cooling operations, and the second is the problem of these agents not being released in the desired quantity and in the right places. This study focuses on the design of a new and effective firefighting tool to be used in aerial firefighting methods and will eliminate the above shortcomings. This designed tool is thrown the fire from aircraft. It contains a very effective mineral with extinguishing-cooling properties. This extinguishing tool is also assisted by some electronic sensors and software to perform its task autonomously after being dropped from the aircraft. The design of this tool, which takes its shape and dimensions from a real wartime munition (Mark 82 type air to ground low drag bomb), was created using the 3D modeling program Catia V5.R21, and the structural, numerical, and flow analyzes were performed using Ansys 16.0 software. The resulting design was awarded a prize in a national competition (TUBITAK 2242-University Students Research Project Competitions, Turkey second prize, 2019) and a patent application was filed for the commercial manufacture of the product.

**Keywords:** Smart Fire Extinguishing Ammunition, Aerial Firefighting, Fire Extinguishing Bomb.

### INTRODUCTION

Fires, occurring in a variety of environments and of different sizes, continue to threaten the entire world. Compared to last year from Arctic to Amazon the number of fires were increased by 13% across the globe (WWF, 2020). In the coming period due to climate change and other human-induced negative factors, hotter and drier weathers will increase the fires all over the world.

The fires' contribution to the climate crisis alone would be more than enough reason for the global community to view this increase as a major threat. In addition, forest fires have serious consequences for human health and well-being, biodiversity and economies worldwide (WWF, 2020). Fires not only threaten forests. Many points such as petrochemical plants, oil and gas transmission lines, ammunition depots, factories, and residential areas are risky places where fires are more likely to occur.

Today, flying vehicles are used as well as ground vehicles in the fight against fires. Firefighting methods are divided into two basic groups as land fighting methods and aerial fighting methods. In land fighting, traditional vehicles such as trucks, pickups, fire trucks, and construction machines are often used (İnce, 2019). The aerial firefighting method is in two ways. The first method is aerial support activities, where fire exit points are determined, fire extinguishing activities are

monitored and coordinated. The second method is the direct intervention method. Here, the transportation of fire personnel or the bombardment of the fire with extinguishing agent is carried out. In bombardment with aircraft from above, water, foam, gel or some fire retardant materials are thrown on the fire (Alder, 1990).

Aerial firefighting is the use of aircraft and other aerial resources to combat wild. Airplanes, helicopters, and parachute and paratrooper crews are used to fight fires from the air. Aerial firefighting can take many forms – from surveillance drones, to huge water bomber jets and light utility helicopters equipped with buckets (Figs. 1-3). Table 1 summarizes aerial firefighting methods.



(a) Aerial firefighters



(b) Wildland fire aircraft

**Figure 1.** Aircrafts used in aerial firefighting activities (RAS, 2021; Idaho, 2021)



(a) Fire rescue heavy helicopter with water bucket



(b) Wildfire blackcomb helicopter

**Figure 2.** Helicopters used in aerial firefighting activities (Alamy, 2021; The Flying Moose 2021)



(a) Quadcopter with cage and rail system



(b) Drone with fireball

**Figure 3.** Drones used in aerial firefighting activities (Champagnie and Simonis, 2013; Radu, 2019)

**Table 1.** Aerial firefighting methods

	Aerial Vehicles	Methods	Extinguishing Agent
1	Aircrafts	Water intake tank	Water

2	Helicopters	Helitank / Water buckets	Water
3	Drones	Fireballs	Monoammonium Phosphate / Gunpowder
4	Aircrafts/UAVs	<b>Smart Fire Extinguishing Ammunition</b>	<b>A boron-based extinguishing material</b>

Fires, occurring in a variety of environments and of different sizes, continue to threaten the entire world. Today, due to its independence from geography and the possibility of observing the entire fire area from above, the aerial method of fire suppression provides more effective results for fires that occur in open areas than other methods. However, still the existed tools used today to fight fires from the air cannot have the expected effect in extinguishing fires. There are two main reasons for this. The first is the low effectiveness of the extinguishing agents used in extinguishing and cooling operations, and the second is the problem of these agents not being released at the desired points, in the desired quantity, and at a safe distance. This study focuses on the design of a new and effective firefighting tool to be used in aerial firefighting method, that will eliminate the above shortcomings. This designed tool, that contains a very effective mineral with extinguishing-cooling properties, is thrown to the fire from aircraft. This extinguishing tool is also assisted by some electronic sensors and software to perform its task autonomously after being dropped from the aircraft. The designed product was named as “smart fire extinguishing ammunition” “SFEA”, taking into account the various electronic equipment and software that makes the product autonomous. The design of this tool, which takes its shape and dimensions from a real wartime munition (Mark 82 type air to ground low drag bomb), was created using the 3D modeling program Catia V5.R21, and the structural, numerical, and flow analyzes were performed using Ansys 16.0 software.

### WHAT IS "SMART FIRE EXTINGUISHING AMMUNITION (SFEA)"?

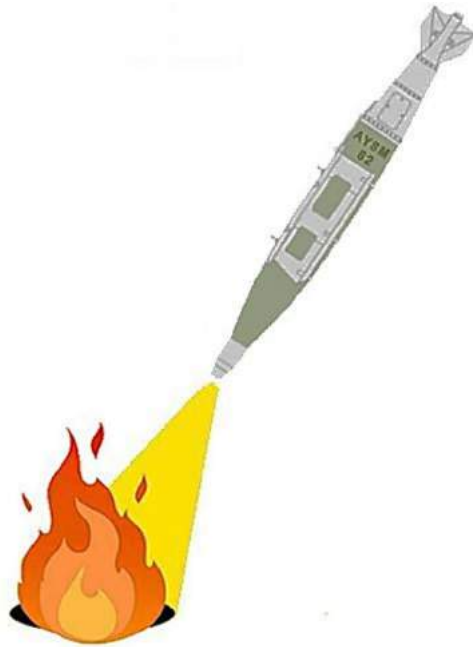
An innovative ammunition, an effective product that has not been designed before, that can be used in aerial firefighting has been designed (Fig. 4). In order to ensure the practicality and cheapness of its use, the ammunition was created with reference to the dimensions of the MK-82 type air-to-ground general purpose ammunition, which is a NATO ammunition. In this way, it will be possible to load the extinguisher bomb without the need for any change on the aircraft using this ammunition. A Mark series general purpose ammunition is given in Fig. 5, the SFEA in Fig. 6. The target of the product is open area fires such as forests, petro-chemical plants, oil and gas transmission lines and ammunition depots outside of residential areas.

The SFEA ensures the achievement of the following objectives:

- The product will be able to determine the most suitable point for its task after being thrown from the aircraft.
- Problem of leaving extinguisher elements at a sufficient amount, at an accurate position safely will be solved.
- The extinguishing agent the SFES contains is thrown to the fire point with minimum deviation without being affected by weather conditions.
- A new and an effective product that has not been designed before will be brought to the aviation and firefighting industry.

### THE STRUCTURE OF THE SFEA

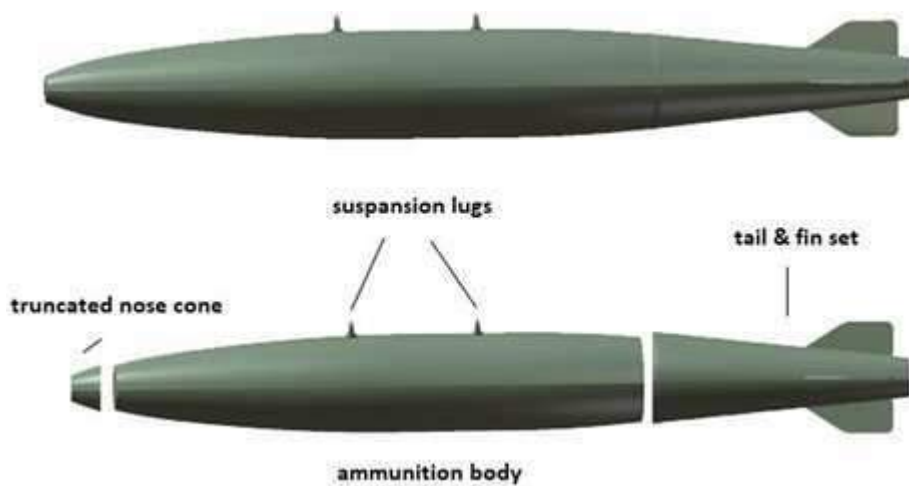
SFEA consists of fuselage, nose cone, tail-wing assembly, extinguisher - cooling material, explosive, detonator, electronic hardware and software. Fig. 6 shows the elements that make up the smart fire extinguishing ammunition.



**Figure 4.** Smart Fire Extinguishing Ammunition (SFEA)



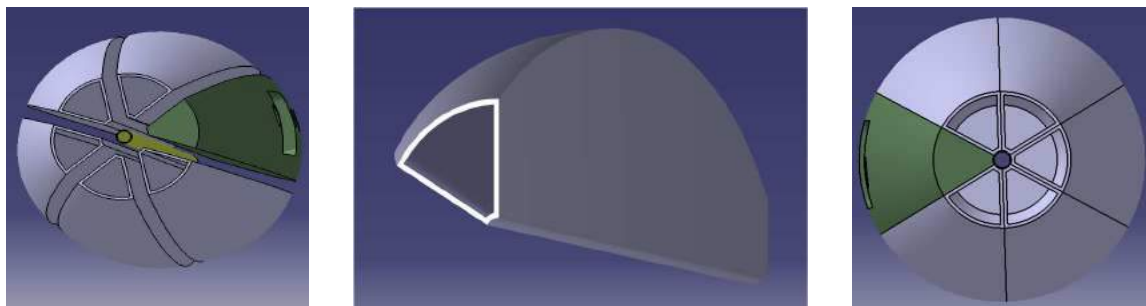
**Figure 5.** A Mark series general purpose ammunition (Krishnamoorthy et al., 1997)



**Figure 6.** Smart Fire Extinguishing Ammunition (SFEA) (Toptaş and Yılmaz, 2021)

## THE STRUCTURAL AND CHEMICAL COMPONENTS OF THE SFEA

In order to scatter the extinguishing agent in a particular pattern, ammunition body should have a sliced structure, not a single piece. So, the ammunition body was designed as a six-piece structure (Fig. 7). When these six pieces come together, they form a 32 mm diameter cylindrical space that allows the explosive to be placed in the center. Five of the slices that make up the ammunition body are empty. These cavities are designed for the extinguishing agents to fill. The sixth slice is designed as a volume to contain suspension hangers that will load the ammunition into the aircraft, and electronic sockets such as a communication socket, and electronic cards.

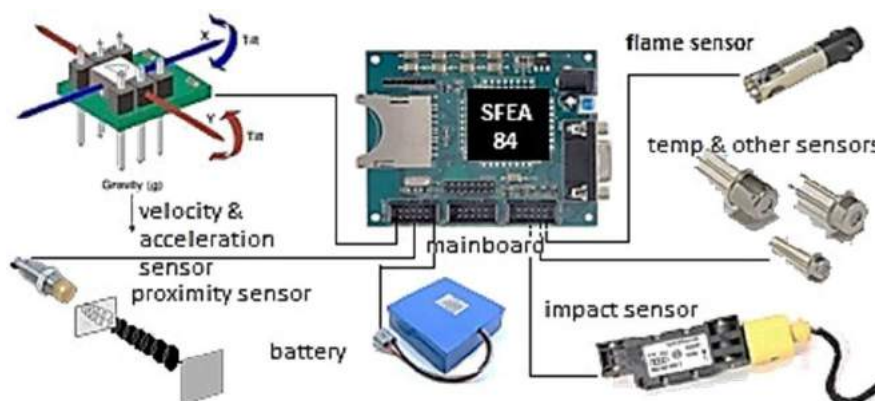


**Figure 7.** Sliced body structure of the SFEA.

A boron-based extinguishing material is used in the SFEA. This domestically produced product does not have any carcinogenic and toxic properties due to its mineral structure. The material used in the SFEA also provides rapid cooling after the drowning. This material reduces the temperature reaching 450 °C in fires to 24 °C within 10 s, and is quite useful in forest fires.

The SFEA contains an explosive substance that enables the extinguishing agent to explode in the fire area or above the flames. Dynamite, which can be detonated with the help of an electrical fuse, was chosen as the explosive substance. The fact that dynamite, which is a civilian explosive type, is relatively simpler and cheaper to supply than military explosives was effective in making this choice.

To perform its task with high precision, there are several sensors (flame, proximity, altitude, velocity, acceleration, pressure, impact) on the SFEA (Fig. 8). Those measuring flame, distance, and impact from these sensors are located in the ammunition's nose.

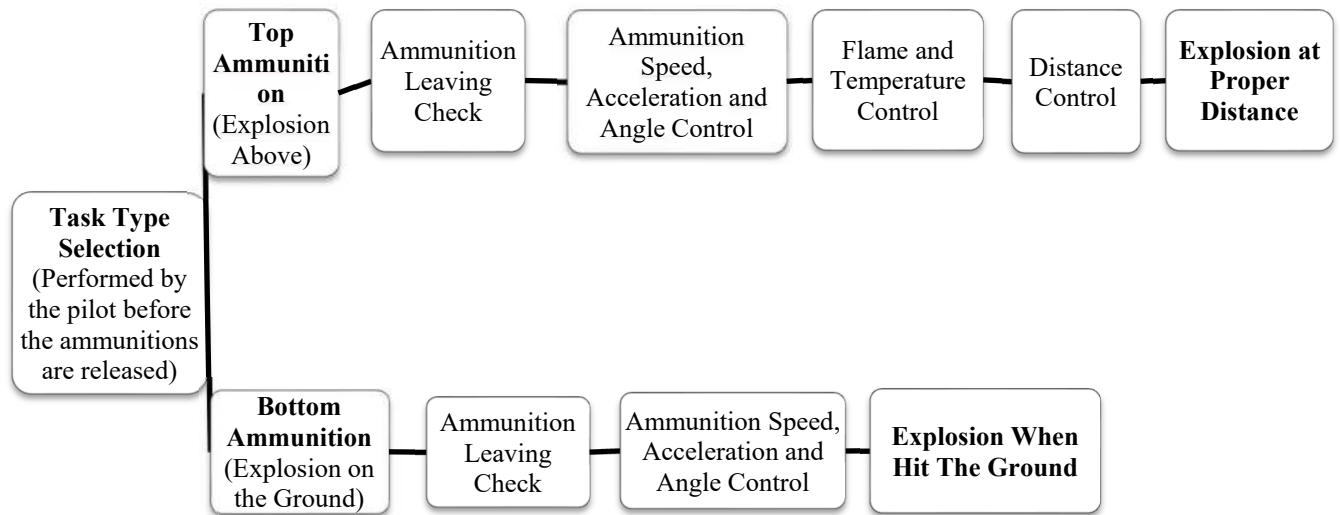


**Figure 8.** Electronic components of SFEA

## WORKING ALGORITHM

In order for the SFEA to fully perform its duties, it is essential that it be able to take a number of autonomous decisions. While making these decisions, the SFEA uses a software algorithm that quickly and accurately interprets the data it receives from its sensors. This software was written in C programming language. The algorithm working scheme of SFEA's software is presented in Fig 9.





**Figure 9.** Algorithm working scheme of SFEA's software

## MANUFACTURE OF THE SFEA

In the SFEA, polycarbonate (PC) material was used in the ammunition body. Polycarbonate material is a type of plastic that can be molded easily and disintegrates by showing a brittle feature when exposed to sudden impact. By using this feature of polycarbonate, it is aimed that the extinguishing material can easily get out during the explosion.

The fins of the ammunition were cut from a 4 mm thick ST-37 steel sheet by a metal plasma cutter. After the necessary rounding of the sharp corners the fin surfaces were painted against corrosion. The conical shape of tail where fins are located also produced with steel sheet. Fins and conical tail were welded together.

The designed nose cone was manufactured with multijet fusion 3D print technology. In production fiber reinforced Nylon-12 material was used.

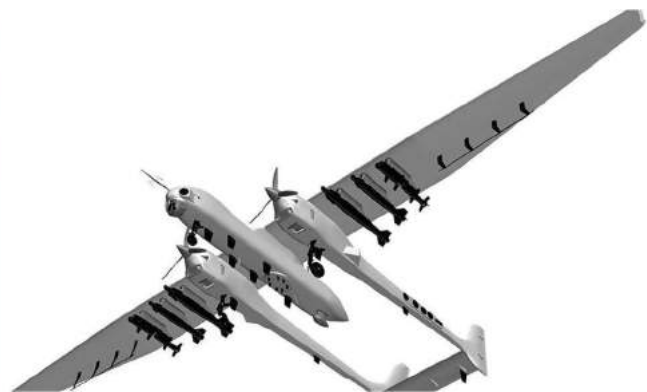
## PLATFORMS WHERE THE SFEA CAN BE USED

Possible platforms where the SFEA can be loaded and dropped are shown in Fig. 10.

## CONCLUSION

In this study, we designed a smart fire extinguisher ammunition (SFEA), which is an effective product that could be used in aerial firefighting methods. To ensure its practicality and inexpensive use, the ammunition was created concerning to the dimensions of the MK-82 type, general air-to-ground purpose NATO ammunition. The design dimensions are similar to an existing warfare munition, allowing it to be loaded directly onto the aircraft without making any improvements or modifications to the aircraft.

The SFEA is a new product for both the firefighting industry and the aviation industry. If the product goes into mass production, a combat vehicle that will make significant contributions to the fight against fire will be obtained. The extinguisher-coolant can be left to the fire in the right amount, at an accurate position so that no harm is caused to the environment due to excessive use of chemicals while extinguishing the fires. In addition, by considering both the efficiency of the product and the speed factors of the aircraft, fires can be controlled without spreading to large areas as before.



**Figure 10.** Platforms where the SFEA can be used

## ACKNOWLEDGEMENTS

The smart fire extinguisher ammunition (SFEA) design participated in the 2242 University Students Research Project Competitions organized by TÜBİTAK Scientist Support Programs in the category of Defense, Space and Aviation, and won the Second Prize in Turkey in the Final Competition held between 17-22 September 2019. A patent application was filed to the Turkish Patent and Trademark Office for the design. We would like to thank the Rectorate of İnönü University for their support for the patent application.

## REFERENCES

Alamy 2021. Available at: <https://www.alamy.com/stock-photo-fire-rescue-heavy-helicopter-with-water-bucket-water-bombing-a-bushfire-73579848.html> [10.08.21]

Alder R 1990. Fighting bush fires from the air. Institute of Fire Engineers, December 1990, Adelaide, Australia.

Champagnie B, Simonis A 2013. EML 4905 Senior Design Project Prepared in Partial Fulfillment of the Highway Wind Turbines.

Idaho, 2021. Available at: [http://www.idahofireinfo.com/2018/07/wildland-fire-aircraft\\_31.html](http://www.idahofireinfo.com/2018/07/wildland-fire-aircraft_31.html) [03.08.21]

İnce A 2019. Yangına Karşı Alınacak Güvenlik Tedbirleri. Available at: <http://www.abdurrahmanince.net> [21.04.21]

Krishnamoorthy LV, Kirk DR, Glass R 1997. Aerodynamic Database for the Mk 82 General Purpose Low Drag Bomb. DSTO-TR-0554, Canberra (Australia), Defence Science and Technology Organization.

Radu VT 2019. Use of drones for firefighting operations. Master Thesis Report. Aalborg University, Esbjerg, Denmark.

RAS 2021. Available at: <https://www.aerosociety.com/news/aerial-firefighters/> [10.08.21]

The Flying Moose 2021. Available at: <https://theflyingmoose.net/the-absurd-diversification-of-canadas-helicopters/> [10.08.21]

Toptaş M, Yılmaz M 2021. Akıllı yangın söndürme mühimmatının sayısal analizi. JAV, 5(1): 22-35.

Toptaş M, Yılmaz M 2021. Design and prototyping of air-to-ground smart fire extinguisher ammunition. 5th International Anatolian Energy Symposium , Trabzon, Turkey, pp.337-345.

WWF 2020. Fires, Forests and The Future: A Crisis Raging Out Of Control? Available at: [https://wwfeu.awsassets.panda.org/downloads/wwf\\_fires\\_forests\\_and\\_the\\_future\\_report.pdf](https://wwfeu.awsassets.panda.org/downloads/wwf_fires_forests_and_the_future_report.pdf) [03.08.21]

## BASMA YÜKÜ ALTINDA AMALGAM RESTORASYONLU DIŞ İLE SAĞLIKLI DIŞLERDE OLUŞAN GERİLMELERİN KARŞILAŞTIRILMASI

### COMPARISON OF STRESSES IN HEALTHY TEETH WITH AMALGAM-RESTORED TEETH UNDER COMPRESSIVE LOAD

Kadir DOĞAN<sup>1</sup>, İsmail Yasin SÜLÜ<sup>2</sup>

<sup>1,2</sup>*İnönü Üniversitesi, Makine Mühendisliği Bölümü, Malatya/TURKEY*

#### Özet

Bu çalışmada, sağ üst premolar diş sınıf II kavite alanı oluşturarak amalgam restorasyonlu ve sağlıklı diş olmak üzere iki farklı katı model tasarlanmıştır. Katı model olarak tasarlanan dişler üzerine iki farklı çiğneme kuvveti uygulanmıştır. Uygulanan iki farklı kuvvet sonucunda dişlerde meydana gelen toplam deformasyon ve eşdeğer stres (Von-Misses) değerleri sonlu elemanlar analiz yöntemi ile incelenmiştir. Çalışmanın sonucunda amalgam restorasyonlu ve sağlıklı dişte meydana gelen toplam deformasyon ve eşdeğer stres değerleri elde edilmiştir. Sonuç olarak amalgam restorasyonlu dişte oluşturulan kavite alanı ve kullanılan dolgu materyalinde meydana gelen değişimler incelenmiştir.

**Anahtar kelimeler:** Sonlu Elemanlar Yöntemi, Amalgam, Eşdeğer Gerilme (Von-Misses), Toplam Deformasyon

#### Abstract

In this study, two different solid models were designed: amalgam-restored and healthy tooth by creating a Class II cavity area to the upper right premolar tooth. Two different chewing forces were applied on the teeth designed as solid models. The values of total deformation and equivalent stress (Von-Misses) occurring in the teeth as a result of two different forces applied were examined by finite element analysis method. As a result of the study, total deformation and equivalent stress values occurred in amalgam-restored and healthy teeth were obtained. As a result, the cavity area created in the amalgam-restored tooth and the changes in the filling material used were examined.

**Keywords:** Finite Element Method, Amalgam, Equivalent Stress (Von-Misses), Total Deformation

#### 1. Giriş

Dolgu, çürük nedeniyle veya üzerine uygulanan kuvvet sonucu deforme olmuş bir diş normal görünümünü ve fonksiyonunu kazandırma yöntemidir. Dolgular günümüzde diş hekimliği alanında yaygın kullanıma sahip olan ve kullanım amacına göre değişiklik gösteren malzemelerdir. Bu malzemeler deformasyon sonucu kırılma, çürüme gibi problemlerin yanı sıra estetik kaygılar durumlarında da dental uygulamalarda tercih edilen malzemelerdir.

Dolguların tarihçesine baktığımız zaman net bir başlangıç zamanının bilinmemesine rağmen ortaya çıkışı milattan önceye dayandırılmaktadır. Dolgular, çürüyen bir dişteki tüm çürük ve artıklar temizlendikten sonra ortaya çıkan boşluğun, dişin normal formuna uygun olarak ve ağızda uzun süre problem yaratmadan bir madde ile restorasyonudur. Dolgu, çürük nedeniyle zarar görmüş bir diş normal fonksiyonunu ve görünümünü kazandırmanın bir yöntemidir (Altun, 2005). Malzeme biliminin gelişmesine paralel olarak dental uygulamalarda kullanılan dolgu malzemelerinde çeşitlilik gözlenmiştir. Sahip oldukları özelliklere göre kullanılan bu dolgular aynı zamanda kullanım yerine, maliyetine, diş hekimi tavsiyesine, hasta isteğine göre vs. tercih edilmektedir. Günümüzde yaygın kullanım alanına sahip dolgulardan birisi de amalgam dolgularıdır. Amalgam restorasyonlar geçen yüzyılın sonundan beri diş hekimliğinde

yaygın bir şekilde kullanılmış, yeterli mekanik özellikleri, ucuz maliyetleri ve uzun ömürleri nedeniyle diş hekimleri tarafından birçok operasyonlarda kullanım tercihi olmuştur (Kaman & Gangler , 2000).

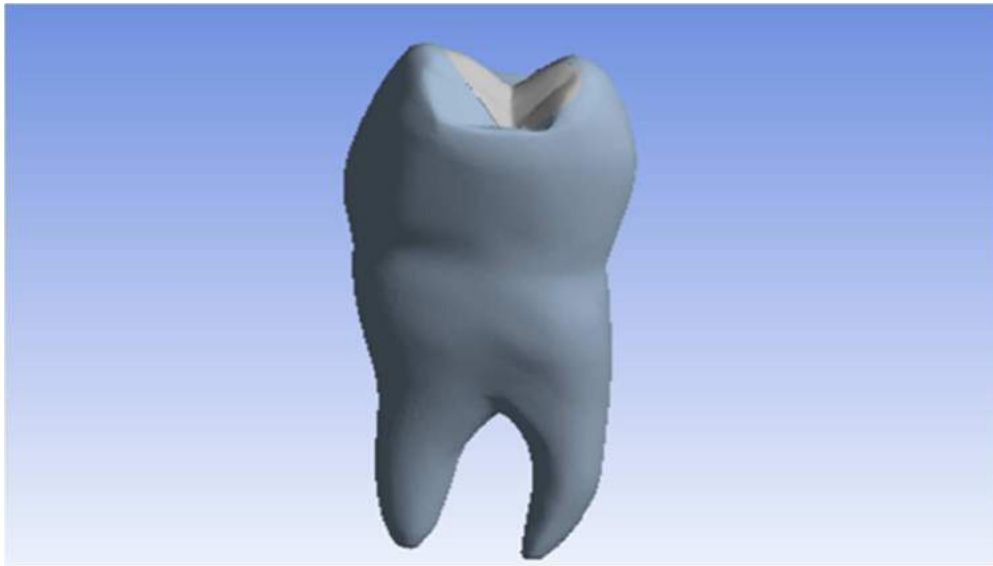
Amalgam diş hekimliğinde ilk defa 7.yy.da Çinliler tarafından kullanılmış, 1970’li yıllara kadar yapılan restorasyonların %75’ini oluşturmuştur. Günümüzde estetik dolgu materyallerinin gelişmesi ile dental amalgamın tercih edilmesi azalmış olsa da diş hekimliğinde sık kullanılan restoratif materyaller arasında yer almaktadır (Secerli Dürer,20017).Hazırlanması ve kaviteye uygulamasının kolaylığı, kavite duvarlarına adaptasyonunun iyi olması ve çiğneme baskılarına karşı dayanıklılığı gibi özelliklere sahip olması amalgamın yaygın kullanımının başlıca sebeplerindendir.

Çalışmamızda sağ üst premolar diş üzerine sınıf II kavite açılmıştır.Açılan kavite alanına amalgam dolgu ile restorasyon yapılarak çalışma tamamlanmıştır.Gerçekleştirilen restoratif çalışmanın yanında çürük olmayan sağlıklı sağ üst premolar diş de çalışmada kullanılmıştır.Bu iki diş üzerine belirlenen farklı kuvvetler uygulanmıştır.Elde edilen bu iki diş için Sonlu Elemanlar Yöntemi kullanılarak toplam deformasyon ve eşdeğer stress(Von-Misses) değerleri analiz edilmiştir.

Bu çalışmanın amacı, premolar dişe açılan Sınıf-II direkt amalgam restorasyonların biyomekanik özelliklerini iki farklı çiğneme kuvveti uygulayarak Sonlu Elemanlar yöntemi ile ölçmektir.İki farklı çiğneme kuvveti sonucunda meydana gelen gerilmeler karşılaştırılarak bulgular bölümünde tartışılacaktır.

## 2. Materyal ve Yöntem

Bu çalışmada, sağ üst premolar diş kullanılmıştır (Şekil 1.).Modelin oluşturulmasında katı modelleme programı ile tersine mühendislik yöntemi kullanılarak tek tek katı hale getirildi. Katı hale gelen parçaların yüzeylerinde geometrik hata kontrolü yapıldı ve parçalardaki hatalar nokta bulutuna uygun yeni yüzeyler atılarak düzeltildi. Mine, dentin ve sınıf-II kavite, tomografi görüntülerindeki kalınlıklar referans alınarak ölçeklendirme yöntemiyle katı modelleme programında ayrı modeller haline getirildi.



**Şekil 1.**Üst 1.Premolar Diş Modeli

Çürük nedeniyle kaybedilen diş dokularının yerine konulabilecek en ideal materyali seçmek yüzyıllardır araştırmacıların en önemli uğraş alanlarından biridir.Çürük yerine ilave edilecek bu malzemenin olabildiğince ana dokuya benzer özellik taşıması ve dayanıklılık oranının bu



dokuya yakın olması istenmektedir.Çürük temizlenip kavite şekillendirilirken dişler daha kırılğan hale gelir.Bu kırılğanlığın minumumda tutulabilmesi için kavite hazırlanırken 1/3 kuralı göz önüne alınır (Görgül, Ömürlü, & Kınoglu, 1990).Kavitenin isthmusunun bukkal ve lingual tüberküllerinin arasındaki mesafenin 1/3'ü kadar yapılmasının kırılmaya karşı dayanıklılığı artıracığı çeşitli araştırmacılar tarafından gösterilerek kural olarak benimsenmiştir (Cavel, Kelsey, & Blankenau, 1985; Elderton, 1934).Çalışmamızda bu kurala uygun Sınıf II kavite hazırlanmıştır.

Çalışmada mine,dentin ve sınıf-II kavite olarak belirlenen katı geometrilerine Ansys programında Tablo 1'de belirtilen malzeme özellikleri tanımlanmıştır.Belirlenen değerler literatür bilgiler baz alınarak oluşturulmuştur.Modeldeki tüm yapılar izotropik, homojen ve elastik olarak varsayıldı.Bu parametreler dikkate alınarak sonlu elemanlar yöntemi ile analizler gerçekleştirildi.

**Tablo 1.** Malzemelerin mekanik özellikleri

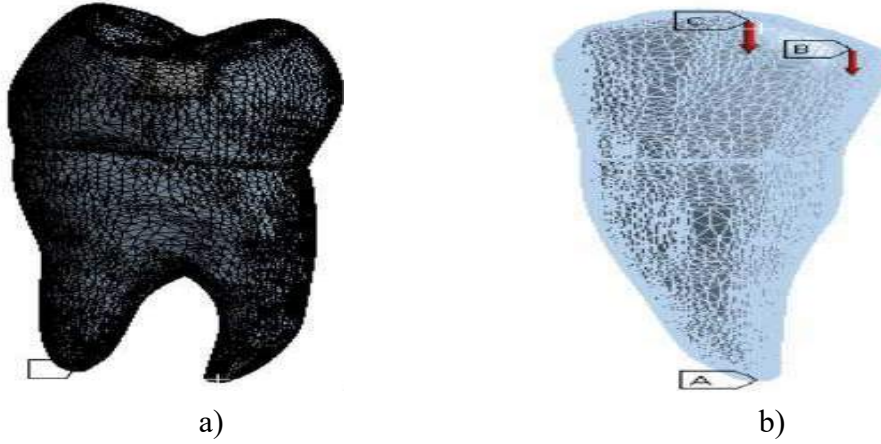
MALZEME	ELASTİSİTE MODÜLÜ(GPa)	POİSSON ORANI	REFERANSLAR
Dental Amalgam	48,3	0.35	(Kara, 2014)
Yapıştırıcı Siman	8,3	0.24	(Bader & Shugars, 2004)
Mine	48	0.23	(Fennis, ve diğerleri, 2005)
Dentin	18.6	0.31	(Arola & Sarubin, 2001)
Pulpa	0.002	0.45	(Beer & Johnston, 1981)

Sonlu elemanlar analizinde, analiz edilecek canlı ya da cansız yapıların gerçeğe en yakın şekilde modellenmesi yapılır.Tüm model, matematiksel olarak anlamlı parçalara(elemanlara) bölünür.Elemanlar birbirlerine 'düğümlemlerle' bağlı olup farklı geometrik şekillerde olabilir.Düğümlemler aracılığıyla bir elemandaki fiziksel değişiklik diğer elemanlara da yansır.Böylece boyutları belirlenmiş bir modelde, bilgisayar yardımı ile belirlenen şiddet, yön ve alandaki kuvvet uygulanmasına bağlı olarak ortaya çıkan gerilmeler(stres), zorlanmalar(strain) ve yer değiştirmeler(deplasman) ölçülendirilebilmektedir (Sonugelen & Artuç, 2002). Çalışmamızda nümerik analizler, ANSYS paket programı ile yürütülmüştür.

Gerilme değerleri ölçülürken Von-Mises gerilmesi dikkate alınmıştır.Von-Mises gerilmesi tüm yönlerde oluşan normal ve kayma gerilmelerinin bileşkesidir.Bu gerilme restoratif materyal ve diş dokusunda meydana gelebilecek hasarı incelemek açısından önemlidir.Bu şekilde malzemede kalıcı deformasyon meydana gelip gelmeyeceğini ya da kırılmanın oluşup oluşmayacağını saptamak mümkün olabilmektedir (Beer & Johnston, 1981).

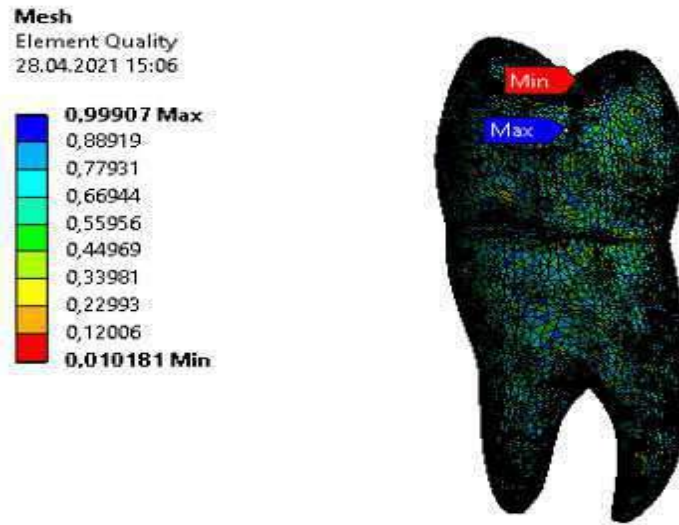
Sonlu elemanlar analizinde modeller üzerine uygulanan statik ve dinamik kuvvetler 100 N ile 2000 N arasında değişmektedir (Özdemir & Kahvecioğlu, 2020). Poiate ve ark yaptıkları bir çalışmada 100 N'luk kuvvet miktarını; çiğneme kuvveti olarak, 500 N'luk kuvvet miktarını; parafonksiyonel kuvvet miktarı olarak, 800 N'luk kuvvet miktarını ise travmatik kuvvet olarak nitelendirmişlerdir (Poiate, de Vasconcellos, de Santana, & Poiate, 2009).Çiğneme kuvveti diştten dişe farklılık göstermekle beraber ön dişlerden arka dişlere doğru artış göstermektedir.Çalışmamızda analizini yaptığımız dişin literatürdeki normal çiğneme kuvveti olarak 280 N olarak belirtilmiştir (Saraçoğlu & Kümbüloğlu).

Literatürdeki bu bilgiler göz önüne alınarak normal çiğneme kuvveti olarak Şekil 2(b)'de gösterilen 280 N ve parafonksiyonel kuvvet olarak 500 N'luk kuvvet uygulanmıştır. Travmayı simüle etmesi için uygulanan bu kuvvetler 90°lik açı ile lingual tüberküllere ve oklüzal yüzeye yayılı yük olarak uygulanmıştır. Dişin sonlu elemanlar modeli Şekil 2(a)'de gösterilen kök kısmından tüm yönlerdeki hareketini engelleyecek şekilde mesnetlenmiştir. Belirlenen bu kuvvetler çürük içermeyen sağlıklı diş ve sınıf II kavite açılan amalgam restorasyonlu diş modellerine uygulanmıştır. Uygulanan kuvvetler sonucunda amalgam restorasyonlu ve sağlıklı dişte oluşan toplam deformasyon ve eşdeğer stres (Von-Mises) değerleri incelenmiştir.



Şekil 2. Sonlu elemanlar modelinde (a) Mesnetin konumu (b) Uygulanan kuvvetlerin dağılımı

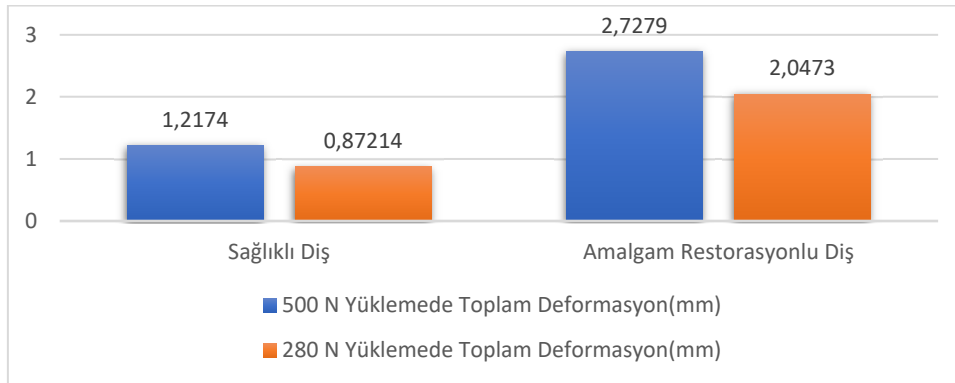
Ansys paket programında mesh oluşumu 257795 elemandan ve 439194 düğümden oluşmuştur. Oluşturulan mesh ideal kalitede olup Şekil 3'te element kalitesi gösterilmiştir.



Şekil 3. Mesh Element Quality Gösterimi

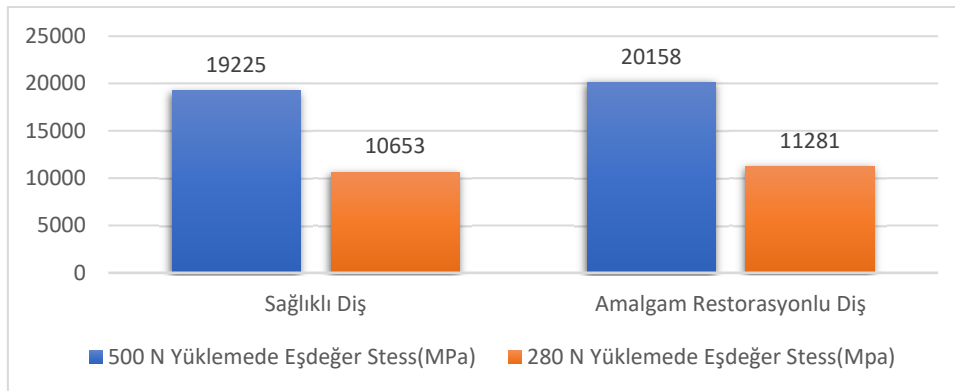
### 3. Bulgular

Uygulanan her iki kuvvet sonucunda oluşan toplam deformasyonlar değerlendirildiğinde, genel olarak maximum deformasyonların palatinal tüberkül tepelerinde olduğu gözlemlenmiştir. Minimum deformasyon miktarları ise dişin sabitlendiği kök uçlarında meydana gelmiştir. Aynı yükleme durumunda amalgam restorasyonlu dişte meydana gelen toplam deformasyon miktarının sağlıklı dişe göre daha fazla olduğu tespit edilmiştir. Her iki diş için çiğneme kuvveti artırıldığında toplam deformasyon miktarında da artma gözlemlenmiştir. Uygulanan 280 N ve 500 N yükleme durumunda maximum deformasyonun 500 N'luk yükte meydana geldiği tespit edilmiştir. Uygulanan yükleme durumlarında iki diş grubu için de oluşan deformasyon miktarları incelendiğinde dişte lüksasyon yaralanması oluşturabilecek düzeylerde olmadığı anlaşılmıştır.

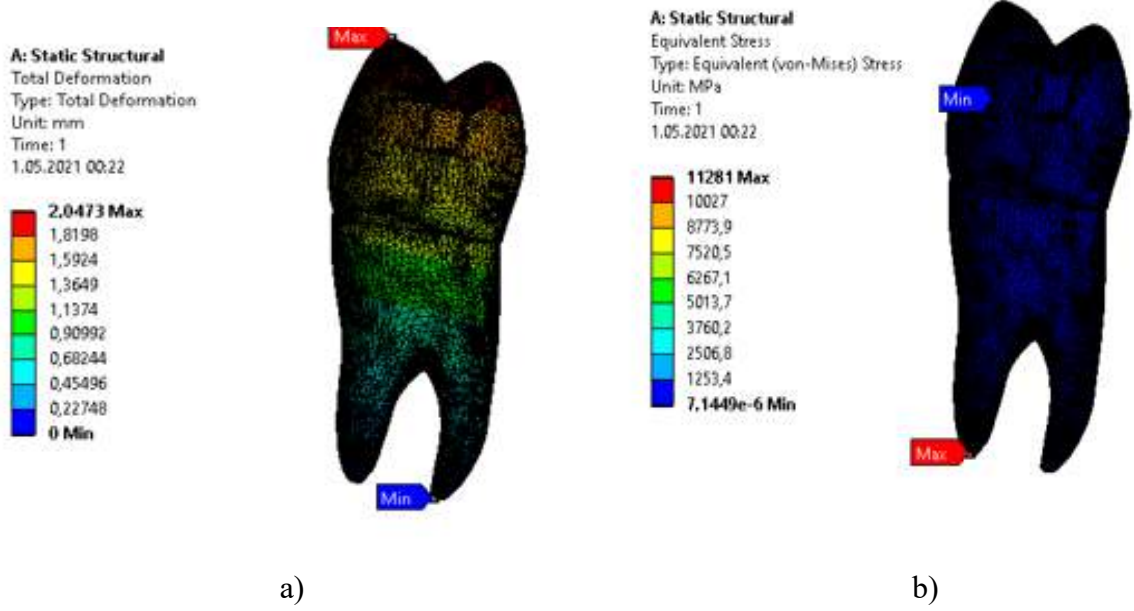


Şekil 4. İki farklı yükleme durumunda meydana gelen maximum toplam deformasyon

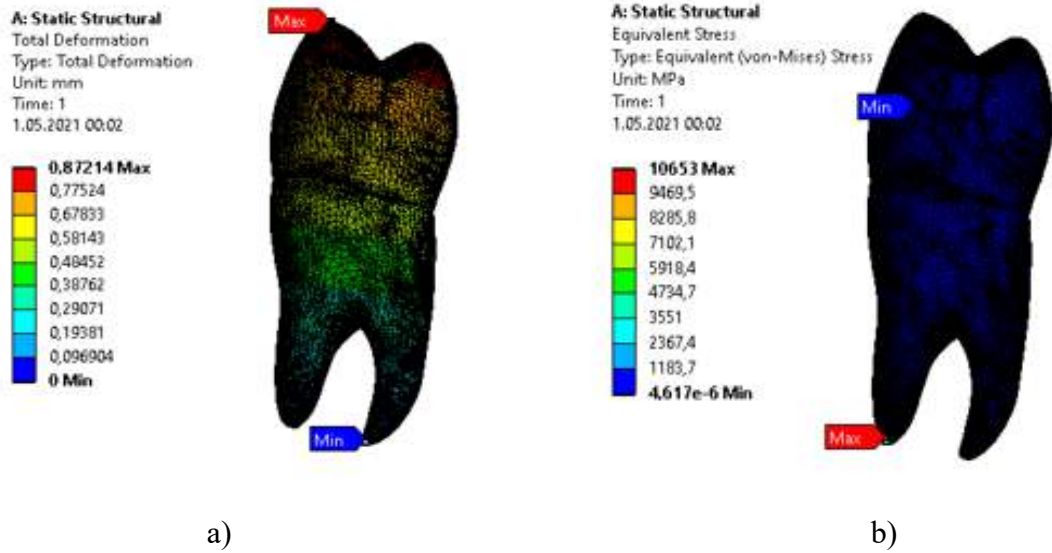
Uygulanan vertikal yüklemelerinde en yüksek Von-Misses eşdeğer stres değerlerinin dişlerin sabitlendiği kök uçlarında meydana geldiği gözlemlenmiştir. Amalgam restorasyonlu ve sağlıklı dişte oluşan stres miktarları yükleme durumuna göre farklılık gösterdiği tespit edilmiştir. Her iki diş için uygulanan çiğneme kuvveti artırıldığında eşdeğer stresin (Von-misses) arttığı gözlemlenmiştir. Uygulanan 280 N ve 500 N yükleme durumunda maximum eşdeğer stresin 500 N'luk yük altında amalgam restorasyonlu dişte meydana geldiği tespit edilmiştir.



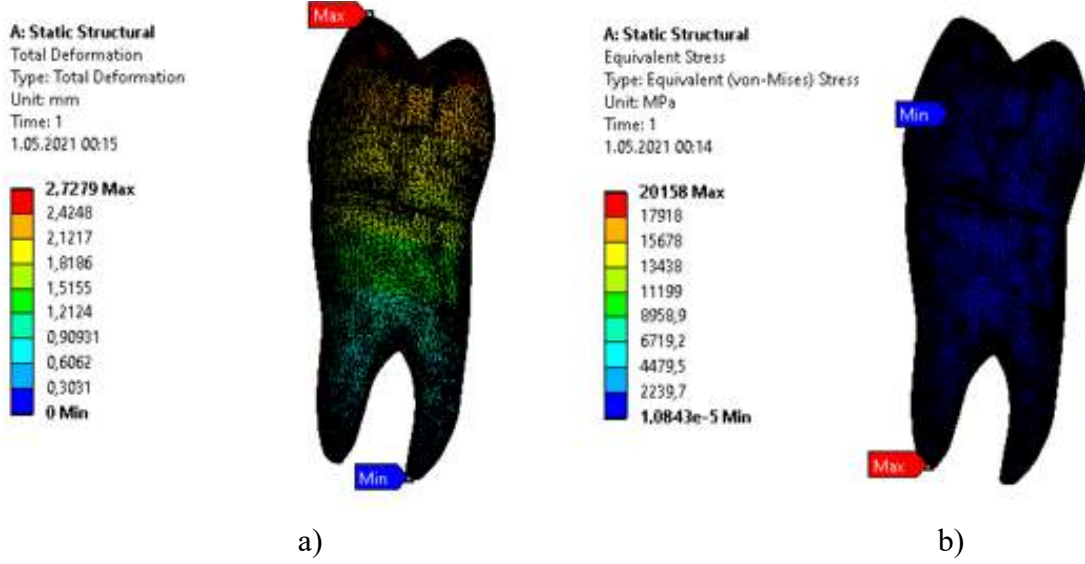
Şekil 5. İki farklı yükleme durumunda meydana gelen maximum eşdeğer stress



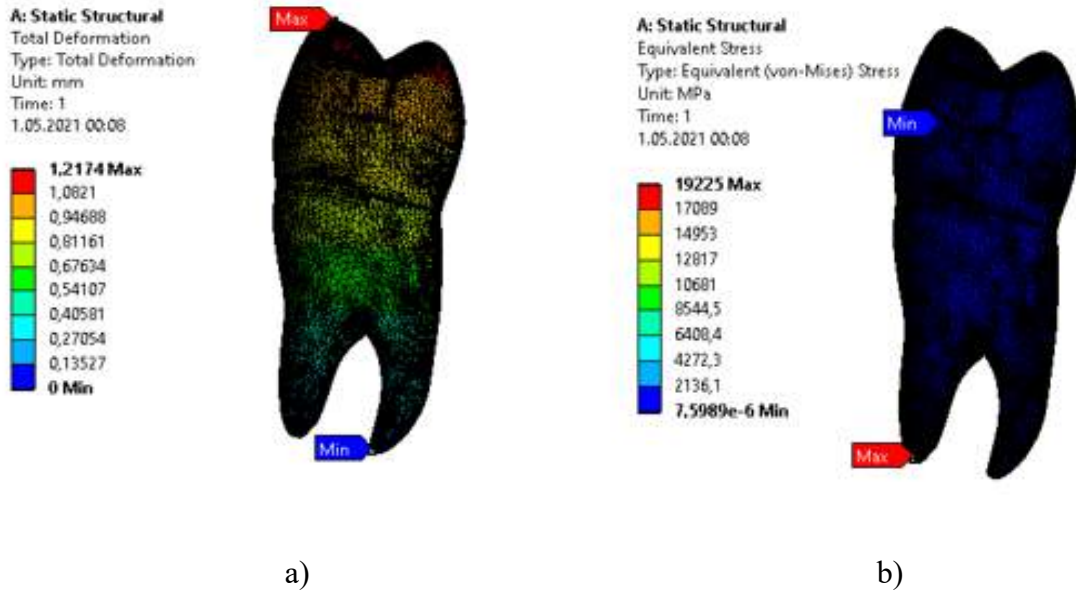
Şekil 6.280N Yükleme Durumunda Amalgam restorasyonlu Diş (a)Toplam Deformasyon (b)Eşdeğer Stress(Von-Misses)



Şekil 7.280N Yükleme Durumunda Sağlıklı Diş (a)Toplam Deformasyon (b)Eşdeğer Stress(Von-Misses)



Şekil 8.500N Yükleme Durumunda Amalgam restorasyonlu (a)Toplam Deformasyon (b)Eşdeğer Stress(Von-Misses)



Şekil 9.500N Yükleme Durumunda Sağlıklı Diş (a)Toplam Deformasyon (b)Eşdeğer Stress(Von-Misses)

#### 4.Tartışma

Bu çalışmada sağ üst premolar diş modeli modellenmiştir.Çalışmamızda amalgam restorasyonlu ve sağlıklı diş olmak üzere iki farklı diş modeli üzerinde çalışılmıştır.Bu modeller üzerine 280 N ve 500 N olmak üzere iki farklı yükleme durumu oluşturulmuştur.Oluşturulan yükleme durumlarında meydana gelen toplam deformasyon ve eşdeğer gerilme(Von-Misses) değerleri iki diş için de karşılaştırılarak sonuçlar analiz edilmiştir.



280 N ve 500 N yükleme durumlarında amalgam restorasyonlu ve sağlıklı diş üzerinde meydana gelen toplam deformasyon değerleri incelendiğinde sağlıklı dişte meydana gelen deformasyon miktarının amalgam dolgulu dişe göre daha düşük olduğu gözlemlenmiştir. (Şekil 6-7). Amalgam dolgulu diş için bu deformasyon değerinin sağlıklı dişe göre daha büyük değerde olmasının sebebi olarak, diş açılan kaviteden dolayı ve bu kavite alanına tanımlanan amalgam, siman gibi malzemelerin farklı mekanik özelliklere sahip olması ön görülmüştür. Bu iki dişte meydana gelen maximum toplam deformasyonun palatinal tüberkül tepelerde meydana geldiği gözlemlenmektedir. Toplam deformasyon değerlerinin ise kök uçlarına doğru gidildikçe azaldığı görülmektedir. Bu bölgelerde maximum ve minimum deforme değerlerinin oluşması uygulanan kuvvete yakınlık oranına göre değişkenlik gösterdiği yorumlanmıştır.

Amalgam restorasyonlu diş üzerine uygulanan 280 N'luk kuvvet sonucunda meydana gelen deformasyon değerinin (Şekil 6.a) aynı dişe uygulanan 500 N'luk kuvvet sonucunda oluşan deformasyon değerinden (Şekil 8.a) düşük olduğu gözlemlenmiştir. Yine aynı şekilde sağlıklı diş modeline uygulanan 280 N'luk kuvvet sonucunda meydana gelen deformasyon değerinin (Şekil 7.a) aynı dişe uygulanan 500 N'luk kuvvet sonucunda oluşan deformasyon değerinden (Şekil 9.a) düşük olduğu gözlemlenmiştir. Sağlıklı diş ve amalgam restorasyonlu dişe uygulanan kuvvet miktarı arttıkça dişte meydana gelen deformasyon miktarının arttığı tespit edilmiştir.

Önal ve arkadaşları (Önal, Eyüboğlu, Gören, Ergücü, & Erdilek, 2008) molar dişlere uyguladıkları farklı yükler ve yüklerin uygulama yüzeyi değişikliği sonucunda dişte meydana gelen maksimum yer değiştirme değerlerinin (mm) değişiklik gösterdiği sonucuna varmışlardır.

280 N ve 500 N yükleme durumlarında amalgam restorasyonlu ve sağlıklı diş üzerinde meydana gelen eşdeğer gerilmelerin (Von-Misses) değerleri incelendiğinde aynı yükleme durumunda her iki dişte meydana gelen gerilmelerin birbirine yakın değerler olduğu sonucu ortaya çıkmıştır. Bu iki farklı yükleme sonucunda her iki dişin tüm bölgelerinde gerilmelerin oluştuğu tespit edilmiştir. Bu gerilme değerleri incelendiğinde dişlerin kök uçlarında stres yoğunluğunun arttığı gözlemlenmiştir. Stres yoğunluğunun azaldığı bölgeler ise preentin tabası ve çevresinde meydana geldiği görülmüştür.

280 N'luk yükleme durumu incelendiğinde amalgam restorasyonlu dişin uygulanan kuvvet sonucunda meydana gelen maximum stres değerinin (Şekil 6.b) sağlıklı dişte oluşan maximum stres değerine (Şekil 7.b) göre daha büyük olduğu saptanmıştır. Yine aynı şekilde 500 N'luk yükleme durumunda amalgam restorasyonlu dişte meydana gelen maximum stres değerinin (Şekil 8.b) sağlıklı dişte meydana gelen maximum stres değerinden (Şekil 9.b) daha büyük olduğu tespit edilmiştir. 500 N ve 280 N'luk yükleme durumunda değer olarak daha büyük olan 500 N'luk kuvvet sonucunda maximum stressin oluştuğu tespit edilmiştir. Bu iki farklı yükleme sonucunda dişe uygulanan kuvvet miktarı arttıkça dişte oluşan stres miktarlarının da arttığını gözlemlemekteyiz. Eşit yükleme durumunda sağlıklı diş ve amalgam restorasyonlu dişte oluşan farklı stres değerlerinin oluşmasında, farklı mekaniksel özelliklere sahip malzemelerin restorasyon işlemi kullanılması sebep olduğu tespit edilmiştir. Amalgam restorasyonlu dişte dış etkilere karşı direnme özelliğinin zayıfladığı analizler sonucunda öne sürülmüştür.

Görgül ve arkadaşları (Görgül, Ömürlü, & Kınoglu, 1990) yapmış oldukları çalışmada MOD türü kavite açılmış dişlerde mekanik direncin azaldığı sonucuna varmışlardır. Görgül ve arkadaşlarının yapmış olduğu çalışma, yaptığımız çalışmayı destekler nitelikte olup benzer sonuçların çıktığını göstermektedir.

## 5.Sonuç

Bu çalışmanın bulgularından elde edilen sonuçlara göre;

- Dişler üzerine uygulanan kuvvet miktarı arttıkça dişlerde meydana gelen toplam deformasyon ve eşdeğer stres(Von-Mises) değerlerinin arttığı tespit edilmiştir.
- Amalgam restorasyonlu ve sağlıklı dişlerde meydana gelen maximum toplam deformasyonun palatinal tüberkül tepelerinde olduğu gözlemlenmiştir.
- Sağlıklı diş ve amalgam restorasyonlu dişlerde oluşan eşdeğer streslerin(Von-Misses) dişlerin tüm bölgelerinde meydana geldiği ve maximum stres yoğunluğun kök uçlarında olduğu saptanmıştır.
- Dişte meydana gelen çürük nedeniyle yapılan amalgam restorasyon işlemi sonrasında dişin dış etkilere karşı direnme özelliğinin zayıfladığı sonucuna varılmıştır.
- Amalgam restorasyonlu dişte gözlemlenen dış etkilere karşı direnme özelliğinin zayıflaması, restorasyon için oluşturulan kavite alanı ve bu alanını doldurmak için kullanılan amalgam dolgu, siman gibi malzemelerin mekanik özelliklerinden kaynaklandığı öne sürülmüştür.

### Kaynakça

- Altun, C. (2005). Kompozit Dolgu Materyallerinde Son Gelişmeler. *Gülhane Tıp Dergisi* , 77-82.
- Beer, F., & Johnston, E. (1981). *Mechanics of Materials*. içinde Japan.
- Beer, F., & Johnston, E. (1981). *Mechanics of Materials*. Japan.
- Cavel, W., Kelsey, W., & Blankenau, R. (1985). An invitro study of cuspal fracture. *J.ProsthetDent*, 17-20.
- Elderton, R. (1934). Cavo-surface angles, amalgam margin angles and occlusal cavity preparations. *Br.Dent J.*, 319-324.
- Fennis, W., Kuijs, R., Barink, M., Kreulen, C., Verdonschot, N., & Creugers, N. (2005). Can internal stresses explain fracture resistance of cusp-replacing composite restorations ? In *Adhesive Restorations Replacing Cusps*. 59-71.
- Görgül, G., Ömürlü, H., & Kınoglu, T. (1990). Posterior Kompozit ve Amalgam Restorasyonların Dişlerin Kırılma Dayanıklılığına Etkileri. *G.Ü.Dişhek. Fak. Der*, 207-217.
- Görgül, G., Ömürlü, H., & Kınoglu, T. (1990). Posterior Kompozit ve Amalgam Restorasyonların Dişlerin Kırılma Dayanıklılığına Etkileri. *G.Ü.Dişhek.Fak.Der*, 207-217.
- Kaman, W., & Gangler , P. (2000). Filling repair and repair fillings . *Schweiz Monatsschr Zahnmed*, 15054-71.
- Kara, R. (2014). Sınıf V Restorasyonlarda Beş Farklı Restoratif Materyalin Stres Dağılımının Sonlu Elemanlar Yöntemi İle Analizi.
- Önal, B., Eyüboğlu, T., Gören , B., Ergücü , Z., & Erdilek, N. (2008). Molar Dişlerde İnley Restorasyonların Mekanik Performansının İncelenmesi:3 Boyutlu Sonlu Elemanlar Analizi. *GÜ Diş Hek Fak Derg*, 27-33.
- Özdemir, S., & Kahvecioğlu, F. (2020). Kök ucu açık dişlerde sonlu elemanlar analizi kullanılarak farklı. *Selcuk Dent J*, 318-325.
- Poiate, I., de Vasconcellos, A., de Santana, R., & Poiate, E. (2009). Three-dimensional stress distribution in the human periodontal ligament in masticatory, parafunctional, and trauma loads: finite element analysis. *J Periodontol*, 80,11,1859-67.
- Saraçoğlu, A., & Kümbüloğlu, Ö. (tarih yok). Maddeler Bilgisi. İzmir.
- Secerli Dürer, T. (20017). Amalgam Dolgular. *Bilimsel Tamamlayıcı Tıp, Regülasyon ve Nöralterapi Dergisi*, 3.
- Sonugelen, M., & Artuç, C. (2002). Ağız Protezleri ve Biyomekanik. *Ege Üniversitesi Diş Hekimliği Fakültesi Yayınları*, 3-8.

# THE HYDRAULICAL COMPARISON AND ECONOMICAL EFFECTIVENESS OF PRACTICAL PROFILE SPILLWAY AND BROAD THRESHOLD STILL WAY BULDINGS

**Giorgi Noselidze**

*Georgian Technical University, Engineering, Department of hydro enginnering, , Tbilisi, 68 M. Kostava st, Georgia*

## Abstract

The spillway plays an important role in the successful operation of the reservoir. The spillway supports superfluous and floods water expense from reservoir emergency since up stream to down stream. There are different types of spillway in the world which operates on the different types of dams. There are two important types of spillway buildings: the practical profile spillway and broad-threshold spillway are different in structural and hydraulic forms from each other. It's important to compare these two types of spillway each other with hydraulic operation standpoint. There are discusses the maximum estimated emergency discharge in the down stream with a practical profile planned self on the dam. Spillway on the investigated, designed or operation construction. The analyses of the discussed examples show the replacement of the practical profile spillway with a broad-threshold spillway which will increase the reliability and economy of the building. It is for eased the hydraulic calculation of optional coupling of broad-threshold water intake with a chute.

**Key words:** emergency water, down stream, spillway, wide threshold, chute.

## INTRODUCTION

For the existence of civilizations intensive use of water facilities is essential, for which the forms and magnitude of anthropogenic influence on hydrological facilities is significantly increasing.

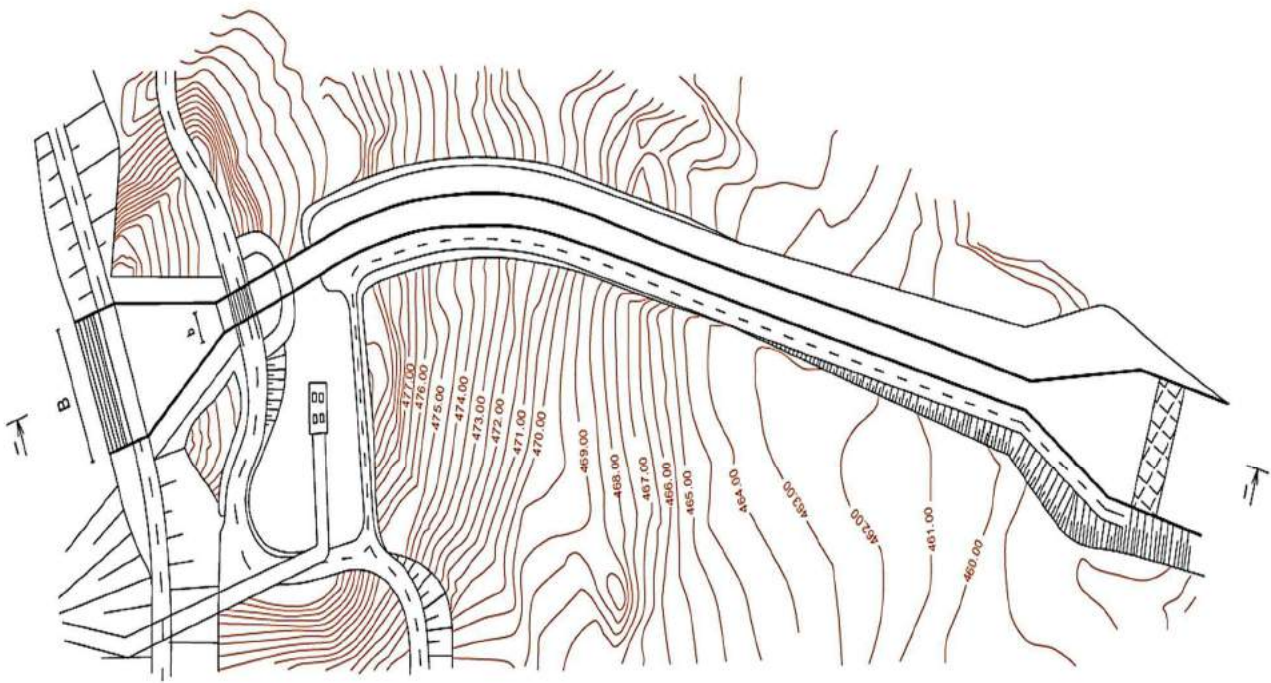
It is a common knowledge that the hydro technical construction requires to let the catastrophic water input flow freely from the headrace towards the tail-bay during the floods so that the water input does not create a problem to the normal exploitation of hydro technical construction. [2]

The work deal with the existing projected water drainage plant from the point of hydraulic and economic view. We also offer a broad threshold drainage plant project with its economic and hydraulic considerations, which implies the fundamental changes in the existing structures. The important factors for all construction is the physical and economic characteristic that has led to the necessity of replacement of the existing structures with alternative structures.

If the current projected practical profile water weir will be replaced with a broad threshold structure. The project will experience a signification change in economic terms that will be reflected in the reduction of expenditures, thus making it more attractive and profitable to investors. From the economic point of view, the inexpensiveness of the project is not enough, and the project needs to be physical consistent as well, for which the hydraulic calculation of the drainage plant is presented and it is based on the theories and formulas of the famous scientist. [3]

## METODOLOGY

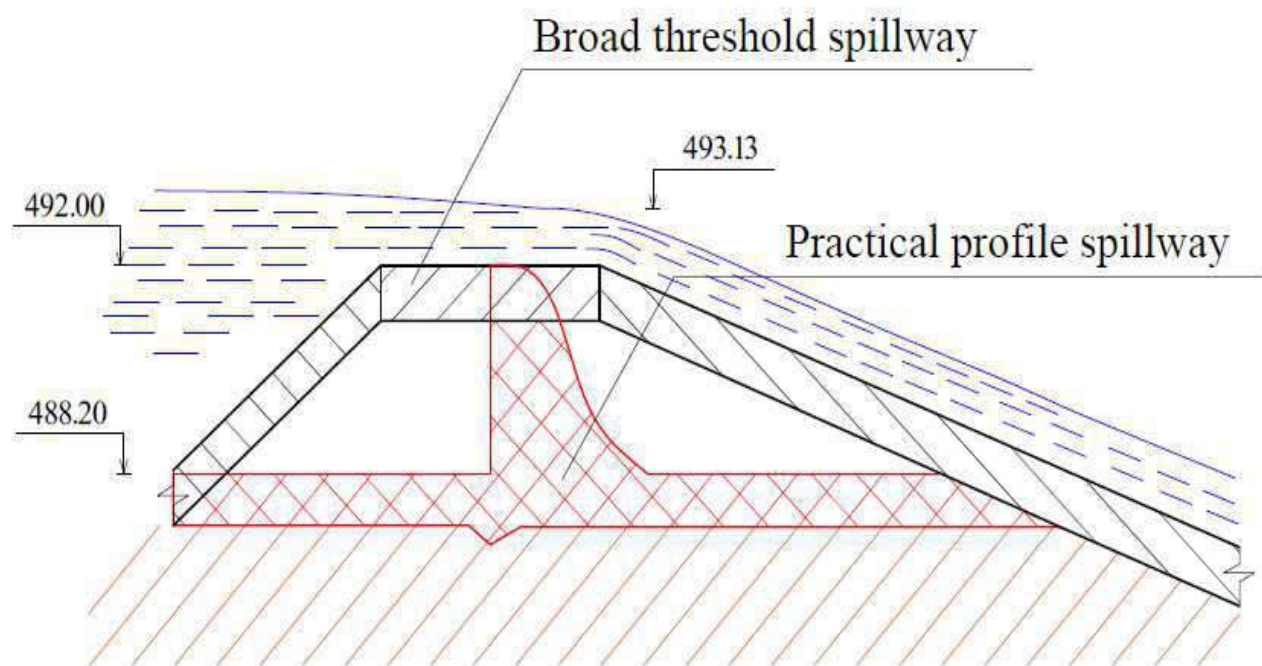
This questions will be more understandable, must consider a real project. For example, the Akhasheni-khevi is one of the rivers in Georgia. The project is designed to build a rubble dam on this river, which will dam up the water in the ravine of Akhasheni-khevi and form a water reservoir. On the earth dam will plans construction of spillway, which is practical profiles spillway. [1]



**Figure 1.** Spillway of earth dam

My purpose, review of practical profile spillway and broad threshold spillway. In order will be successful review of two type spillway, the hydraulic and economic aspects must be consider of two type spillway.

Practical profile spillway, which must spend from 135 m<sup>3</sup>/sec discharge water from up stream to down stream.



**Figure 2.** Practical profile Spillway and Broad threshold spillway

There is the diagram of spending water. Calculation of stream pass on is made with following formulas. The calculation formula of spillway.

$$Q = mb\sqrt{2g}H_0^{\frac{3}{2}} \quad (1)$$



$Q$  – Discharge water

$m$  – coeffcent of spillway profile

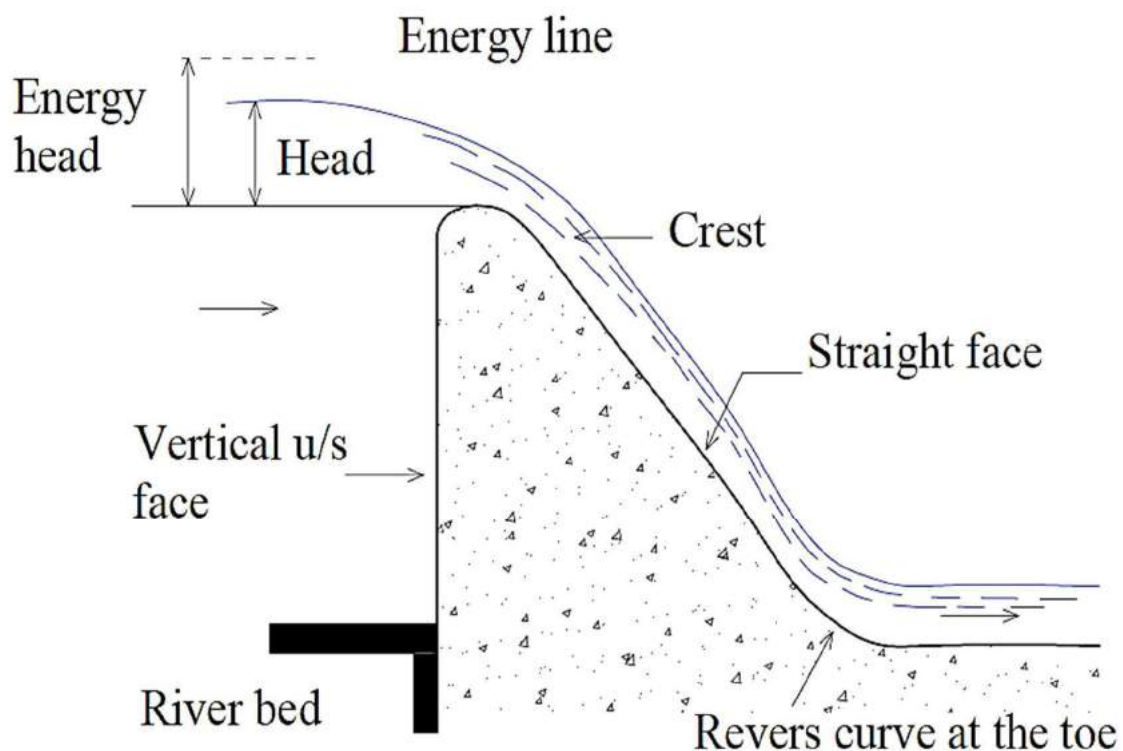
$b$  – Width of spillway

$H_0$  – Pressure

$g$  – Acceleration of free fall

## RESULTS AND DISCUSSION

Using these formulas, calculate the flood discharge water of Akhasheni-Khevi reservoir for practical profile spillway



**Figure 3.** Practical profile Spillway

$Q$  – Discharge water 135 m<sup>3</sup>/sec

$m$  – coeffcent of spillway profile 0.49

$b$  – Width of spillway 40 m.

$g$  – Acceleration of free fall 9.81 m/s<sup>2</sup>

$$135 = 0.49 \cdot 40 \cdot \sqrt{2 \cdot 9.81} H_0^{\frac{3}{2}}$$

From were pressure discharge water on the spillway is

$$H = H_0 - \frac{v^2}{2g} = 1.14 \text{ m}$$

Let us now consider broad threshold which must spend 135 m<sup>3</sup>/sec discharge water from up stream to down stream. [4]



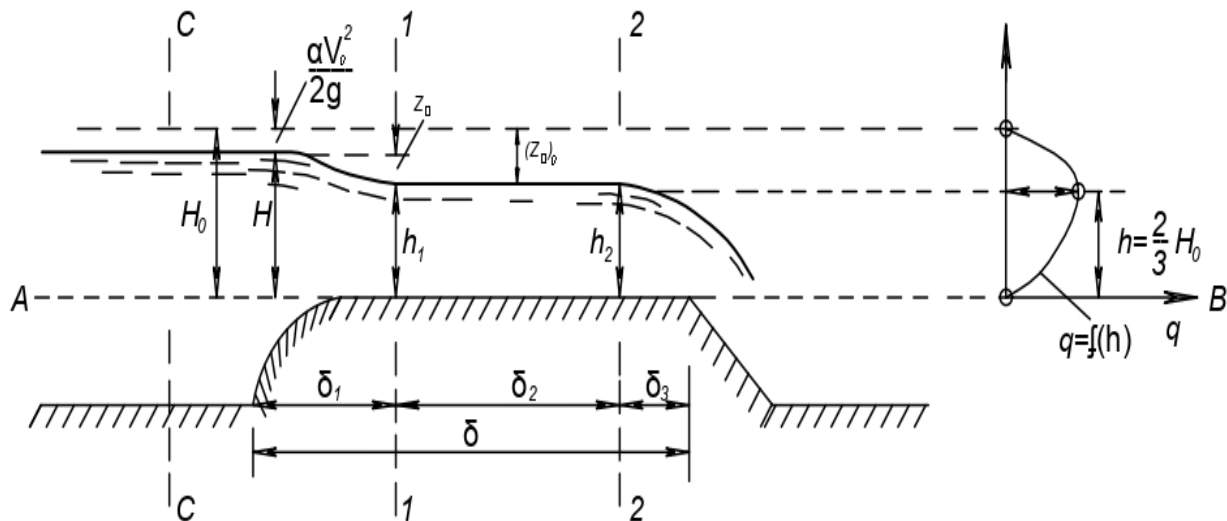


Figure 4. Broad threshold Spillway

$$Q = mb\sqrt{2g}H_0^{\frac{3}{2}}$$

$Q$  – Discharge water 135 m<sup>3</sup>/sec

$m$  – coefficient of spillway profile 0.38

$b$  – Width of spillway 40 m.

$g$  – Acceleration of free fall 9.81 m/s<sup>2</sup>

Using these formulas, calculate the flood discharge water of Akhasheni-Khevi reservoir for broad threshold spillway.

$$135 = 0.38 \cdot 40 \cdot \sqrt{2 \cdot 9.81} H_0^{\frac{3}{2}}$$

$$H_0 = 1.59$$

$$h = \frac{2}{3} \cdot 1.59$$

$$h = 1.06 \text{ m}$$

We determined the spillway profile pressure, now it's needful will determine height and of depth stream among 1-1 and 2-2 cuts.

My purpose was to determine discharge water height for practical profile spillway and it is 1.14 meters, also I calculated discharge water height for broad threshold and it is 1.05 meters.

## CONCLUSION

Both type of spillway are successful of hydraulically, but from economic point of view, it difficult to build a water profile of a partial profile due its shape and complex outline, than the broad threshold spillway.

The calculation carried out using the formulas obtained based on this theoretical survey-findings reveal that the new type of water drainage plant is fully functional from the point of hydraulic view and will work properly without any delay under normal exploitation conditions.

In terms of hydraulic component, the water height at the broad threshold spillway is less than the height of the runoff water at the practical profile.

**REFERENCE**

P Novak, A.I.B. Maffat and C. Nalluri, R. Narayanan (2007) “Hydraulic Structures” ISBN 0-203-96463-2 page 700

R. M. Khatsuria (2004) “Hydraulics of Spillway and Energy Dissipators” ISBN 9780824757892 page 672

Gerardo Magela Pereira (2020) “spillway Design – step by step” ISBN 9780367419363 page 418

“Belgidrovotxoz” (2014) Construction project of Akhasheni-Khevi dam.

## LPG TÜP VALFİ EMNİYET PİMİ OPTİMİZASYONU OPTIMIZATION OF LPG CYLINDER VALVE SAFETY PIN

**Berkay SAYILGAN<sup>1\*</sup>, Engin ŞAŞMAZ<sup>2\*\*</sup>, Aydoğan ÖZDAMAR<sup>3\*\*\*</sup>**

<sup>1</sup>Ege University, Faculty of Engineering, Department of Mechanical Engineering, İzmir, Turkey.

ORCID 0000-0002-5668-9172

<sup>2</sup>ECA Valf Sanayii A.Ş., Organize Sanayi Bölgesi, Kurtuluş Cad. No: 1, Manisa, Turkey.

ORCID 0000-0002-6751-6373

<sup>3</sup>Ege University, Faculty of Engineering, Department of Mechanical Engineering, İzmir, Turkey.

ORCID 0000-0002-6580-4101

### Özet

Bu çalışmada, elle çalıştırılan tip LPG tüp valflerinin, demonte edilmesini engelleyen emniyet mekanizmalarında, sonlu elemanlar nümerik yöntemi kullanılarak, optimum tasarım elde edilmiştir. Optimum tasarımın, üretim hızını düşürmemesi, kullanılan malzeme miktarının azaltılması ve 22 Nm torka dayanması istenmektedir. Elle çalıştırılan tip LPG tüp valfleri; volan, mil ve gaz akışının sağlandığı kanalları da üzerinde bulunduran bir kafes olmak üzere, üç ana bölümden meydana gelmektedir. Volan-Mil bağlantısını destek parçasına dayanarak, sistem içerisinde tutan pimlerden oluşan emniyet mekanizmaları bulunur. Çalışmada, çift pimli ve orbital pimli olmak üzere iki farklı emniyet mekanizması tasarımı üzerinde durulmuştur. Sonlu elemanlar nümerik yöntemini kullanan ANSYS programı yardımıyla gerçekleştirilen analizler sonucunda, çift pim tasarımında pim çapının 3 mm'den 2.9 mm'ye ve destek yüksekliğinin 5.4 mm'den 5.3 mm'ye düşürülmesinin uygun olduğu görülmüştür. Orbital pim tasarımında ise, pim çapının 2.5 mm'den 2.4 mm'ye ve destek yüksekliğinin 1.9 mm'den 1.8 mm'ye düşürülmesi uygun bulunmuştur. Ayrıca, analizlerde görülen deformasyon değerlerine göre orbital pim ve çift pim mekanizmaları karşılaştırılmış ve maliyet açısından orbital pim tercih edilirken, uzun ömür açısından çift pim mekanizmasının kullanılması gerektiği anlaşılmıştır.

**Anahtar Kelimeler:** Çift pim mekanizması, Orbital pim mekanizması, LPG, CuZn<sub>30</sub>, CuZn<sub>39</sub>Pb<sub>3</sub>.

### Abstract

In this study, an optimum design was obtained by using the finite element method (FEM) for safety mechanisms that prevent the disassembling of the handwheel type LPG cylinder valves. The optimum design is requested to reduce amount of raw material used, to withstand to 22 Nm torque and not to reduce production speed. LPG Cylinder valves with handwheel consist of three main parts; these are body, handwheel and spindle. A safety mechanism consisting of pin or pins hold the handwheel - spindle connection inside of the valve body by leaning them on the pin parts. In this study, two different safety mechanism designs; the double pin and the radial pin are emphasized. As a result of the ANSYS analysis using FEM, the pin diameter in the double pin design has been reduced from 3 mm to 2.9 mm and height of the support has reduced from 5.4 mm to 5.3 mm. In the radial pin design, the pin diameter has reduced from 2.5 mm to 2.4 mm and the support height has reduced from 1.9 mm to 1.8 mm. In addition, according to the deformation values obtained by the analysis, these two safety pin designs are compared and consequently the double pin type is preferred in terms of the long-life usage while the radial pin type is preferred in terms of cost.

**Keywords:** Double pin mechanism, Radial pin mechanism, LPG, CuZn<sub>30</sub>, CuZn<sub>39</sub>Pb<sub>3</sub>.

## GİRİŞ (INTRODUCTION)

LPG (Sıvılaştırılmış Petrol Gazı), propan ve bütan gazlarından oluşan (%30 propan ve %70 bütan), kolayca gaz fazına geçebilen, renksiz bir sıvıdır. LPG, tüplerde depolanan, ısıtmada veya araçlarda kullanılan bir yakıttır. Son yıllarda, doğalgaz hatlarının yayılması ve halkın tüm kesimlerinin kullanabileceği bir hale gelmesine rağmen LPG, sektördeki yerinden kopmamış ve önemli bir enerji alanı olarak kullanılmaya devam etmektedir. 2019 yılı verilerine göre Türkiye dünyanın en büyük 16. LPG pazarı olarak karşımıza çıkmaktadır (T.C. Enerji Piyasası Düzenleme Kurumu, 2019). Ayrıca otogaz kullanımı açısından dünyada, Güney Kore'den sonra ikinci sıradadır. Türkiye'de LPG pazarının en büyük payı, %79.18 ile otogaza aittir. İkinci sırayı ise %18.09'luk pay ile tüp segmenti almıştır (T.C. Enerji Piyasası Düzenleme Kurumu, 2019). Aynı zamanda dünyada LPG, yenilenebilir enerjiden sonra en hızlı büyüyen enerji kaynağıdır. Gerek Türkiye'nin pazardaki konumu gerek dünyadaki pazarın gelişime açık olması, bu alandaki çalışmaları daha önemli kılmaktadır. Tüp dolum aşamasındaki maliyetlerin azaltılması da bu sebepten dolayı büyük önem arz etmektedir.

LPG tüplerinin dolumu ve boşaltımı, elle kontrol edilen bir valf aracılığıyla sağlanmaktadır. Valf; kalıp, volan, mil ve volan-mil mekanizmasını kalıp içerisinde tutmaya yarayan, pimlerden meydana gelmektedir. Tüm bu parçalar arasında pimler, çok küçük boyutlarda olmasına rağmen yüksek üretim miktarlarından dolayı, büyük maliyetlere sebep olmaktadır. Kullanılan malzeme miktarını azaltmak, tek başına ekonomik açıdan olumlu bir düşünce olsa da ergonomi açısından olumsuz etkiler ortaya çıkarabilir. Bu nedenle, optimum tasarıma ulaşmak hem maliyet hem de işlevsellik olarak önemlidir. Bahsedilen bu tasarıma ulaşabilmek için, pim çapları küçültülebilir veya volanın alt bölümünde pime dayanacağı parçanın yüksekliği değiştirilebilir. Pimlerin ve volanın üretim malzemesi de deformasyonu etkileyen faktörlerden biridir. Kalıp  $CuZn_{40}Pb_2$ , volan ve mil gibi iç parçalar  $CuZn_{39}Pb_3$ , pimler ise  $CuZn_{30}$  pirincinden üretilir.

LPG tüp valflerinde pimler, emniyet mekanizmaları olarak kullanılır. Çift pimli, orbital pimli ve vidalı olmak üzere 3 farklı emniyet mekanizması bulunmaktadır. Bu çalışmada, çift pimli ve orbital pimli emniyet mekanizmaları için optimum tasarım yapılacaktır.

Orbital pim mekanizmasında, kafes üzerinde bulunan bir yuvadan çıkılan pim, kafes içerisinde ve mil çevresinde dolanır. Bu sayede milin, sistemden çıkması tek pim ile durdurulmuş olur. Çift pim mekanizmasında ise, kafes üzerine açılan, yatayda paralel iki yuvadan, birer pim çıkarılır. Mil yukarı çekilirken, bu pimlere dayanarak bir emniyet mekanizması oluşturulmuş olur.

Elle çalıştırılan LPG tüp valflerinde optimum tasarıma ulaşmak için, pim çapı ve volanın alt bölümünde, pime dayanacağı parçanın yüksekliğinin azaltılması, bu çalışmanın ana hedefini oluşturmaktadır.

## KAYNAK ARAŞTIRMASI (LITERATURE SURVEY)

Bakıra çinko katılması sonucu oluşan sarı renkteki alaşımlara, pirinç adı verilir. Kolay şekil alması, mekanik direncinin yüksek olması, korozyona karşı dayanıklı olması ve ergime-döküm kolaylığı nedeniyle, LPG tüp valflerinde pirinç malzemesi kullanılmaktadır. Bu çalışmada, iki ayrı pirinç malzeme üzerinde durulmuştur. Bunlardan ilki, ekstrüzyon yöntemiyle küçük pimler haline getirilerek emniyet pimi olarak kullanılan  $CuZn_{30}$ 'dur. Bir diğer pirinç ise, kurşun katılmış  $CuZn_{39}Pb_3$  pirincidir. Kurşun, pirincin sünekliğini azaltır ve işlenebilmesini kolaylaştırır. Bu nedenle volan ve mil gibi işlenmesi gereken parçalarda malzeme olarak  $CuZn_{39}Pb_3$  kullanılır.

Rhim (2006), LPG tüp valflerinde emniyet mekanizması olarak kullanılan pimlerin uzunlukların değiştirmiş ve geçen toz miktarını ölçerek optimum tasarıma ulaşmayı hedeflemiştir. Optimum tasarım olarak 39 mm uzunluk ve 0.25 gram toz geçişine izin veren optimum tasarıma ulaşmıştır.

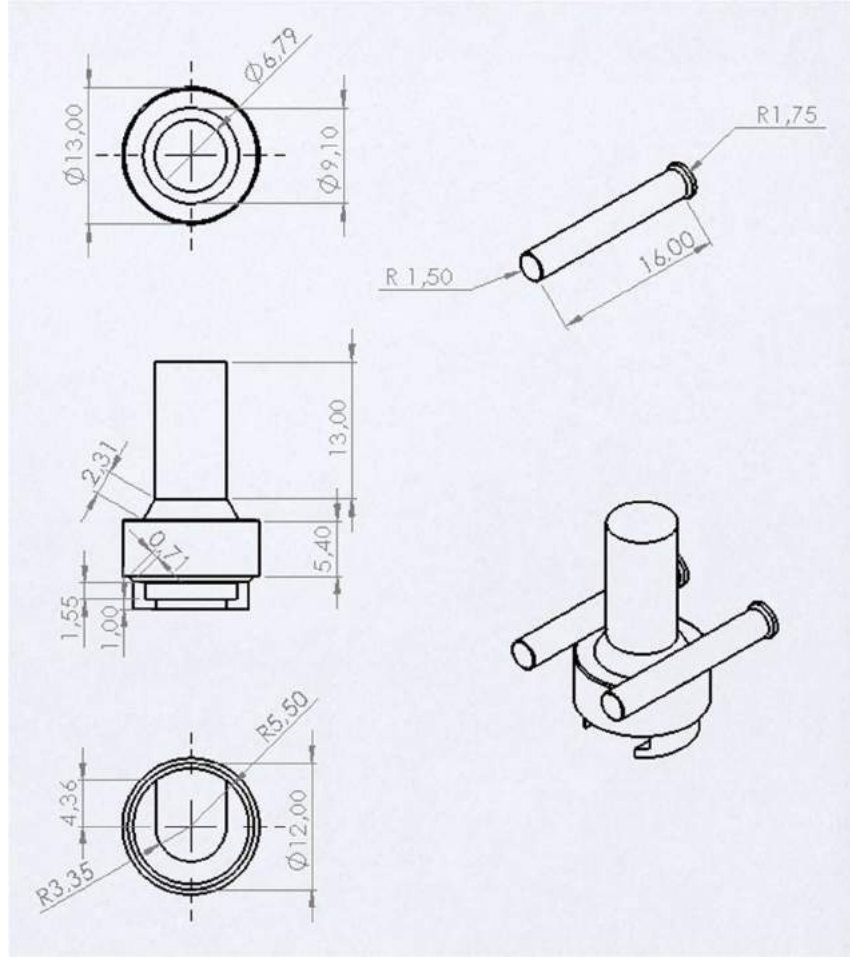
Sonlu elemanlar yöntemi ile analiz yapılan bu çalışma için her iki pirincin özelliklerinin bilinmesi gerekir ve bu özelliklerin belirlenebilmesi için birtakım testler malzemelere uygulanır. Literatür araştırmalarında, çekme testleri sonucunda mekanik özelliklerin ASTM standartlarına göre farklılık gösterdiği görülmüştür. Sergueeva vd. (2009) bu farklılık üzerinde durmuşlar ve malzeme özelliğinin çekme özelliklerine etkisini araştırmışlardır. Jha vd. (2015), bakır ve pirinç malzemeler içindeki alaşımların, çekme özellikleri ve sertlik değerleri üzerine çalışmışlardır. Bu çalışmada pirinç malzeme olarak vanaların volanlarında da kullanılan  $\text{CuZn}_{39}\text{Pb}_3$  kullanılmıştır. Çekme testi sonucunda maksimum gerilme 475 MPa olarak ölçülmüştür.

### **PROBLEMİN TANIMI (DEFINITION OF THE PROBLEM)**

Türkiye ve Dünya’da LPG kullanımı göze alındığında, bu alanda yapılacak çalışmalar önem kazanmaktadır. Gelişen teknolojiyle birlikte, tüp dolum aşamasının önemli parçalarından biri olan tüp valflerinde, yapılacak geliştirme çabalarının geleceğe yönelik atılan büyük adımlar olacağı göz ardı edilmemelidir. Tüp valflerinde, sistemi bir arada tutmak için pimler kullanılır. Çok küçük ölçülerde olan bu pimler, üretilen her valfte kullanıldığından genel maliyeti artırmaktadır. Bu çalışma, hali hazırda üretimde olan emniyet mekanizmalarının, ölçülerini değiştirerek, kullanılan malzeme miktarını azaltmak ve dayanımı, kullanılan tasarıma eşdeğer yeni bir tasarım elde etmek için yapılmıştır.

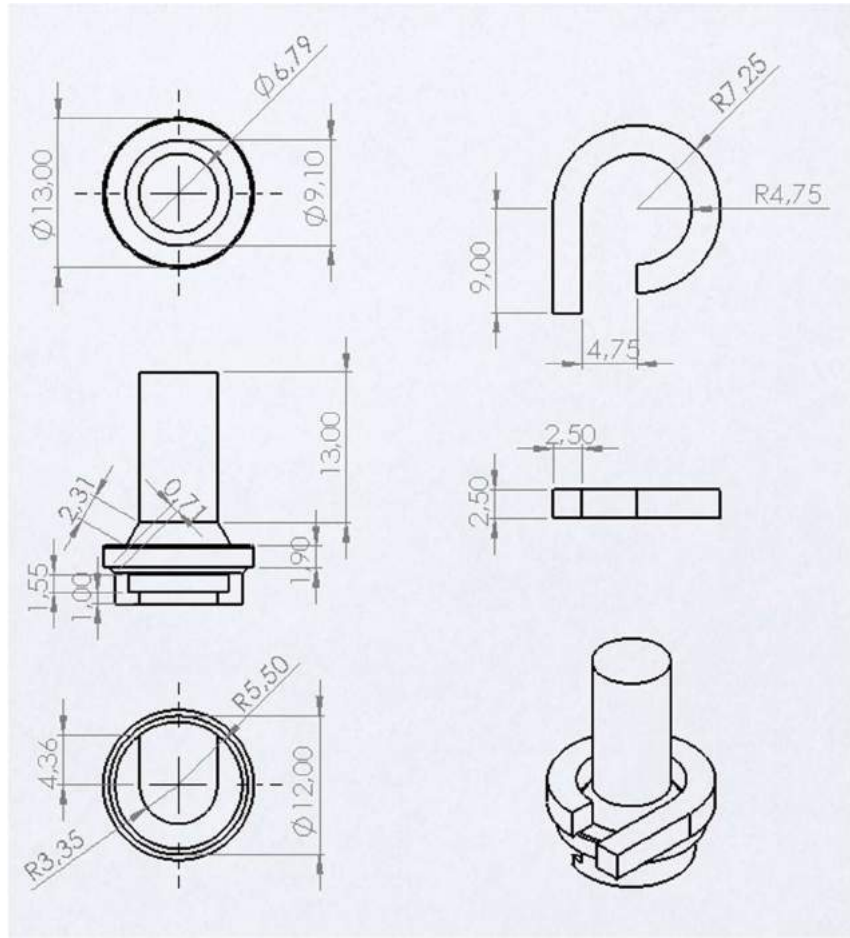
Çift pimli emniyet mekanizması, kalıp üzerinde açılan, yatayda paralel iki delikten, pimlerin çakılması sonucu oluşmuştur. Volanın sistemden çıkmasını engellemek için bulunan bu pimler, kurşunsuz pirinçten ( $\text{CuZn}_{30}$ ), ekstrüzyon ile üretilmektedir. Silindirik yapıdaki bu pimlerin çapı 3 mm’dir. Ayrıca, volana bağlı milin en altında bulunan, tork uygulandığı zaman pimlere dayanarak emniyet mekanizmasının diğer bölümünü oluşturan bir destek parçası bulunur. Bu destek parçasının özellikleri de pimin dayanımını etkileyen faktörlerdendir. Valfin iç bölümünde bulunan ve volanın bir parçası olan bu destekte, otomat pirinci olarak bilinen  $\text{CuZn}_{39}\text{Pb}_3$  kullanılır. Çapı kalıbın iç duvarlarına sürtmeyecek, aynı zamanda pimlere tam anlamıyla dayanabilecek ölçüde olmalıdır. Analizlere konu olacak temel özelliği yüksekliktir. Çift pimli emniyet mekanizmalarında destek parçasının yüksekliği 5.4 mm olarak üretilmektedir. Çift pimli emniyet mekanizmasının, üzerinde analiz yapılacak referans bölümün teknik resmi, Şekil 1’de verilmiştir.





**Şekil 1.** Çift pimli emniyet mekanizması teknik resmi (Technical drawing of the double pin safety mechanism)

Orbital pimli emniyet mekanizmasında, pim ve volan için kullanılan malzeme özellikleri, çift pimli emniyet mekanizmaları için belirtildiği üzere sırasıyla kurşunsuz ve otomat pirincidir. İki emniyet mekanizması arasında en temel fark pimin yapısıdır. Orbital pimli emniyet mekanizmalarında kare kesitli, tek pim kullanılır. Kalıp üzerinde açılan bir delikten çakılan pim, kalıp iç yüzeyini takip eder ve dairesel bir yapı alır. Bu nedenle volan desteği ile tüm yüzeyi temas halinde bulunur ve emniyet bir pim ile sağlanmış olur. Pim kesitindeki karenin bir kenar uzunluğu 2.5 mm'dir. Orbital pimli emniyet mekanizmasında volanın destek parçasının yüksekliği ise 1.9 mm'dir. Orbital pimli emniyet mekanizmasının, üzerinde analiz yapılacak referans bölümün teknik resmi Şekil 2'de verilmiştir.



**Şekil 2.** Orbital pimli emniyet mekanizması teknik resmi (Technical drawing of the radial pin safety mechanism)

Her iki sistem arasında özellikle volan-mil mekanizmalarının, destek yükseklikleri arasında ciddi bir fark vardır (1.9 mm – 5.4 mm). Ancak, bu fark, deformasyon açısından negatif bir etki yaratır. Bu sebeple, maliyet açısından orbital pim tercih edilirken, uzun ömür açısından çift pimli emniyet mekanizmaları tercih edilir.

Çalışmadaki amaç, maliyeti düşürecek, ancak dayanımdan ödün vermeyen bir tasarıma ulaşmaktır. Bu amaç doğrultusunda emniyet mekanizmalarında incelenecek bölümlerin bir kesiti SolidWorks kullanılarak çizilmiştir. Önce destek yüksekliği sabit tutulup pim çapları, 0.1 mm düşürülmüş ve analiz sonuçları kaydedilmiştir. Daha sonra ise, pim çapları sabit tutulup, destek parçasının yüksekliği her iki emniyet mekanizması için 0.1 mm düşürülerek analizler yapılmış ve sonuçlar elde edilmiştir. En son adımda ise, her iki emniyet mekanizması için önceki analizler sonucunda elde edilen pim çapı ve destek yüksekliği, birleştirilmiş bir tasarım ortaya çıkmıştır. Çizilen tasarımın analiz sonuçları, referans olarak ele alınan tasarımın analiz sonuçları ile karşılaştırılmış ve optimum tasarım elde edilmiştir. Analiz sonuçlarının karşılaştırılmasında, toplam deformasyon ve Von-Misses değerlerine bakılır.

## MATERYAL VE YÖNTEM (MATERIAL AND METHOD)

Bu çalışmada farklı özelliklerdeki pirinç malzemeler, moment kuvveti ile sıkıştırmaya tabi tutulmuştur. Pimler, kurşunsuz pirinç ve destek parçası, otomat pirincidir. Pimler valf üretim standardı olarak 22 Nm torka dayanabilmektedir. Bu tork değeri, aşırı kullanımlar (anormal) durumlar için dayanması gereken değerdir. Normal çalışma şartlarında görülen maksimum tork değeri, 3 Nm'dir. Analizler 22 Nm tork altında gerçekleştirilmiştir.

ANSYS® programı ile sonlu elemanlar metodu kullanılarak yapılan statik analizlerde, volan-mil mekanizmasına 22 Nm'lik +y yönünde bir moment uygulanmıştır. Pimlerin baş kısımları sabit mesnet seçilmiş ve pim yüzeyinde deformasyon sadece y yönünde serbest bırakılmıştır. 10 saniye zorlanma uygulanacak şekilde analiz çözümü yapılmıştır. İlk olarak referans ölçülerindeki çizim analizi yapılmış, ardından sırasıyla pim çapı ölçüleri 0.1 mm azaltılarak ve volan destek parçasının yüksekliği 0.1 mm azaltılarak analizler gerçekleştirilmiştir. Analiz sonuçlarında, toplam deformasyon değerleri ve Von-Misses değerleri karşılaştırılmıştır. Pim malzemesi olan  $\text{CuZn}_{30}$  için elastisite modülü  $E=110$  GPa, volan-mil mekanizmasında kullanılan  $\text{CuZn}_{39}\text{Pb}_3$ 'ün elastisite modülü  $E=97$  GPa'dır.

## SONLU ELEMENLAR YÖNTEMİ (FINITE ELEMENT METHOD)

### Materyal Özellikleri (Material Properties)

LPG tüp valfi emniyet mekanizmalarında yapılan analiz çalışmalarında, kullanılan materyalin özellikleri analize dahil edilmiştir. Her iki tasarım çeşidinde de volan-mil  $\text{CuZn}_{39}\text{Pb}_3$ , pimler ise  $\text{CuZn}_{30}$  olarak tanımlanmıştır. Tablo 1 ve Tablo 2' de verilen malzeme özellikleri ANSYS kütüphanesine tanımlanmıştır.

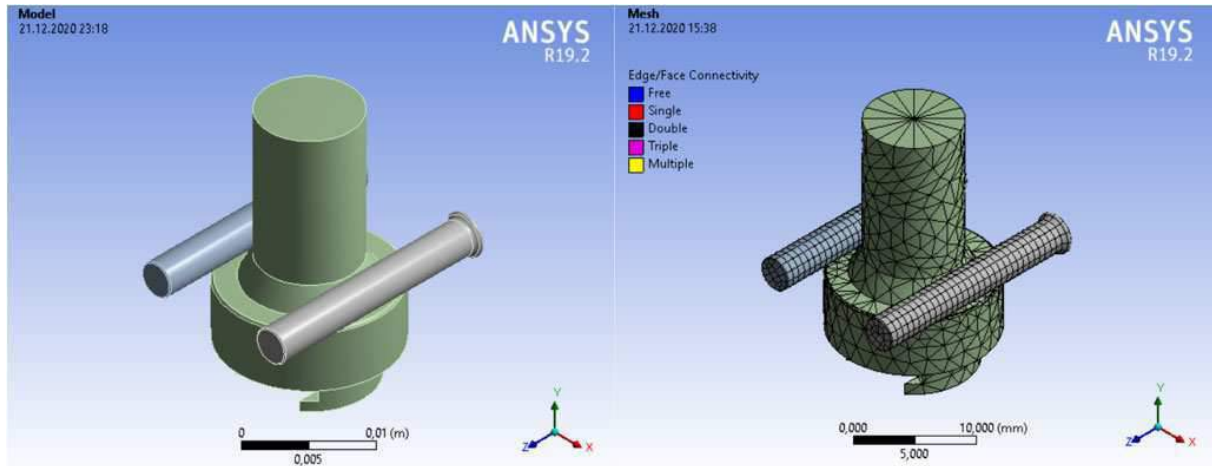
**Tablo 1.**  $\text{CuZn}_{30}$  malzeme özellikleri ( $\text{CuZn}_{30}$  material properties)

Yoğunluk	Young Modülü	Akma Dayanımı	Çekme Dayanımı
$8.53\text{e-}06 \text{ kg/mm}^3$	$1.1\text{e+}05 \text{ MPa}$	160 MPa	300 MPa

**Tablo 2.**  $\text{CuZn}_{39}\text{Pb}_3$  malzeme özellikleri

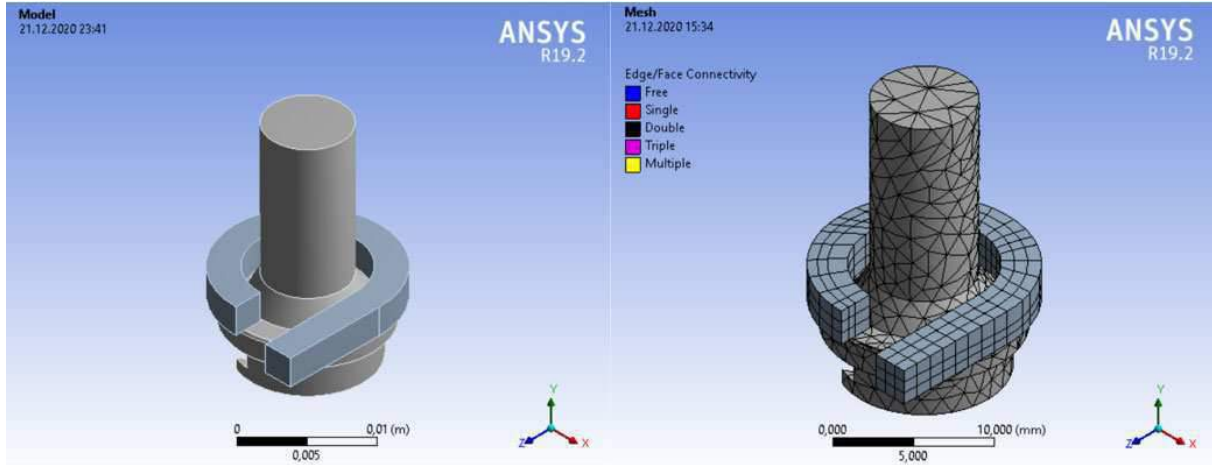
Yoğunluk	Young Modülü	Akma Dayanımı	Çekme Dayanımı
$8.47\text{e-}06 \text{ kg/mm}^3$	97000 MPa	390 MPa	500 MPa

### Katı Modelleme ve Mesh Görünümü (Solid Modelling and Mesh view)



**Şekil 3.** Çift pim mekanizması katı modellemesi ve mesh görünümü (Solid modelling and mesh view of double pin mechanism)

Şekil 3'te görüldüğü üzere, katı modelleme ANSYS programına aktarılmış ve kurulan modele üç boyutlu olarak mesh atılmıştır. Pimlerin mil ile temas ettiği bölgeler gerilimin yüksek olacağı bölgelerde ağların yoğun, diğer bölümlerde ise daha seyrek olduğu görülmektedir. Çift pim mekanizması için 11716 adet düğüm ile 4137 adet ağ elemanı atılmıştır.

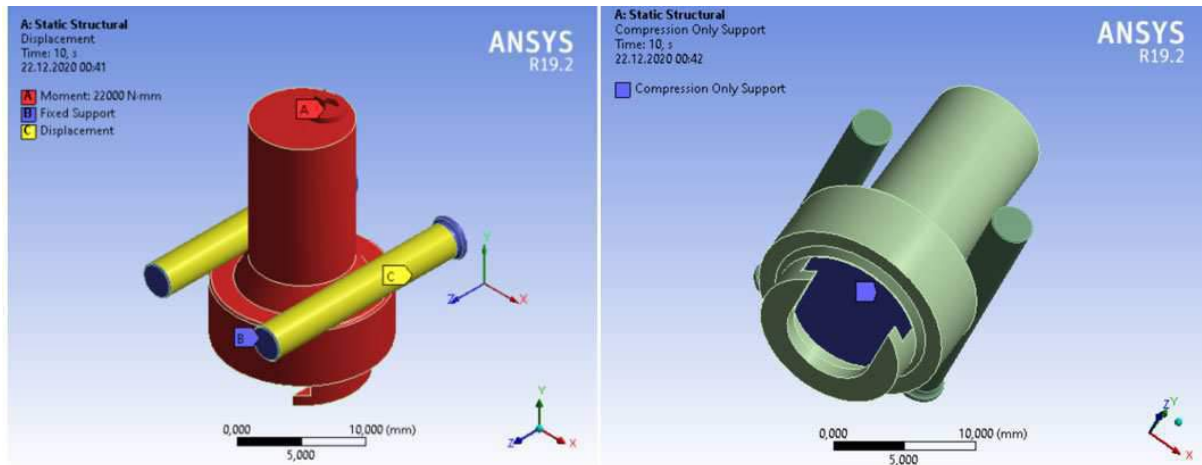


**Şekil 4.** Orbital pim mekanizması katı modellemesi ve mesh görünümü (Solid modelling and mesh view of radial pin mechanism)

Aynı şekilde orbital pim mekanizması da çift pim mekanizması gibi ANSYS'te benzer adımlardan geçmiştir. Bu işlem sonucunda, 7221 adet düğüm ile 3183 adet ağ elemanı atılmıştır (Şekil 4). Her iki sistem için de otomatik mesh modülü kullanılmıştır. Elde edilen sonuçlar, eleman sayısından bağımsız sonuçlardır.

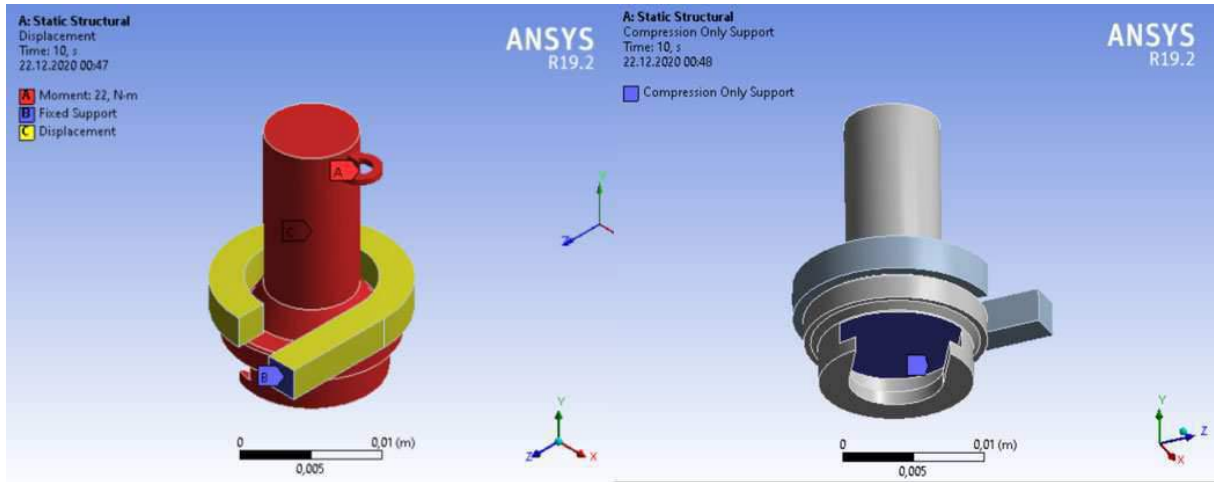
### Sınır Şartları (Boundry Conditions)

Çift pim mekanizmasında yapılacak olan analizler için, volan-mil mekanizmasına +y yönünde 22 Nm'lik bir tork değeri girilmiştir. Pimlerin her iki baş kısmı da sabit kabul edilmiş ve bu baş kısımlar arasında kalan bölgenin hareketi z yönüyle sınırlandırılmıştır. Bu sınırlar, dış kabın çeperleridir. Analize dış kap-pim arasında oluşacak gerilmeler hesaba katılmamıştır. Aynı zamanda volan-mil mekanizması alt bölümüne, yalnızca sıkıştırma desteği tanımlanmıştır. Böylece, destek parçasının pimlere temasından sonra -y yönünde bir hareket yapması engellenmiştir (Şekil 5).



**Şekil 5.** Çift pim mekanizması sınır şartları (Boundary conditions of double pin mechanism)

Orbital pim mekanizmasında tek pim girişi olacağından, pimin sadece baş kısmı sabit kabul edilmiştir. Geri kalan şartlar, çift pim mekanizması ile aynıdır (Şekil 6).

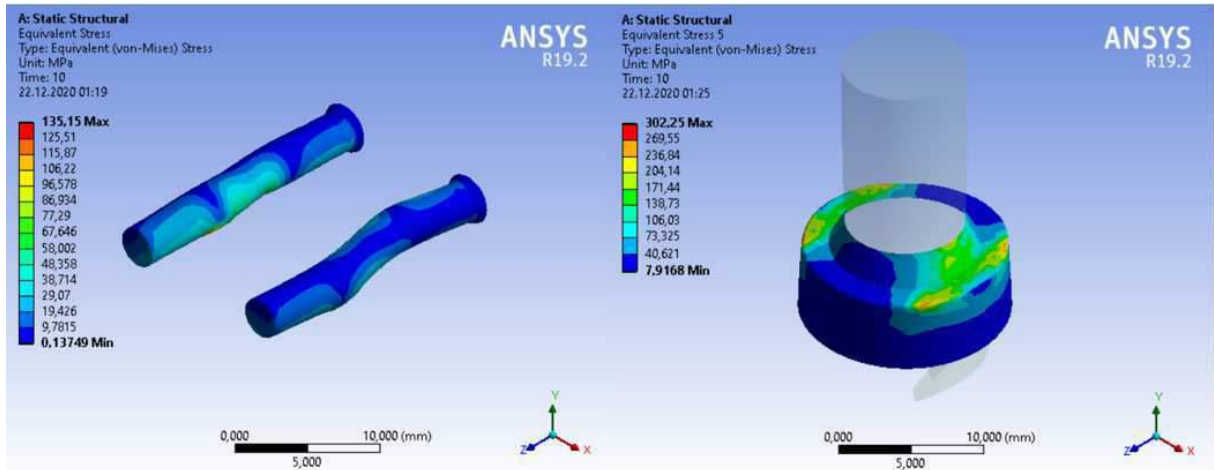


Şekil 6. Orbital pim mekanizması sınır şartları (Boundary conditions of radial pin mechanism)

### Sonlu Elemanlar Yöntemi Problem Çıktıları (Results of Finite Element Method)

ANSYS programında sonlu elemanlar yöntemi kullanılarak yapılan analizler sonucunda, referans geometrilerindeki deformasyonlar Şekil 7 ve Şekil 8’de gösterilmiştir.

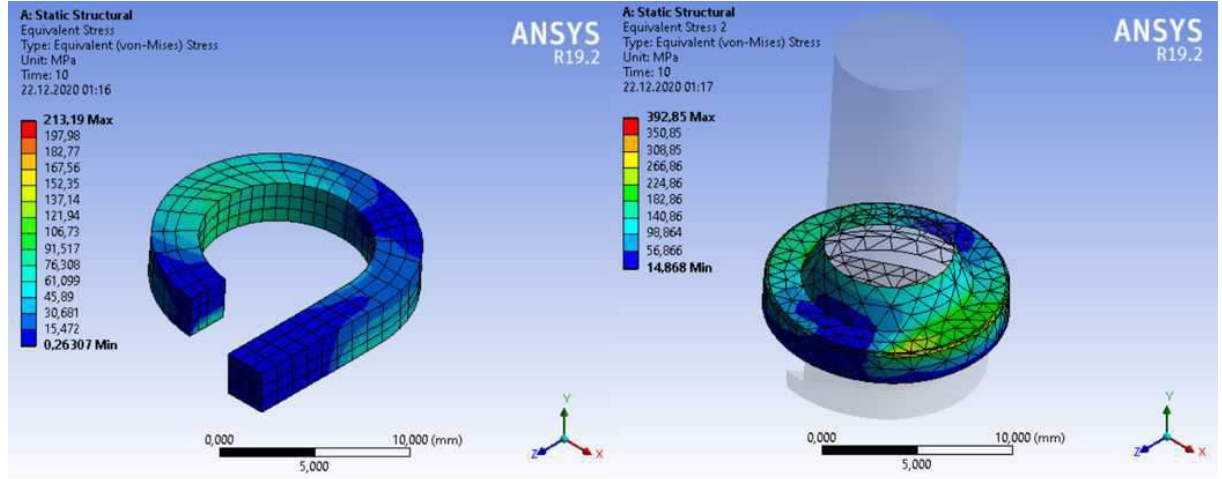
Çift pim mekanizmasında referans geometrisinde pim çapları 3 mm ve volan-mil destek parçasının yüksekliği 5.4 mm olarak alınmıştır. Bu tasarımla, pimlerdeki ortalama gerilme 20.98 MPa ve destekteki ortalama gerilme 67.43 MPa olduğu sonucuna varılmıştır. Pimlerdeki en yüksek gerilme, pimlerin orta bölümünde meydana gelirken, destekteki en yüksek gerilme pimlerle temas edilen yüzeyde gerçekleşmektedir.



Şekil 7. Çift pim mekanizması analiz sonuçları (Analysis results of double pin mechanism)

Orbital pim tasarımında ise, kare kesitli pimin bir kenar uzunluğu 2.5 mm ve destek yüksekliği 1.9 mm olarak kabul edilmiştir. Analiz sonucunda, pimdeki ortalama gerilme 39.24 MPa ve destekteki ortalama gerilme 96.68 MPa olduğu görülmüştür. Orbital pim tasarımında pimin en yüksek gerilme değerleri, pimin dışa yönelik uzantısının, desteğe temas ettiği ilk noktada görülmektedir. Destekteki en yüksek gerilme değeri de yine bu noktada ortaya çıkmıştır.





Şekil 8. Orbital pim mekanizması analiz sonuçları (Analysis results of radial pin mechanism)

## ARAŞTIRMA BULGULARI (FINDINGS)

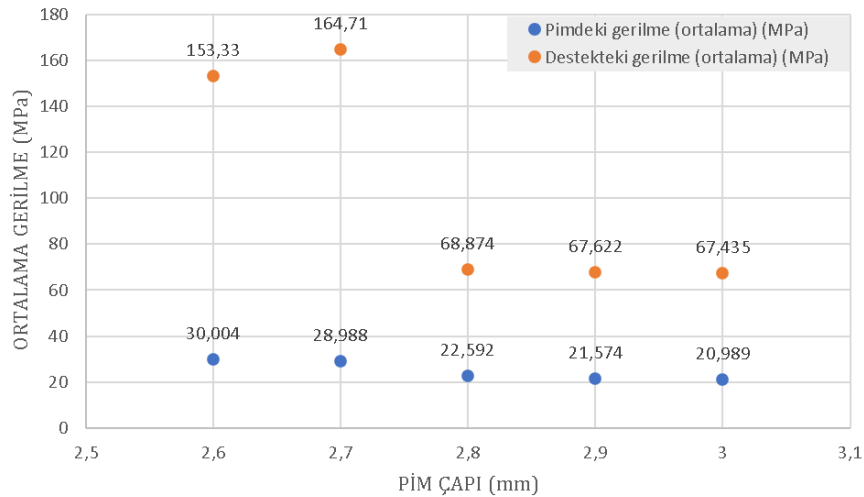
### Çift Pimli Emniyet Mekanizması Analiz (Analysis of Double Pin Mechanism)

Tablo 3 çift pimli emniyet mekanizma tasarımında, destek yüksekliği sabit tutulup pim çapının azaltılması sonucu ortaya çıkan analiz sonuçlarını göstermektedir.

Tablo 3. Pim çapının azaltılması sonuçları (Results of reducing the pin diameter)

Ölçüler (Pim Çapı – Destek Yüksekliği) (mm)	Pimdeki gerilme (ortalama) (MPa)	Destekteki gerilme (ortalama) (MPa)
3 – 5.4 (Referans Geometrisi)	20.989	67.435
2.9 – 5.4	21.574	67.622
2.8 – 5.4	22.592	68.874
2.7 – 5.4	28.988	164.710
2.6 – 5.4	30.004	153.330

Pim çapı 2,7 mm'ye düşürüldüğünde, Şekil 9'da görüldüğü üzere destekteki gerilme ve pimdeki gerilme değerleri pik yapmaktadır.

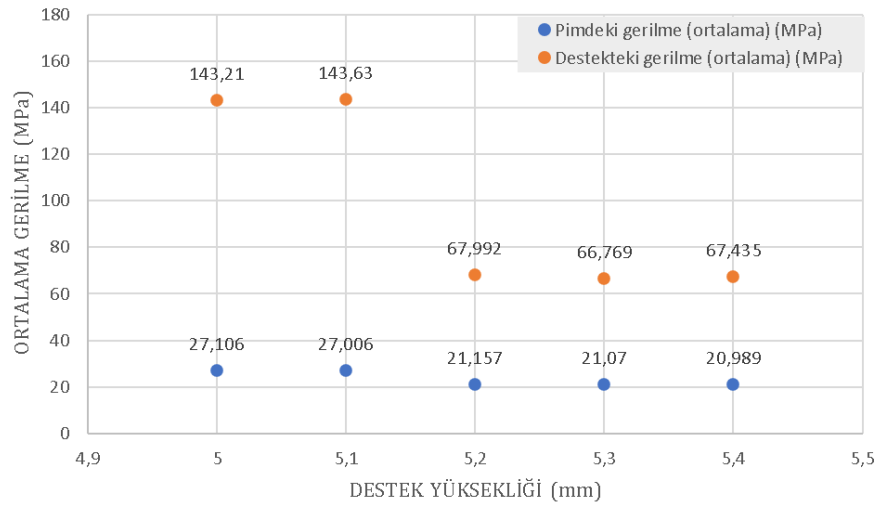


Şekil 9. Pim çapının değişimi grafiği (Graphic of changing the pin diameter)

**Tablo 4.** Destek yüksekliğinin azaltılması sonuçları (Results of reducing the support height)

Ölçüler (Pim Çapı – Destek Yüksekliği) (mm)	Pimdeki gerilme (ortalama) (MPa)	Destekteki gerilme (ortalama) (MPa)
3 – 5.4 (Referans Geometrisi)	20.989	67.435
3 – 5.3	21.070	66.769
3 – 5.2	21.157	67.992
3 – 5.1	27.006	143.630
3 – 5.0	27.106	143.210

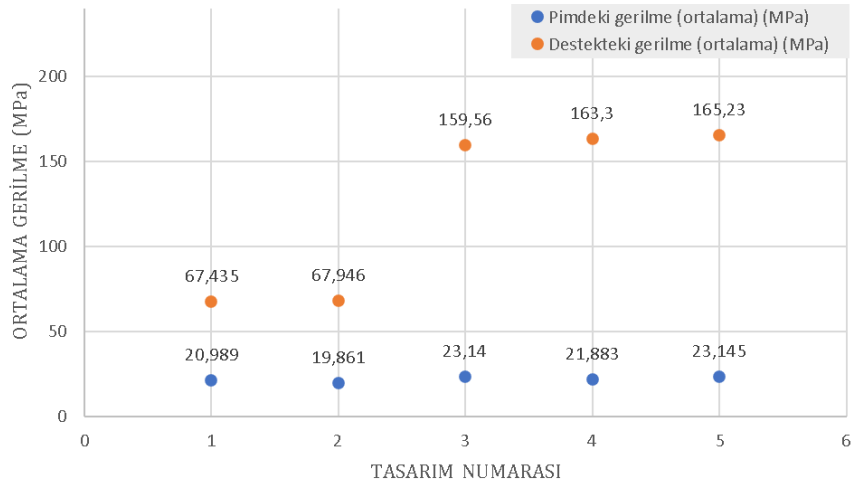
Tablo 4, çift pimli emniyet mekanizma tasarımında, pim çapının sabit tutulup, destek yüksekliğinin azaltılması sonucu ortaya çıkan analiz sonuçlarını göstermektedir.

**Şekil 10.** Destek yüksekliğinin değişimi grafiği (Graphic of changing the support height)

Destek yüksekliği 5.1 mm'ye düşürüldüğünde, Şekil 10'da görüldüğü üzere destekteki gerilme ve pimdeki gerilme değerleri pik yapmaktadır.

**Tablo 5.** Optimum tasarım analizleri (Analysis of optimum design)

Tasarım Numarası	Ölçüler (Pim Çapı – Destek Yüksekliği) (mm)	Pimdeki gerilme (ortalama) (MPa)	Destekteki gerilme (ortalama) (MPa)
1	3 – 5.4 (Referans Geometrisi)	20.989	67.435
2	2.9 – 5.3 (Seçim)	19.861	67.946
3	2.9 – 5.2	23.140	159.560
4	2.8 – 5.3	21.883	163.300
5	2.8 – 5.2	23.145	165.230



Şekil 11. Optimum tasarım grafiği (Graphic of optimum design)

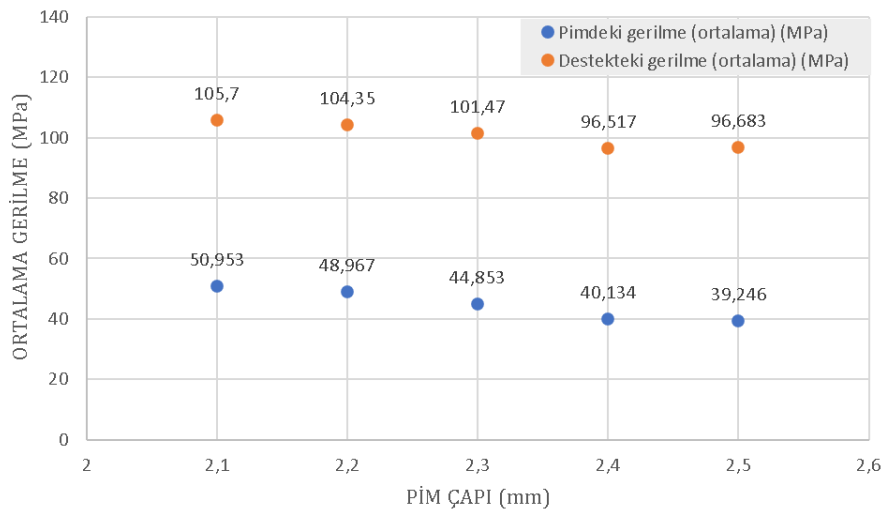
**Orbital Pimli Emniyet Mekanizması Analizi (Analysis of Radial Pin Mechanism)**

Tablo 6, orbital pimli emniyet mekanizma tasarımında, destek yüksekliği sabit tutulup pim çapının azaltılması sonucu ortaya çıkan analiz sonuçlarını göstermektedir.

**Tablo 6.** Pim çapının azaltılması sonuçları (Results of reducing the pin diameter)

Ölçüler (Pim Çapı – Destek Yüksekliği) (mm)	Pimdeki gerilme (Ortalama) (MPa)	Destekteki gerilme (Ortalama) (MPa)
2.5 – 1.9 (Referans Geometrisi)	39.246	96.683
2.4 – 1.9	40.134	96.517
2.3 – 1.9	44.853	101.470
2.2 – 1.9	48.967	104.350
2.1 – 1.9	50.953	105.700

Pim çapı 2.3 mm'ye düşürüldüğünde, Şekil 12'de görüldüğü üzere destekteki gerilme ve pimdeki gerilme değerleri pik yapmaktadır.

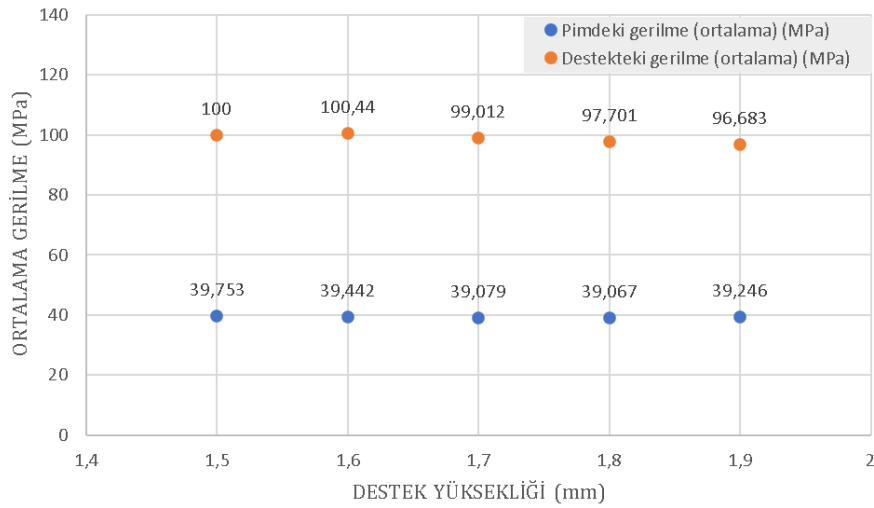


Şekil 12. Pim çapının değişimi grafiği (Graphic of changing the pin diameter)

Tablo 7, orbital pimli emniyet mekanizma tasarımında, pim çapı sabit tutulup destek yüksekliğinin azaltılması sonucu ortaya çıkan analiz sonuçlarını göstermektedir.

**Tablo 7.** Destek yüksekliğinin azaltılması sonuçları (Results of reducing the support height)

Ölçüler (Pim Çapı – Destek Yüksekliği) (mm)	Pimdeki gerilme (Ortalama) (MPa)	Destekteki gerilme (Ortalama) (MPa)
2.5 – 1.9 (Referans Geometrisi)	39.246	96.683
2.5 – 1.8	39.067	97.701
2.5 – 1.7	39.079	99.012
2.5 – 1.6	39.442	100.440
2.5 – 1.5	39.753	100.000

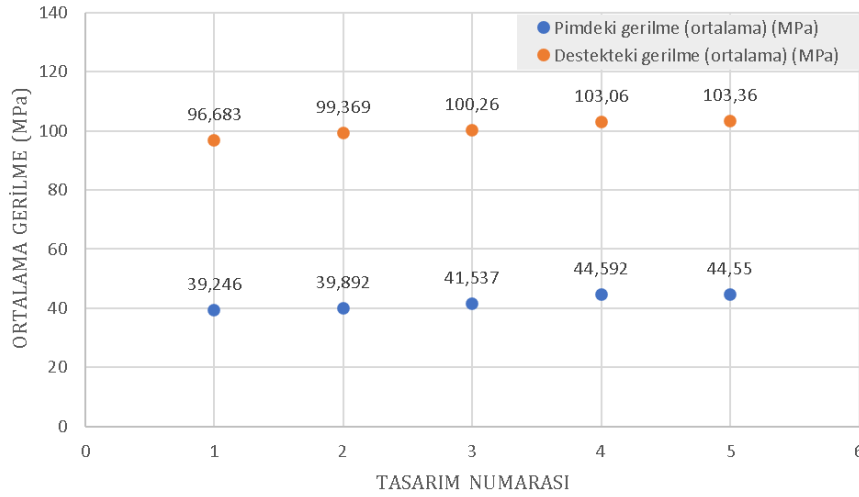


**Şekil 13.** Destek yüksekliğinin değişimi grafiği (Graphic of changing the support height)

Pim çapı sabit tutulup destek yüksekliği düşürüldüğünde, pim üzerindeki gerilmede bir değişiklik olmazken, destek yüksekliğindeki gerilme ilk pikini 1.7 mm’de yapmaktadır (Şekil 13).

**Tablo 8.** Optimum tasarım analizleri (Analysis of optimum design)

Tasarım Numarası	Ölçüler (Pim Çapı – Destek Yüksekliği) (mm)	Pimdeki gerilme (Ortalama) (MPa)	Destekteki gerilme (Ortalama) (MPa)
1	2.5 – 1.9 (Referans Geometrisi)	39.246	96.683
2	2.4 – 1.8 (Seçim)	39.892	99.369
3	2.4 – 1.7	41.537	100.260
4	2.3 – 1.8	44.592	103.060
5	2.3 – 1.7	44.550	103.360



Şekil 14. Optimum tasarım grafiği (Graphic of optimum design)

## SONUÇ VE TARTIŞMA (RESULT AND DISCUSSION)

Bu çalışmanın amacı, malzeme miktarını azaltarak, üretim maliyetini düşürmek, ancak dayanıklılık ve işlevsellikten bir şey kaybetmemektir. Bu amaç doğrultusunda, iki farklı emniyet tasarımı olan, çift pim mekanizması ve orbital pim mekanizmaları üzerinde analizler gerçekleştirilmiştir. Her iki mekanizma için de öncelikle pim çapı sabit tutulup destek yüksekliği 0.1 mm azaltılarak analizler yapılmıştır. Aynı işlem, bu kez destek yüksekliği sabit tutulup pim çapı azaltılarak tekrarlanmıştır. Analizler sonucunda çıkan sonuçlar ile oluşturulan grafikler dikkate alınarak, optimum tasarım olma potansiyeline sahip değerlerden örnek tasarımlar oluşturulmuştur. Son olarak, örnek tasarımların, ANSYS'te yapılan analiz sonuçları not edilmiş ve optimum tasarıma ulaşılmıştır. Yapılan analizler sonucunda, çift pim mekanizması için, 2.9 mm pim çapı ve 5.3 mm destek yüksekliğine sahip 2 numaralı tasarımda karar kılınmıştır (Tablo 5). Aynı şekilde, orbital pim tasarımı için pimin kenar uzunlukları 2.4 mm ve volanın yüksekliği 1.8 mm olan 2 numaralı tasarım, analiz çalışmalarından başarıyla geçmiştir (Tablo 8).

Her iki tasarım arasından, özellikle maliyet açısından bir seçim yapılacaksa, orbital pim tasarımı seçilmesi önerilir. Volan yüksekliğinin düşük olması nedeniyle, malzeme miktarı ciddi oranda azalmaktadır. Ancak bu tasarımın dezavantajı, ömrünün çift pim mekanizmasına göre daha kısa olmasıdır. Çift pimli tasarımda, pim üzerine gelen yük noktasal olarak etki eder. Orbital pim tasarımda ise torkun etkisi ile gelen yük çevresel olarak etki eder. Bu özelliğinden dolayı, dayanımı istenen tork değerine daha kısa sürede ulaşılır ve daha yüksek tork değerlerine çıkılsa bile, deformasyona uğramaksızın dayanım göstermeye devam eder. Sonuç olarak, maliyetin en önemli etken olduğu durumlarda orbital pim tercih edilirken, uzun ömür kriterinin etkili olduğu durumlarda çift pim mekanizmasının kullanılması gerekmektedir.

## KAYNAKLAR (REFERENCES)

- EPDK 2019. Türkiye LPG Piyasası Yatırımcı Rehberi. Sıvılaştırılmış Petrol Gazları (LPG) Piyasası Dairesi Başkanlığı. s. III, Ankara.
- Jha, K., Balakumar, D., & Paluchamy, R. 2015. Experimental Analysis Of Microstructure And Mechanical Properties Of Copper And Brass Based Alloys. International Journal of Automotive & Mechanical Engineering, 11.
- Rhim, J. K. 2006. The Development of the Safety Valve for LP Gas Cylinder Using the Sintered Metal. Journal of the Korean Society of Safety, 21(1), 48-52.
- Sergueeva, A. V., Zhou, J., Meacham, B. E., & Branagan, D. J. 2009. Gage Length and Sample Size Effect on Measured Properties During Tensile Testing. Materials Science and Engineering: A, 526(1-2), 79-83.



## QUASI-STATIC INDENTATION (QSI) RESISTANCE AT DIFFERENT LOADING RATES AND COMPRESSIVE RESPONSE OF HOT TOOL WELDED (HTWED) DISSIMILAR THERMOPLASTIC JOINTS

Nahit ÖZTOPRAK <sup>1\*</sup>

<sup>1</sup> Dokuz Eylul University, Faculty of Engineering, Department of Mechanical Engineering, Izmir, Turkey.

ORCID ID: 0000-0003-1132-8768

### Abstract

Thermoplastics and their composites have shown outstanding advantages in terms of recyclability and mechanical properties. Lightweight potential of these materials has become attractive for many engineering applications. With the widespread use of these materials, there is a need to join them together. Hence, it is necessary to better understand the mechanical properties of dissimilar joints. In this research, homopolymer type polypropylene (PP) and PP compound reinforced with 30% glass fiber are used. Hot Tool Welding (HTW) has been considered as an effective way to manufacture sound connections among various joining approaches. HTW experiments are performed on a commercial plastic welding machine, equipped with heated flat plates. The constant pressure (3.25 Bar) and the weld displacement (1 mm) are maintained during the welding processes. The employed welding conditions are 30 s and 60 s for the heating and welding times, respectively. Plate temperatures are separately arranged as 225 °C and 230 °C for the PP and the PP composite, respectively. After HTW, quasi-static indentation (QSI) response at different loading rates and compressive behavior of the thermoplastic composite joints are investigated. The experimental results show that brittle fracture is observed at both rates when QSI is applied from the PP composite. In other respects, the increased displacement is noted by application of the QSI to the neat PP. The average compressive load capacity of the HTWed dissimilar welds is also calculated as 3869.4 N.

**Keywords:** polypropylene composite, hot tool welding, dissimilar joint, mechanical testing

### INTRODUCTION

Thermoplastic composites can be joined with various techniques, ranging from adhesive bonding to welding (Yousefpour et al., 2004; Amanat et al., 2010; Fiebig & Schoeppner, 2018). When these conventional methods are compared, Hot Tool Welding (HTW) has been considered as a simple and effective method to manufacture emerging connections (Gehde et al., 1997; Erdogan & Huner, 2016; Ozes et al., 2016). The fact that it can be applied to intricate geometries obtained by different methods such as extrusion, injection molding and other techniques makes this method highly practicable (Oliveire et al., 2002; Liu & Cheng, 2010). To sketch out the process, once the appropriate parameters have been determined, faying surfaces of the components to be welded are brought into contact with a heated tool/plate under a proper pressure. At this point, it is an important advantage of the method that it can be successfully applied in joining parts with complex geometries. The heated metallic tools are usually coated with Polytetrafluoroethylene (PTFE) film to prevent sticking of the specimens to the heated tools. The tools are withdrawn after the specified heating time. In dissimilar welding, the heating time can be separate for each part. Lastly, matching surfaces of the parts with molten interfaces are pressed together until the weld zone solidifies. At this stage, control of weld displacement is quite significant for arranging a strong joint and structure dimensions (Stokes, 2000; Grewell & Benatar, 2007). The drawbacks such as thermal and mechanical stressing in dissimilar welding process should be considered even

though the technique allows successful joining of different materials. (Potente & Schnieders, 2002).

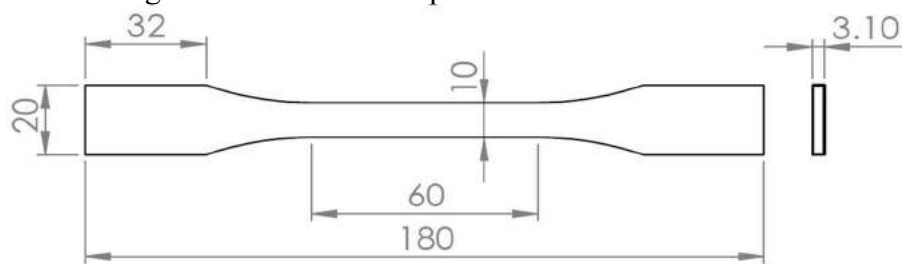
Increase in research activities on thermoplastic polymers in the past few decades and their unique features have expanded their implementation in several industries. However, effects of the quasi-static indentation (QSI) at different loading rates (2 mm/min and 20 mm/min) around weld bead on the joint response are not yet reported in literature. Engineering structures manufactured from thermoplastics and their composites are mostly subjected to loading and environmental conditions causing mechanical deformation. Additionally, welded joints may also represent the weakest part of structures and are sensitive to failure (Thomas, 2018). One of the reasons that can cause damage to welded joints is unexpected working conditions that may disrupt structural integrity (Somers & Pense, 1994). Therefore, for such joints mechanical loading may occur through unforeseen QSI damage not considered in the design phase. In the light of this information, the experimental study presented in this paper seeks the QSI resistance around the weld bead in dissimilar welds between a homopolymer polypropylene (PP) and glass fiber-reinforced PP. Furthermore, compression behavior of the thermoplastic composite joints is examined within the work.

## MATERIALS AND EXPERIMENTAL PROCEDURES

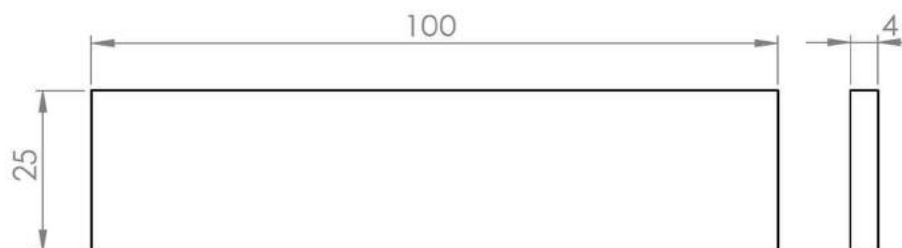
### Materials and sample preparation

In this research, homopolymer type PP with a grade name Petoplen MH418 by Petkim Petrokimya A.S. and PP compound reinforced with 30% glass fiber with a brand name Enflen by Ravago are used. The density of neat PP material is  $0.905 \text{ g/cm}^3$  and it has a melt flow index (MFI) of 4.7 g/10 min at  $230 \text{ }^\circ\text{C}/2.16 \text{ kg}$ . The thermoplastic composite with the melting range of  $160\text{--}165 \text{ }^\circ\text{C}$  has a density of  $1.10 \text{ g/cm}^3$ . The physical properties of the materials are extracted from technical datasheet of the suppliers. The experimentally determined ultimate tensile strength values are 33.65 MPa and 82.94 MPa for the homopolymer type PP and the PP composite, respectively.

For sample preparation, the injection molding, which is the most commonly used manufacturing method for the production of polymers (Yang et al., 2020), is conducted on Dr BOY 50T machine with a screw diameter of 38 mm. Tensile test specimens of the parent materials and HTW specimens are prepared according to BS EN ISO 294-1:2017 (BSI, 2017). Figure 1 and Figure 2 exhibit the sample dimensions.



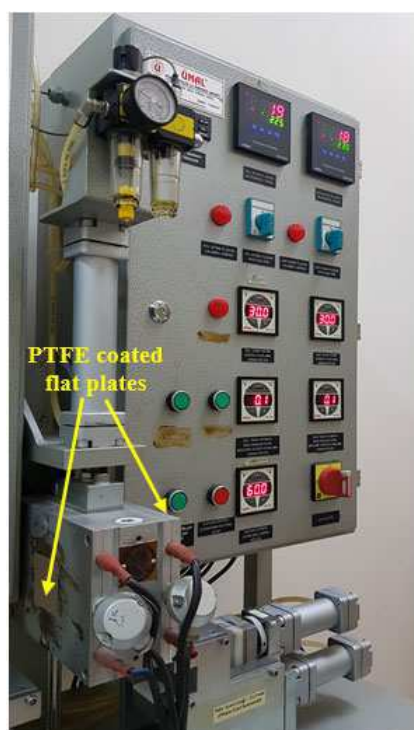
**Figure 1.** Dimensions of parent material tensile test specimens.



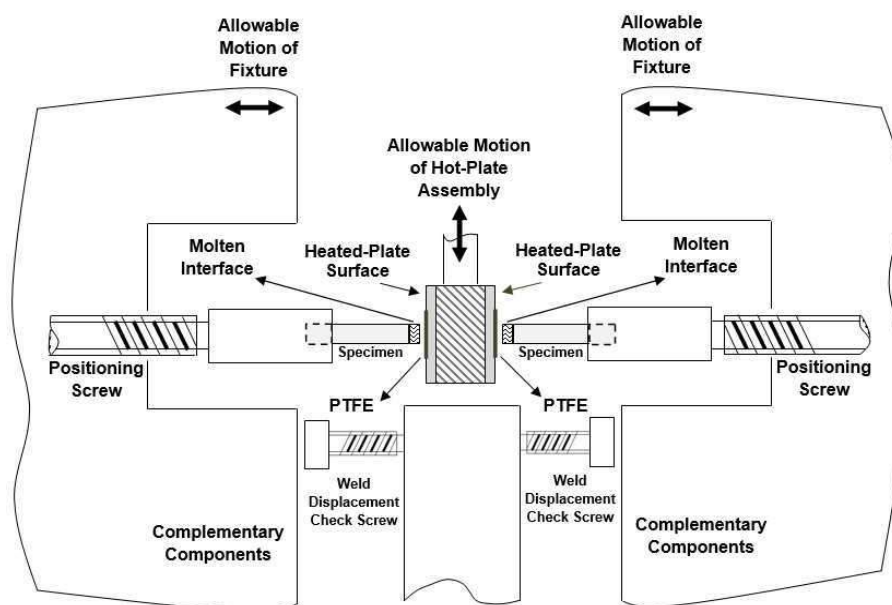
**Figure 2.** Principal dimensions of injection-molded test specimens to be welded.

## HTW process

HTW experiments are performed on a commercial plastic welding machine, equipped with heated flat plates as shown in Figure 3. Surfaces of the tools to be in contact with the samples are coated with PTFE sheets. The constant pressure (3.25 Bar) and weld displacement (1 mm) are maintained during the welding processes. The employed welding conditions are 30 s and 60 s for the heating and welding time, respectively. Plate temperatures are separately arranged as 225 °C and 230 °C for the neat PP and the PP composite, respectively. It is important to point out that the process parameters are chosen based on previous experiments and considering crystallizing point of the materials (Ehrenstein, 2004). Figure 4 also demonstrates the schematic drawing of the HTW setup. The welding machine is able to control the welding process through various apparatus. One of them is the hot plate assembly, which enables the joining of dissimilar materials since it provides different plate temperatures independent of each other. The pneumatic motion assembly is used to put the samples together with the heated tool, to remove them from the hot plates after melting and to assemble the materials for butt-welding. The control unit is also purposed to arrange the pistons and the welding parameters such as plate temperatures, heating times, welding times and waiting times, automatically.



**Figure 3.** Welding machine with PTFE coated tools.



**Figure 4.** Schematic representation of the HPW machine setup.

### Compressive characterization of the joints

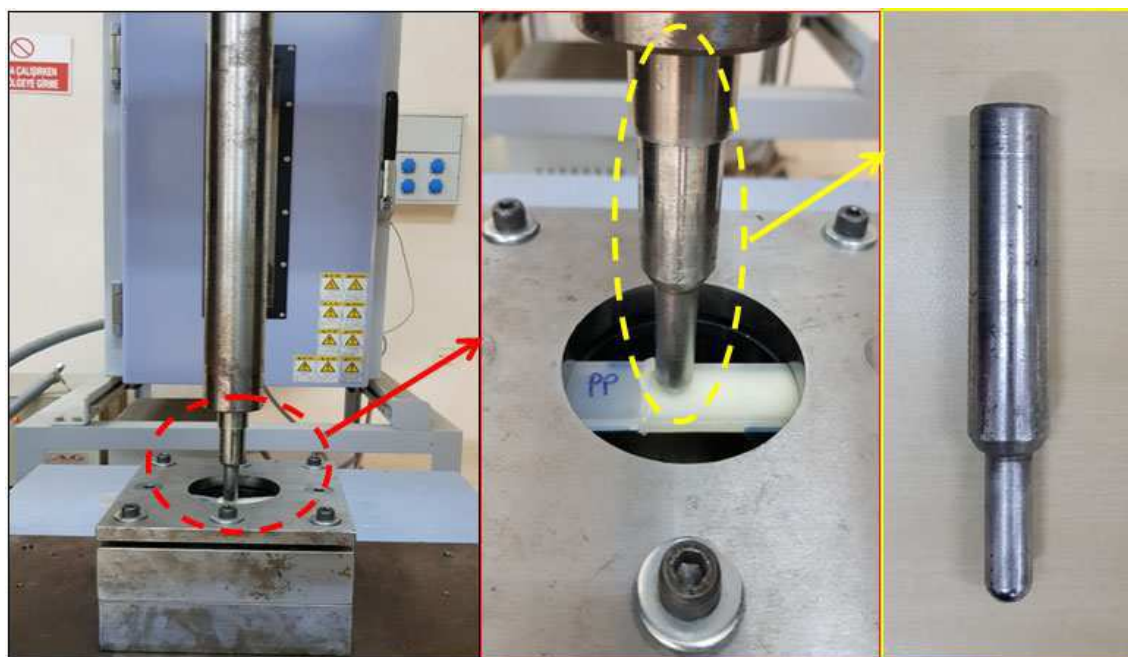
Compression tests are conducted at room temperature using a Shimadzu AG-X (100 kN) universal testing machine considering ASTM D 695 (ASTM International, 2015). Apparatus used for the compression tests is shown in Figure 5. Within the apparatus, the gap between the upper and lower support is set to 25 mm, which is the same as the width of the dissimilar joints. Quasi-static compression tests are performed at a crosshead speed of 1.3 mm/min. Four samples of the HTWed dissimilar joints are examined to obtain more trustworthy experimental data and average values of the findings are reported.



**Figure 5.** Compression test apparatus with sample positioning.

### Quasi-static indentation (QSI) tests

To investigate the penetration resistance applied around the weld zone of HTWed dissimilar joints, the QSI tests are carried out using the same universal testing machine with 100 kN load cell and the test apparatus in the Mechanical Engineering Laboratory of Dokuz Eylul University. The aim of the tests is to evaluate the relationship between the penetration force obtained from dissimilar materials that form the joint and displacement. The test fixture comprises of square cover plate and support plate (180 mm x 180 mm<sup>2</sup>) with 12.7 mm and 50.8 mm thickness, respectively. In the middle of the plates, there is a hole with a radius of 38 mm. Underneath the support plate, there is an additional plate 180 x 180 mm<sup>2</sup> in size, 50.8 mm in thickness, with a 100 x 100 mm<sup>2</sup> square hole inside. Specimens can be fixed between cover and support plates through 8 screws. Figure 6 demonstrates the QSI fixture adapted to the testing machine and the hemispherical shape punch used in this research. In this study, the indentation is applied to both materials of the HTWed dissimilar joints separately at middle of the sample width and a distance of 10 mm from the weld zone, using an indenter with a hemispherical tip of 12.7 mm diameter. Two different crosshead displacement rates of 2 mm/min and 20 mm/min are used in the tests. In this way, different displacement rates are applied to dissimilar materials on both sides of the joint. Three samples are tested for each loading condition and the tests are maintained until the failure of the dissimilar joints.



**Figure 6.** QSI test fixture with a circular hole of 76 mm diameter.

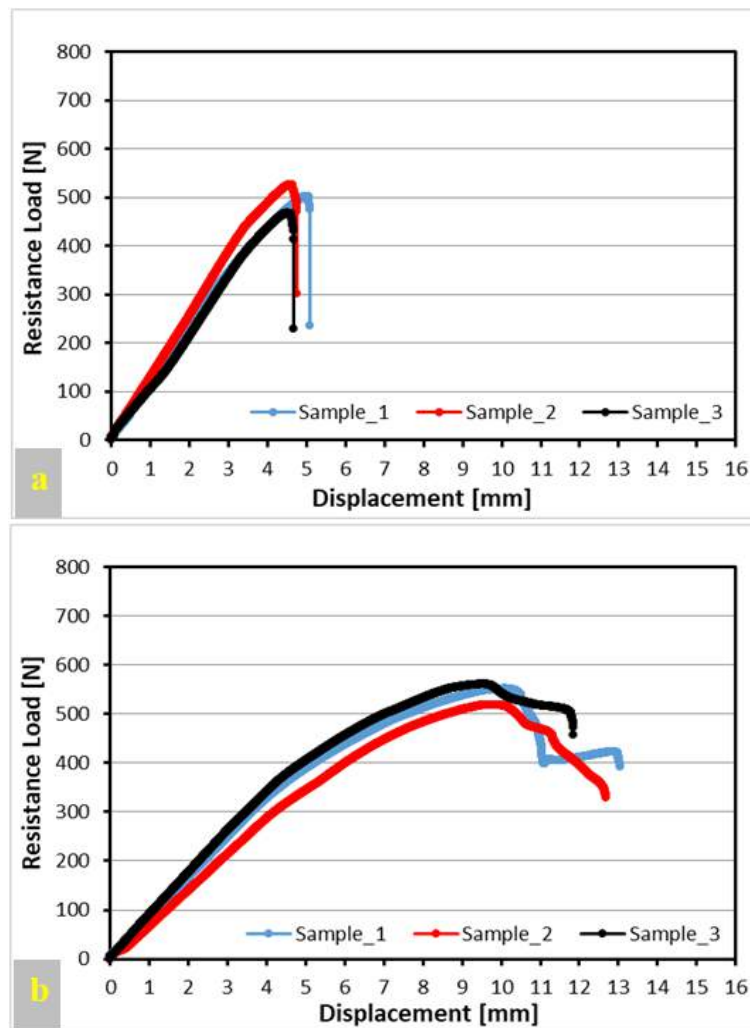
## RESULTS

### QSI resistance of the joints

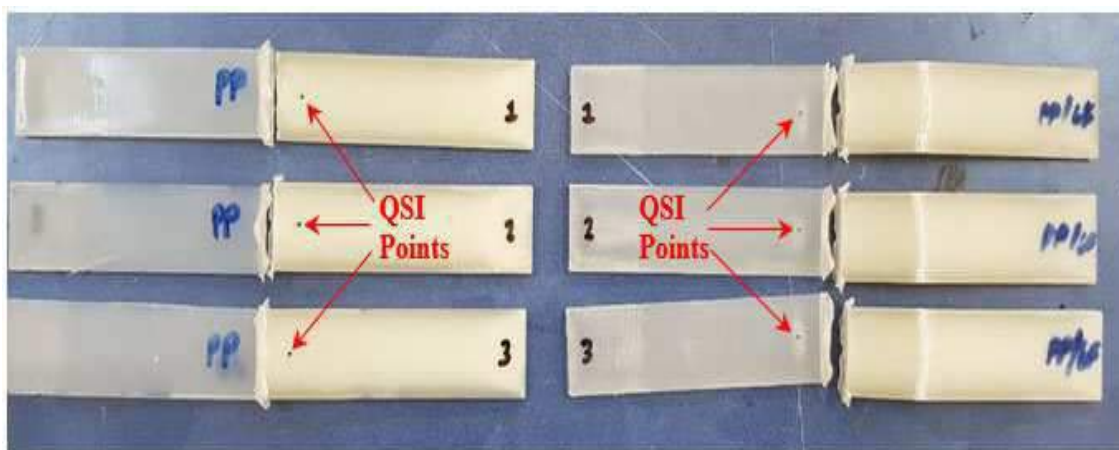
The indentation response of the HTWed dissimilar joints is reported in terms of resistance force versus displacement curves. Average results are considered to compare ultimate loads and displacement at these loads for each condition. The indentation resistance force-punch displacement curves at the loading rate of 2 mm/min are shown in Figure 7. As seen from the figure, there is an almost linear behavior when the QSI is applied from the composite side. A nonlinear trend with a slower load increment is observed subsequent to a linearity up to a certain load when the indentation is performed on the PP. Joint fracture is also reported when the resistance force is maximum for the case where the QSI is applied to the glass fiber-



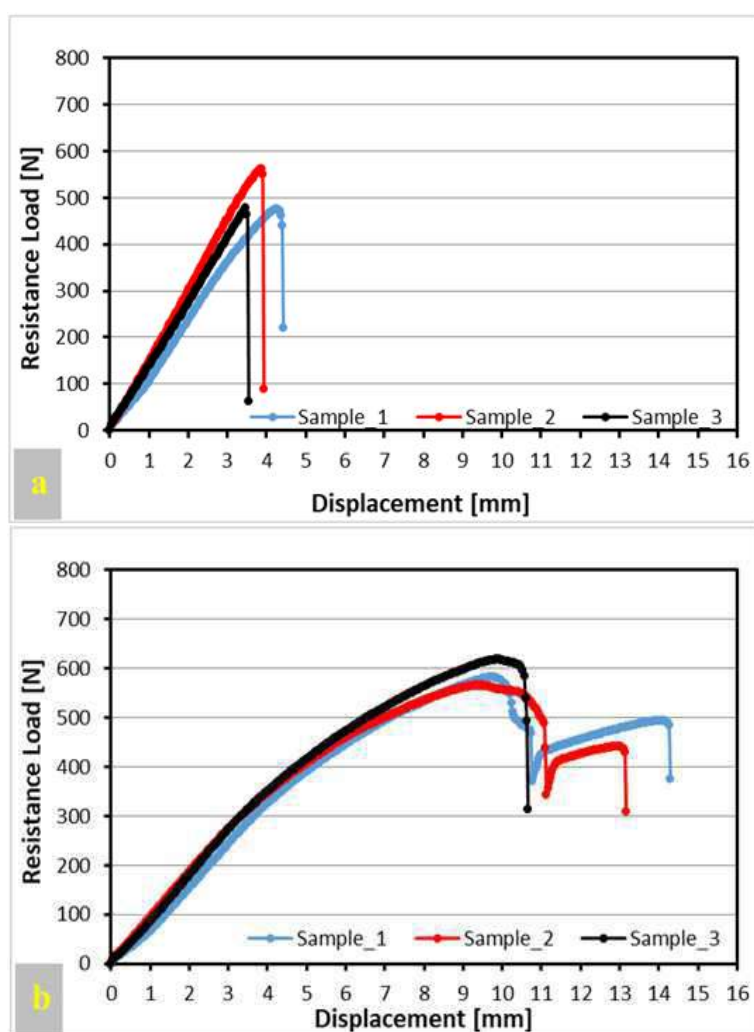
reinforced PP composite. This result indicates the brittle fracture response of the dissimilar welds. While the average maximum force in applying the QSI to the PP composite is 498.78 N, it is calculated as 543.82 N in the other case. At the QSI distance of 10 mm from the weld zone, the load-bearing capacity is lower when the load is applied from the PP composite. The average punch displacement values calculated at the maximum force are 4.68 mm and 9.81 mm for the cases where the QSI is applied to the PP composite and neat PP, respectively. Higher displacement is observed in these samples, as the homopolymer allows time for deformation. During this time, the composite side of the dissimilar joint is also damaged by the contact surfaces with the apparatus. Joint failure is seen after the load drop caused by this observation. Figure 8 demonstrates the failure positions of the specimens after the QSI tests at 2 mm/min. The responses obtained by increasing the loading rate to 20 mm/min are presented in Figure 9. It can be found that a slight increase is noted though there is no significant change in the average resistance load. However, it is observed that the displacement values at the maximum force decrease by applying the QSI to the PP composite side. Joint failure is observed indicating signs of brittle fracture at maximum load. In the case of the QSI to neat PP, the damage in a sample occurs from the contact surface with the apparatus, not by the joint as shown in Figure 10.



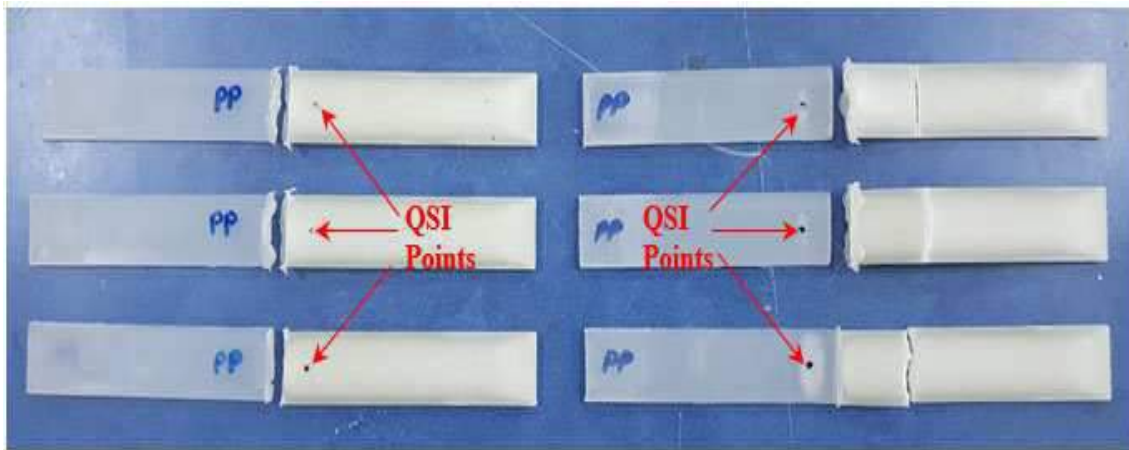
**Figure 7.** Comparison of QSI behavior of the HTWed joints at 2 mm/min after the indentation is applied on: (a) PP composite (b) PP.



**Figure 8.** Views of the HTWed samples after the QSI tests at 2 mm/min.



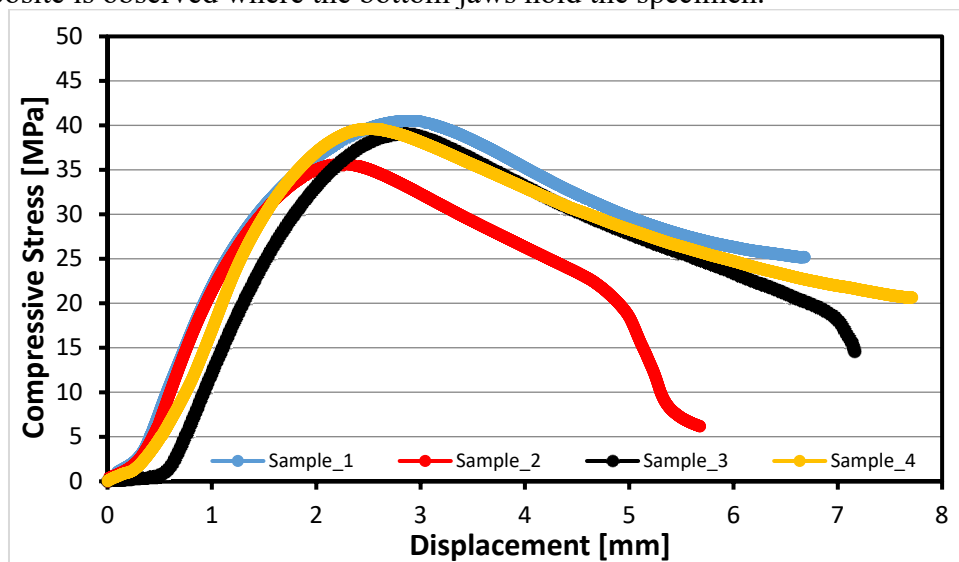
**Figure 9.** Comparison of QSI behavior of the HTWed joints at 20 mm/min after the indentation is applied on: (a) PP composite (b) PP.



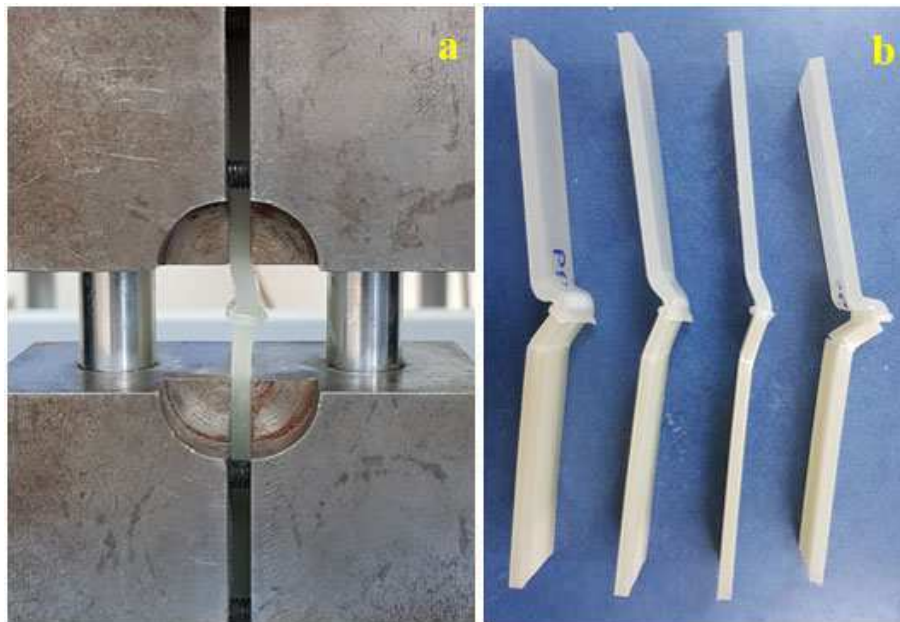
**Figure 10.** Views of the HTWed samples after the QSI tests at 20 mm/min.

### Compressive response

Figure 11 demonstrates the compressive stress-stroke displacement curves of the HTWed dissimilar joints between the neat PP and glass fiber-reinforced PP composite. From the figure, it can be inferred that the compressive stress increases up to a maximum stress level with stroke for all specimens, as expected. As the stress reaches its maximum value, a stress drop in the curves is observed. The stress responses can be characterized by strain softening after the linear elastic region. Large compressive deflections are generally reported for the samples. The mean compression strength of the specimens is calculated as 38.694 MPa. A representative photo of the specimens during the tests in compression and the samples after the tests are shown in Figure 12. Buckling of the neat PP in compression and damage of the PP composite is observed where the bottom jaws hold the specimen.



**Figure 11.** Stress response of HTWed dissimilar thermoplastic joints.



**Figure 12.** (a) Representative sample during the compression test (b) samples after the tests.

## CONCLUSION

Mechanical characterization of the HTWed dissimilar joints between PP and 30% glass fiber-reinforced PP composite are studied in terms of the QSI resistance and compressive response. The effects of different loading rates (2 mm/min and 20 mm/min) in the QSI are also investigated. Higher resistance force is obtained at both loading conditions as a result of the application of the QSI on the neat PP. By applying the QSI to the composite, the HTWed joints present a considerable decrease in stroke displacement. The dominant failure mode in these samples is observed as brittle fracture. The compression test results have shown that the mean compressive strength of the dissimilar joints is 38.694 MPa. Further studies are suggested particularly using various welding parameters to evaluate mechanical properties.

## REFERENCES

- Amanat, N., James, N. L., & McKenzie, D. R. (2010). Welding methods for joining thermoplastic polymers for the hermetic enclosure of medical devices. *Medical Engineering & Physics*, 32(7), 690–699. <https://doi.org/10.1016/j.medengphy.2010.04.011>
- ASTM International. (2015). D695-15 Standard Test Method for Compressive Properties of Rigid Plastics. Retrieved from <https://doi.org/10.1520/D0695-15>
- British Standards Institution (BSI). (2017). BS EN ISO 294-1:2017. Plastics. Injection moulding of test specimens of thermoplastic materials. General principles, and moulding of multipurpose and bar test specimens.
- Ehrenstein, G.W. (2004). *Handbuch Kunststoff-Verbindungstechnik*. Hanser. München, 710s.
- Erdogan, S.E., & Huner, U. (2016). The effect of the welding parameters and the coupling agent on the welding of composites. *Materiali in Tehnologije / Materials and Technology*, 50(5), 655–662. DOI:10.17222/mit.2015.059

- Fiebig, I., & Schoeppner, V. (2018). Influence of fiber orientation and weld position in welding injection-molded fiber-reinforced thermoplastics. *Welding in the World*, 62, 1301–1309. <https://doi.org/10.1007/s40194-018-0649-8>
- Gehde, M., Giese, M., & Ehrenstein, G.W. (1997). Welding of thermoplastics reinforced with random glass mat. *Polymer Engineering and Science*, 37, 702–714. <https://doi.org/10.1002/pen.11714>
- Grewell, D., & Benatar, A. (2007). Welding of Plastics: Fundamentals and New Developments. *International Polymer Processing*, 22(1), 43–60. <https://doi.org/10.3139/217.0051>
- Liu, S.-J., & Cheng, H.-F. (2010). The Influence of Interface Geometry on the Joint Strengths of Hot Plate Welded Composites. *Journal of Reinforced Plastics and Composites*, 29(4), 497–509. <https://doi.org/10.1177/0731684408099410>
- Oliveira, M.J., Bernardo, C., & Hemsley, D. (2002). The Effect of Flame Retardants on the Hot-Plate Welding of Talc-Filled Polypropylene. *Polymer Engineering and Science*, 42, 146–151. <https://doi.org/10.1002/pen.10935>
- Ozes, C., Sayer, S., Yeni, C., & Taskiran, E. (2016). Effect of high filling ratio on the weld strength of hot plate welded calcite filled polypropylene and its comparison with talc filling. *Materialwissenschaft und Werkstofftechnik*, 47, 351–359. <https://doi.org/10.1002/mawe.201600511>
- Potente, H., & Schnieders, J. (2002). Influence of Process Parameters on the Phenomenon of Stress Cracking during Hot Plate Welding. *Journal of Reinforced Plastics and Composites*, 21(6), 489–496. <https://doi.org/10.1177/073168440201006828>
- Somers, B.R., & Pense, A. (1994). Welding failure analysis. *Materials Characterization*, 33, 295–309. [https://doi.org/10.1016/1044-5803\(94\)90049-3](https://doi.org/10.1016/1044-5803(94)90049-3)
- Stokes, V.K. (2000). A phenomenological study of the hot-tool welding of thermoplastics Part 2. Unfilled and glass-filled poly(butylene terephthalate). *Polymer*, 41(11), 4317–4343. [https://doi.org/10.1016/S0032-3861\(00\)00395-5](https://doi.org/10.1016/S0032-3861(00)00395-5)
- Thomas, D.J. (2018). Analyzing the Failure of Welded Steel Components in Construction Systems. *Journal of Failure Analysis and Prevention*, 18, 304–314. <https://doi.org/10.1007/s11668-018-0392-x>
- Yang, X., Tuinea-Bobe, C., Whiteside, B., Coates, P., Lu, Y., & Men, Y. (2020). Molecular weight dependency of  $\beta$  phase formation in injection-molded isotactic polypropylene. *Journal of Applied Polymer Science*, 137, 48555. <https://doi.org/10.1002/app.48555>
- Yousefpour, A., Hojjati, M., & Immarigeon, J.-P. (2004). Fusion Bonding/Welding of Thermoplastic Composites. *Journal of Thermoplastic Composite Materials*, 17(4), 303–341. <https://doi.org/10.1177/0892705704045187>



## EVALUATION AND INFLUENCE OF HOT EXHAUST GAS RECIRCULATION TECHNOLOGY ON THE PERFORMANCE OF A SINGLE-CYLINDER DIESEL ENGINE AND EMISSION LEVELS

Masood A. Masood<sup>1\*</sup>, I.S. Naser<sup>2</sup>, Abdussalam Ali Ahmed<sup>3</sup>, Zayad M. Sheggaf<sup>4</sup>,  
Ahmad A. M. Idris<sup>5</sup>

<sup>1</sup>College of Technical Sciences, Bani Waild, Libya

ORCID: <https://orcid.org/0000-0002-3314-5092>

<sup>2</sup>Renewable Energy Engineering Department, Faculty of Energy and Mining, University of  
Sebha, Libya.

ORCID: <https://orcid.org/0000-0002-9642-6078>

<sup>3</sup>Mechanical Engineering Department, Bani Waleed University, Bani Waleed, Libya.

ORCID: <https://orcid.org/0000-0002-9221-2902>

<sup>4</sup>College of Technical Sciences, Bani Waild, Libya.

ORCID: <https://orcid.org/0000-0001-8204-7221>

<sup>5</sup>Department Of Mechanical Engineering, The Higher Institute Of Science And Technology,  
Tobruk/Libya

ORCID: <https://orcid.org/0000-0002-3314-5092>

### Abstract

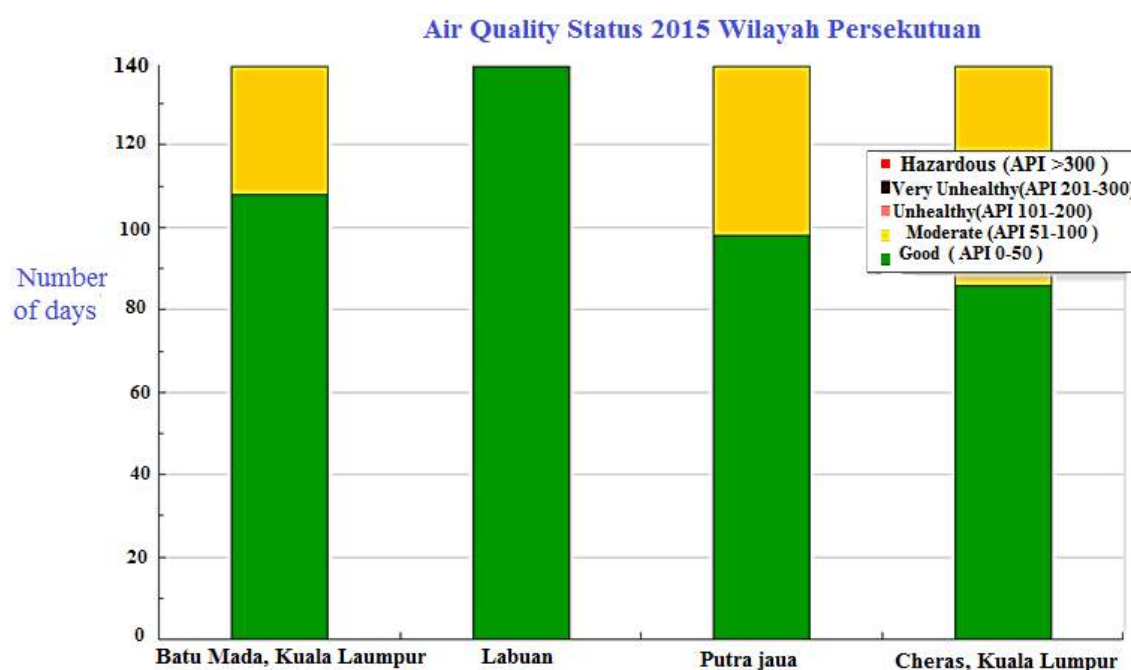
The world today is facing the dilemma caused by air pollution originating from harmful pollutants such as Nitrogen oxide (NO), Carbon monoxide (CO), Carbon dioxide (CO<sub>2</sub>), and unburnt hydrocarbons (UHC) produced by diesel engines. One approach that has had considerable success in overcoming this environmental issue is by introducing exhaust gas recirculation (EGR) into diesel engine system. EGR re-circulates exhaust gas back into the engine cylinder hence lowering peak combustion temperature, which in turn reduces the formation of NO. Experiments was carried out by implementing EGR consisting a non-insulated stainless steel pipe together with an industrial grade ball valve on a 219 cc single cylinder four- stroke Yanmar L48N diesel engine. The objective is to understand the effect of EGR on diesel engine performance and emissions levels of NO in particular, CO, CO<sub>2</sub>, and HC contained in exhaust gas. The engine was operated at an increasing engine speed from 1200rpm up to 3000rpm and significant data such as exhaust gas emission levels was recorded at various EGR loads. EGR flow rate was regulated using the ball valve. This is evident by the increase in particulate emissions that corresponds to an increase in EGR. CO and CO<sub>2</sub> emissions were increasing pattern as EGR ratio increased. The reason for this is the incomplete combustion could occur easier due to the lack of oxygen. The bigger ratio of EGR gives the best NO<sub>x</sub> reduction. Unburned hydrocarbon was increased at lower EGR ratio and later starts to decrease at EGR rate 8.2%.

**.Keywords:** Engine, Diesel, Single-Cylinder, EGR, Emissions.

### 1. Introduction

We live in a world that never stopped expanding as we can see the rapid increase of automotive, heavy industries, and other commercialization. This directly increases the demand for diesel engines since this type of engine runs with cheap fuel and reliable for various functions. Rudolf Diesel built his engine based on the design of the gas engine created by Nikolaus Otto in 1876 with the goal of improving its efficiency. He patented his Diesel engine concepts in patents that were certified in 1892 and 1893. Even though Rudolf Diesel built his first working prototype diesel engine in Augsburg in 1893, the first commercialized diesel engine was manufactured by Inventions (Inventions, 2015).

Despite being multi-functional, the exhaust gases produced by diesel engine will always be an environmental topic for many years to come due to the fact that the emission is a major contributor to air pollution, greenhouse effect, global warming, and health problems. Exhaust gases from diesel engine consists of carbon dioxide (CO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), particulate matters (PM), unburned hydrocarbons (HC), carbon monoxide (CO), and very little water vapor (Karagöz, Y 2015). All of the mentioned substances except water vapor threaten our health and environment. Diesel exhaust has been classified as an IARC Group 1 carcinogen which causes lung cancer and is associated with an increased risk for bladder cancer. Review of air pollution in Malaysia is based on monitoring air quality in several state capitals in Malaysia, which cover air pollutants such as Sulphur Dioxide (SO<sub>2</sub>), Carbon monoxide (CO), Ozone (O<sub>3</sub>), Nitrogen Dioxide (NO<sub>2</sub>), and Suspended Particulate Matter (SPM). In Malaysia, NO<sub>2</sub> and SPM are the predominant pollutants. Figure 1 displays the Air Pollutant Index (API) of several cities in Kuala Lumpur, Malaysia for the year 2015 (Hannu 2013).



**Figure 1:** API readings for Kuala Lumpur in 2015 (Department of Environment, 2013)

Intense development of economy has increased diesel engine usage worldwide consequently affecting people's quality of life and also polluting the air we breathe. We have no other choice but to inhale the exhaust gases which usually saturated around 5 meters from ground level. By doing so, polluted air can stimulate the respiratory tract and lower the immunity of the respiratory system. Other than that, carcinogen in tail gas like benzene class material will lead to lung cancer, thyroid cancer, or other serious health issues (Tang 2014). Environmental laws and emission legislations are being scrutinized and improvised regularly thus stressing automotive industries to also improvise and facilitate methods to control engine's NO emission level. Walke, P., Deshpande, N., & Bodkhe, R. (2008).

NO consists of both NO and NO<sub>2</sub> are combined together (Bowen 1998). NO is colorless and odorless while NO<sub>2</sub> is a reddish brown gas with pungent odor. NO<sub>2</sub> which is formed from oxidation of NO are five times more toxicity than that of NO (Cengel, Y. A., Boles, M. A., & Kanoğlu, M 2002). The nitric oxide formation chain reactions are initiated by atomic oxygen, which forms from the separation of oxygen molecules at high temperatures during combustion process (Abdullah, N. R. 2011). In diesel engines, NO<sub>2</sub> can be 10% to 30% of

total exhaust emissions of oxides of nitrogen. NO formation is almost absent at temperatures below 2000K. Hence any method, that can sustain the instantaneous local temperature in the combustion chamber below 2000K, will be able to reduce NO formation (Jothithirumal & Jamesgunasekaran, 2012).

To overcome this problem, several high end technologies have been invented throughout the years but the most promising and practical approach is known to be the use of EGR (Zheng, 2004). EGR reduces the formation of NO by allowing a small portion of exhaust gas to escape into the intake manifold. This escaped gas portion is only about 6 to 10% of the total, but it's sufficient to dilute the air/fuel mixture just enough to have a "cooling effect" on combustion temperatures. (Walke 2008). This maintains combustion temperatures below 1500 degrees Celsius (2800 degrees Fahrenheit) to reduce the reaction between nitrogen and oxygen particles that forms NO (AA1Car, 2010). By recirculation the lower oxygen exhaust gas into the intake manifold in order to reduce NO. In modern diesel engines, the EGR gas is cooled using a heat exchanger thus allowing the introduction of a larger mass of re-circulated gas. Exhaust re-circulated back into the cylinder can increase engine wear as carbon particulate slips through the rings and into the oil (Hebbar, G. S 2013).

It is reported that emissions from diesel vehicles are significantly more harmful than those from petrol ones (URL, 2015b). In diesel engines, NO emissions can be suppressed by reducing peak combustion temperatures and there are two methods to reduce peak combustion temperatures, which are either using spark control system or EGR. Between both mentioned methods, EGR is found to be a better way to control NO. Over the years, EGR's ability to alter combustion temperature and reduce diesel engine emissions as well as increasing engine's performances has been previously demonstrated but the experimental research was conducted with highly controlled combustion products instead of channeling real combustion products into the intake manifold. Besides that, EGR cooling system was present thus producing very optimistic outcomes (Roy 2014).

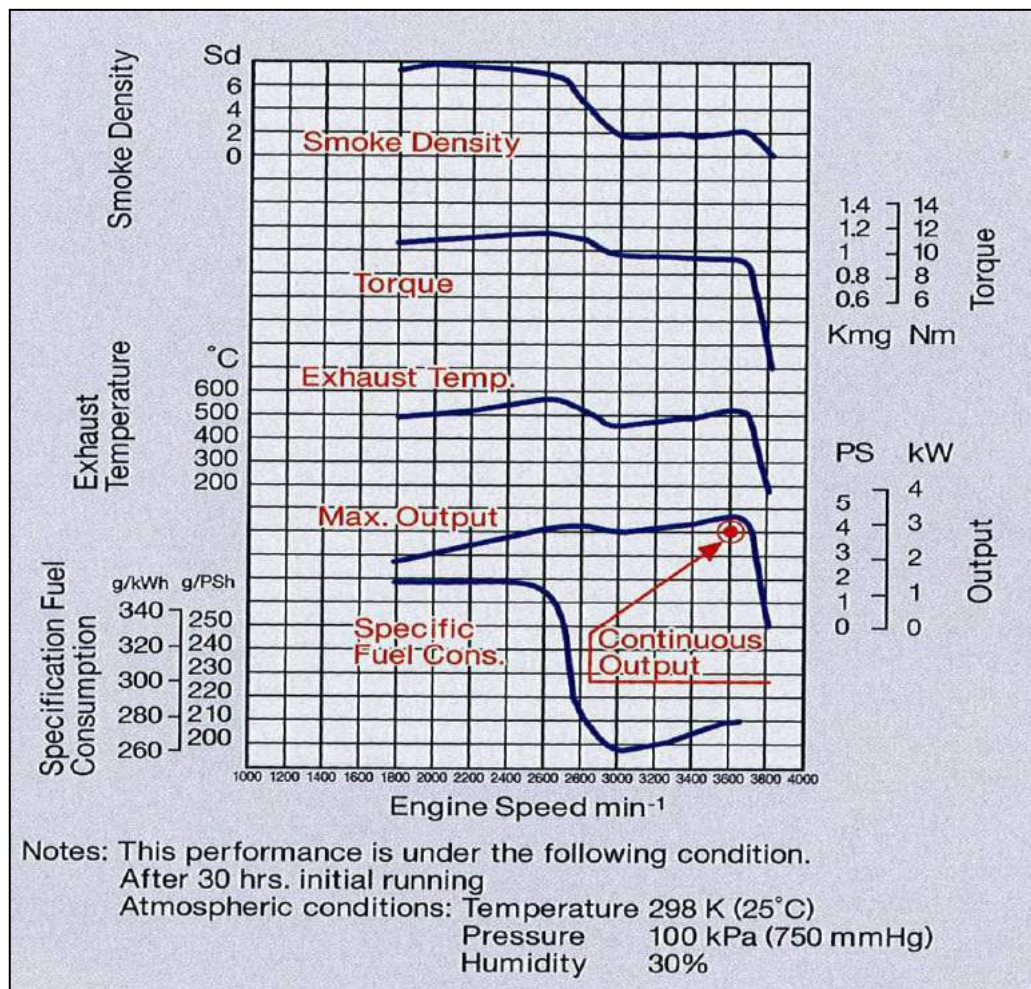
## 2. Problem Statement

It is reported that emissions from diesel vehicles are significantly more harmful than those from petrol ones (URL, 2015b). In diesel engines, NO emissions can be suppressed by reducing peak combustion temperatures and there are two methods to reduce peak combustion temperatures which are either using spark control system or EGR. Between both mentioned methods, EGR is found to be a better way to control NO. Over the years, EGR's ability to alter combustion temperature and reduce diesel engine emissions as well as increasing engine's performances has been previously demonstrated but the experimental research was conducted with highly controlled combustion products instead of channeling real combustion products into the intake manifold. Besides that, EGR cooling system was present thus producing very optimistic outcomes. The benchmark data of a standard Yanmar L48N diesel engine is provided in both Table 1 and Figure 2.

**Table 1:** Benchmark data of a standard Yanmar L48N diesel engine (Zheng et al., 2004)

Emission gas content (g/kW.Hr)	
NO	7.5
CO	8.0
PM	0.80

Performance	
Torque	12Nm
Power	3.5kW



**Figure 2:** Yanmar L48N performance and properties at standard condition (Vidal, 2013).

### 3. Objective

To improve the emission levels of Nitrogen Oxides (NO), Carbon Monoxide (CO), Carbon Dioxide (CO<sub>2</sub>), and Un-burnt Hydrocarbons (HC) of a single cylinder diesel engine.

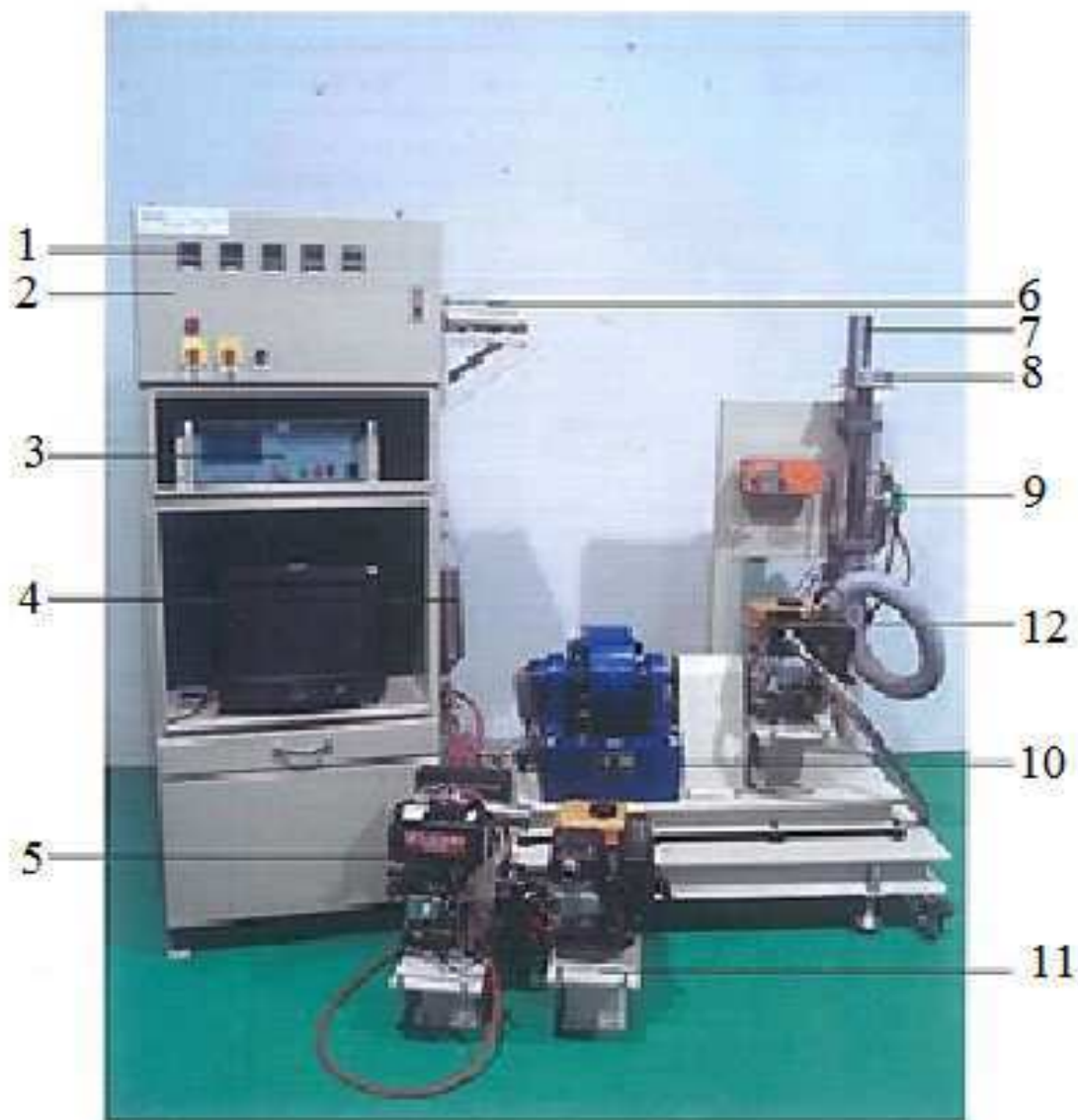
## 4. Methodology

### 4.1 Experiment Setup

For this study, the Mechanical Engineering Laboratory has provided a SOLTEQ Engine Test Bed (Model: TH 03) which enabled wide range of parameters to be studied. Figure.3 and Table.2 presents and labels every equipment and device included in the test bed assembly. In order to conduct this project, an EGR is required to be included into the test bed assembly. Thus, an additional ducting will be added from the exhaust outlet back into the air intake pipe. This project aim is to reduce emission levels of NO, CO, CO<sub>2</sub> and HC of a standard diesel fueled single cylinder, 4-Stroke Diesel Engine by using EGR. Besides that, the other



aim is to compare the engine performances running at different speed and load with and without EGR.



**Figure 3:** SOLTEQ Engine Test Bed (SPTC, 1997).

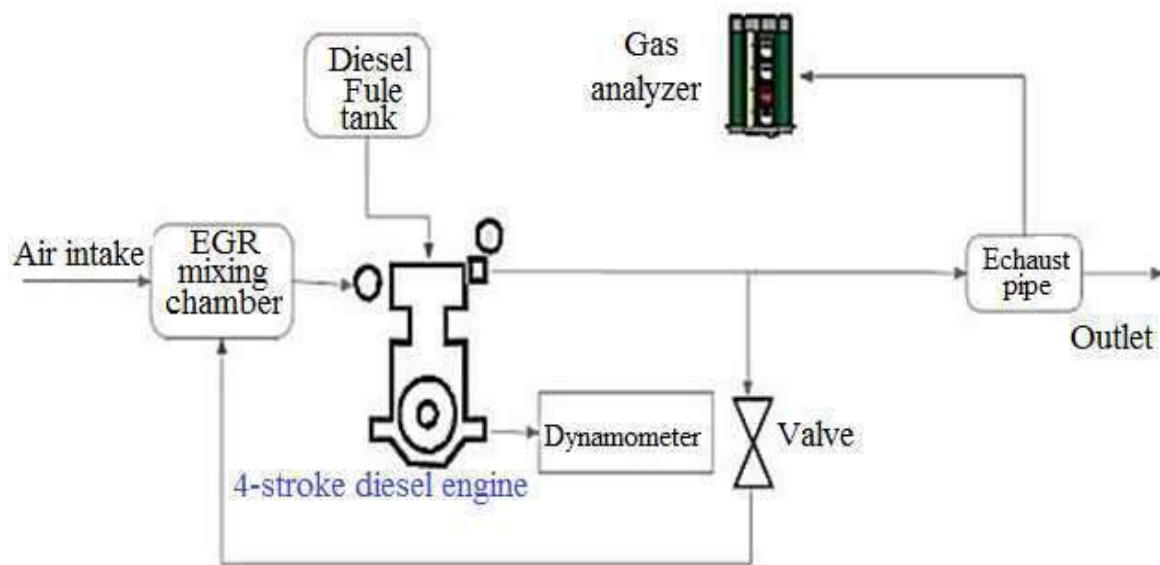
**Table 2:** Equipment description (SPTC, 1997).

No.	Equipment	No.	Equipment	No.	Equipment
1.	Indicator	5.	2 Stroke Petrol Engine	9.	Air Velocity Sensor
2.	Control Panel	6.	Weighing Balance	10.	Dynamometer
3.	Dynamometer Control	7.	Exhaust	11.	4 Stroke Petrol Engine



4.	Fuel Tank	8.	Air Intake	12.	4 Stroke Diesel Engine
----	-----------	----	------------	-----	------------------------

Schematic of the complete experiment setup is illustrated in Figure.4. The EGR rate was regulated by adjusting the lever of the ball valve while monitoring the air velocity meter simultaneously. Data such as air intake speed, temperatures, and torque, power and gas emission properties are recorded in a table format. Calibration of measuring devices is also done before starting the experiments. The engine is coupled to the dynamometer to obtain torque and power readings. The exhaust emission composition details can be identified using gas chromatography. The test bed requires an electrical supply of 220 – 240 Voltage Alternating Current (VAC), 50Hertz (Hz), and 2 Ampere (A). The dynamometer requires a cooling water supply at 20 liters per minute (LPM) to dissipate excess heat energy. Since the engine will run for long hours during experimentations, air ventilation will be required to discharge excess heat out of the laboratory (SPTC, 1997).



**Figure 4:** Schematic of experiment setup.

#### 4.2. Engine Setup

Yanmar engine is shown in Figure.4 and used in this study and the specifications of the engine are listed in the Table.3. As mentioned earlier, the EGR equipped diesel engine to be used during experiments is shown in Figure 5 too.



**Figure 5:** Yanmar L48N diesel engine used during experiment.

**Table 3:** Engine specifications (SPTC, 1997).

<b>Brand</b>	Yanmar Engines
<b>Model</b>	L48N
<b>Engine type</b>	Single cylinder, 4-stroke, air cooled
<b>Ignition</b>	Compression ignition
<b>Starting system</b>	Recoil starter
<b>Fuel</b>	Automotive Diesel Fuel
<b>Lubricant</b>	Automotive Lubricant Oil (SAE #30)
<b>Bore and Stroke</b>	70mm x 57mm
<b>Displacement</b>	219 cc @ 0.219L
<b>Maximum output</b>	3.1 kW / 3000rpm
<b>Continuous output</b>	2.8kW / 3000rpm
<b>Fuel consumption</b>	0.78 / Hour @ 3000 rpm (75% load)

#### 4.3 EGR Control Valve

In order to control the EGR flow rate, the EGR valve opening is regulated manually. The Figure.6 is valve supplied by GP Valve & Actuator Store Sdn. Bhd is capable of withstanding high pressure and temperature, thus being suitable for this EGR system. The ball valve opening can be reduced thus allowing a higher-pressure differential, which channels exhaust gas volume according to the percentage of EGR rate desired. The percentage of recycled

exhaust gas can be represented by an EGR ratio, which is the mass ratio of recycled gases to the total fresh air intake. The fresh air intake contains negligible amounts of CO<sub>2</sub> while the recycled portion carries a substantial amount of CO<sub>2</sub> that increases with EGR flow rate and engine loads. Notably, CO<sub>2</sub> is merely a combustion product. Thus, it is intuitive and practical, to measure EGR ratio by comparing the CO<sub>2</sub> concentrations between the exhaust and intake of the engine as described in equation below:

$$\text{EGR \%} = \text{intake CO}_2 \text{ concentration} / \text{exhaust CO}_2 \text{ concentration} (1)$$

From a general view, the constituent of intake CO<sub>2</sub> is affected by the valve opening and the exhaust CO<sub>2</sub> concentration. A higher exhaust CO<sub>2</sub> concentration leads to a higher intake CO<sub>2</sub> concentration and vice versa.



**Figure 6:** Control valve courtesy of GP Valve & Actuator Store Sdn Bhd (Cengel et al., 2002).

#### 4.4 Measurement Devices and Equipment

A dynamometer, gas chromatography machine, air velocity sensor, and four temperature sensors are essential for experimentation purpose. Air velocity sensor detects the movement of air intake at the inlet pipe meanwhile temperature sensors take temperature readings of intake air, fuel at tank, lubricating oil temperature, and exhaust temperature.

#### 4.5 Eddy Current Dynamometer

The Figure.7 shown eddy current dynamometers use an electrically conductive shaft moving across a magnetic field to produce resistance to movement besides using variable electromagnets to change the magnetic field strength to control the amount of braking. The dynamometer is controlled by a computer, using changes in the magnetic field to match the power output being applied. The dynamometer needs a warm up run about 30 minutes before starting to conduct experiments. The table.4 is shown eddy current dynamometer specifications (SPTC, 1997).



**Figure 7:** Eddy current dynamometer coupled to the diesel engine.

**Table 4:** Eddy Current Dynamometer Specifications (SPTC, 1997).

Brand and Model	Xiang Yi GW 10
Rated absorbing power	10 kW
Rated braking torque	50 Nm
Rated maximum speed	13,000 RPM
Coolant	Fresh water
Measuring accuracy of torque	0.2 – 0.3% FS
Measuring accuracy of rotational speed	1 r/min

#### 4.6 Exhaust Gas Analyzer

The Figure.8 shown equipment used to analyse the exhaust emission is heavy duty and highly accurate. It is also capable of averaging calculations automatically. This device can conduct automatic zero calibration and self-diagnostics. Besides measuring concentrations of NO, HC, CO, and CO<sub>2</sub>, this device is capable of measuring engine speed, fuel temperature, and Lambda. This machine requires power input in the range of 90 to 264VAC or 12VDC (Joel, 1996).



Figure 8: Auto Check Gas and Smoke Analyzer.

#### 4.7 GR Percentage and Ratio:

The EGR percentage is a ratio of volume of EGR used divided by the total intake charge into the cylinder:

$$\% EGR = \frac{(\rho Av)_{air} - (\rho Av)_{EGR}}{(\rho Av)_{air}} \times 100 \quad (2)$$

$$\% EGR = \frac{\Delta \dot{m}}{\dot{m}_{air}} \times 100 \quad (3)$$

Where;  $\rho$  = Density ( $\text{kg/m}^3$ ),  $A$ = Area of pipe flow ( $\text{m}^2$ ), and  $V$ = velocity ( $\text{m/s}$ )

$$EGR \text{ ratio} = \frac{[CO_2]_{\text{intake}} - [CO_2]_{\text{ambient}}}{[CO_2]_{\text{exhaust}} - [CO_2]_{\text{ambient}}} \quad (4)$$

### Results and Discussion

Performances of Diesel Engine without EGR was analyzed and compared with the provided benchmark performances of the diesel engine to ensure reliability of data obtained from experiment.

#### 5.1. Emissions Levels

##### 5.1 Carbon Monoxide (CO)

The carbon monoxide concentration was measured in the engine exhaust pipe. Refer to the graph in Figure 9 it can be defined that the best stable and less emission of CO shown by 10% - 70% opening, started from 1200 rpm – 3000 rpm. CO was increasing pattern as EGR ratio increased. The reason for this is the incomplete combustion could occur easier due to the lack of oxygen.



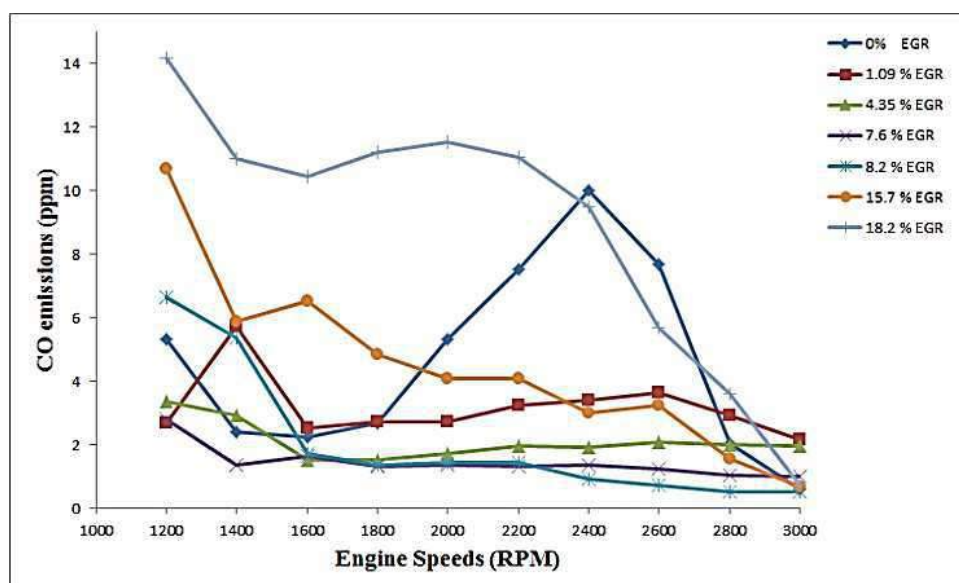


Figure 9: CO (ppm) vs engine speed under different EGR ratio.

### 5.2 Nitrogen Oxides NO<sub>x</sub>

The less percentage of inlet EGR will enhance the emission of nitrogen oxides NO<sub>x</sub> according to the speed of RPM. The best of NO<sub>x</sub> reduction is depending on EGR percentage. The bigger ratio gives the best NO<sub>x</sub> reduction. For example, the reduction of NO<sub>x</sub> emissions was very clear with 8.2%, 15.7% and 18.2% of EGR. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders as shown in Figure 10. This dilutes the O<sub>2</sub> in the incoming air stream and provides gases inert to combustion to act as absorbents of combustion heat to reduce peak in-cylinder temperatures. NO<sub>x</sub> is produced in a narrow band of high cylinder temperatures and pressures.

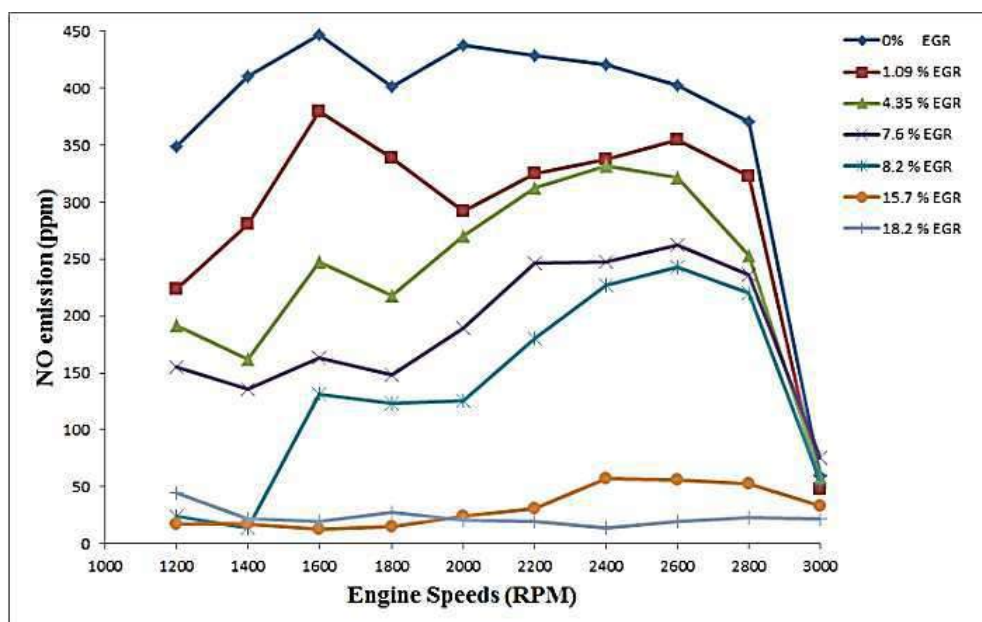


Figure 10: NO (ppm) vs engine speed under different EGR ratio.

### 5.3 Carbon Dioxide (CO<sub>2</sub>)

Refer to the graph it can be defined that the best stable and less emission of CO shown by 30% - 70% opening, started from 1200 rpm – 3000 rpm. As shown in Figure 11, the carbon dioxide concentration increased with the EGR ratio, as anticipated by the modeling predictions of Aithal. Aithal showed that the carbon dioxide concentration increased with the

EGR ratio using chemical kinetics and a phenomenological burning rate model. The reason for this is that carbon dioxide is almost never involved in combustion reactions, due to its inert gas property.

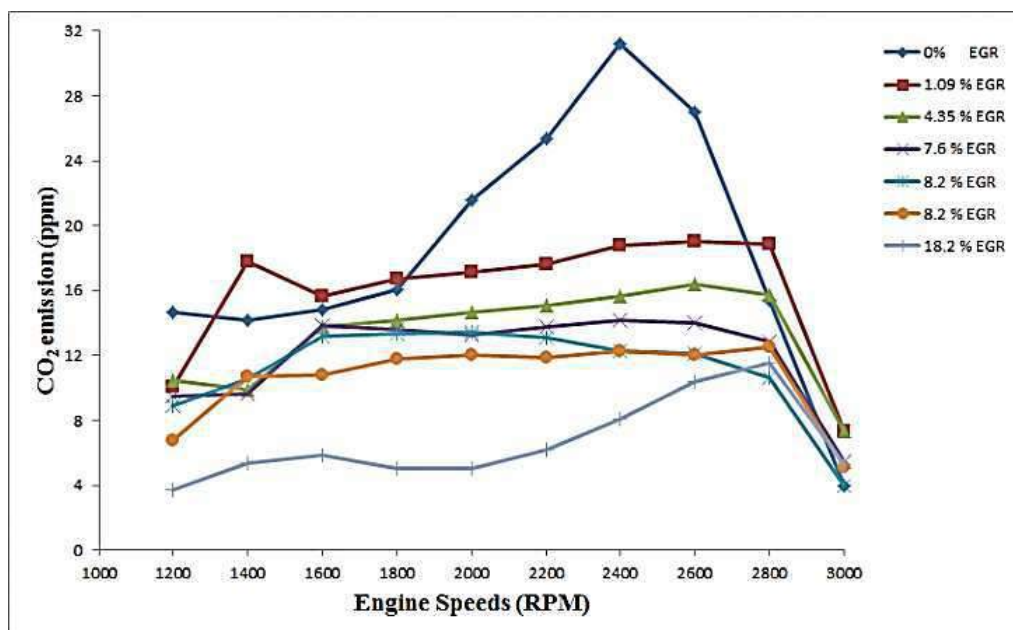
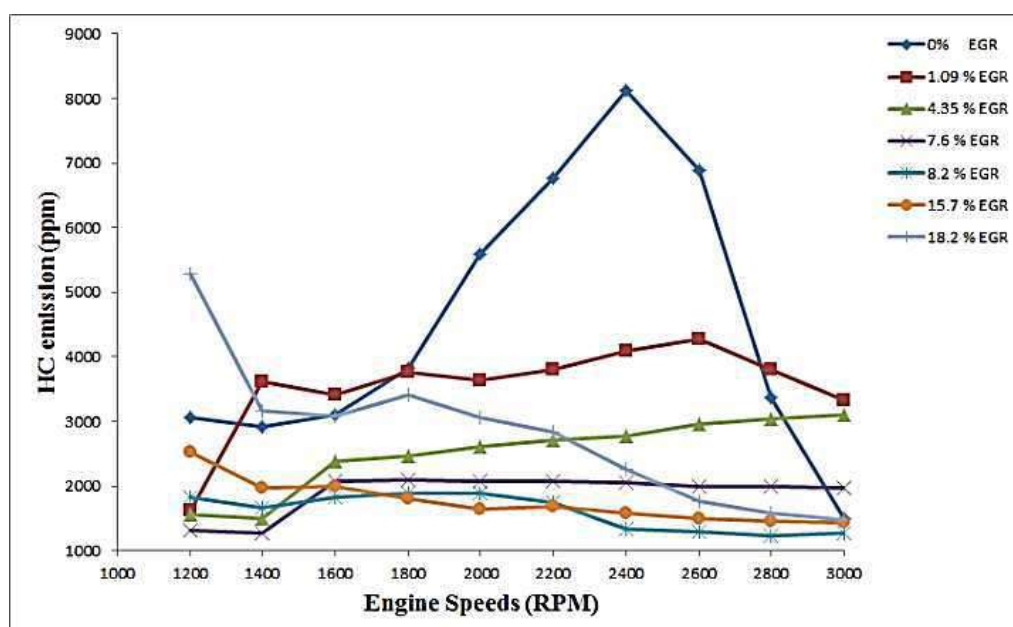


Figure 11: CO<sub>2</sub> (ppm) vs engine speed under different EGR ratio.

#### 5.4 Unburned Hydrocarbon (UHC)

As shown from the graph in Figure 12, there is no stability between the range 50% - 100% opening. 50% opening is the most stagnant which vary from idling speed 1200rpm – 3000rpm constantly. Among the others, HC (ppm) is the largest content compare to rest of the other gases emission. Unburned hydrocarbon was increased at lower EGR ratio and later starts to decrease at EGR rate 70%. This pattern is caused by unburned gas in the exhaust from the previous cycle which is recalculated and burned in the preceding cycle. The EGR, although raising the intake charge temperature, caused lower combustion temperatures due to the following: the local air-fuel ratio is less, and the ignition delay was decreased, thus decreasing the early part of combustion.



**Figure 12:** HC (ppm) vs engine speed under deferent EGR ratio.

## Conclusion

This study was done experimentally using Yanmar diesel engine which has single cylinder and using direct injection method. The results of this study gave good prediction and summarized as follow: 1: CO and CO<sub>2</sub> emissions were increasing pattern as EGR ratio increased. The reason for this is the incomplete combustion could occur easier due to the lack of oxygen. The bigger ratio of EGR gives the best NO<sub>x</sub> reduction. Unburned hydrocarbon was increased at lower EGR ratio and later starts to decrease at EGR rate 8.2%. 2: For performance, the high ratios of EGR are not desired because of breakdown torque and power. Whereas, for NO and HC emissions were given good reduction when using high percentage of EGR. However, CO and CO<sub>2</sub> emissions were provided harm increment with high value of EGR.

## REFERENCES

- 1- Karagöz, Y, Güler, İ, Sandalcı, T., Yüksek, L., & Dalkılıç, A, S, Effect of hydrogen enrichment on combustion characteristics, emissions and performance of a diesel engine. *International Journal of Hydrogen Energy*, (2015)
- 2- Inventions. (2015). Who invented diesel engine?. Retrieved from [http://factbooks.blogspot.my/2007/09/who-invented-diesel-engine\\_07.html](http://factbooks.blogspot.my/2007/09/who-invented-diesel-engine_07.html)
- 3- Hannu Jääskeläinen, (2013). Early History of the Diesel Engine, [https://www.dieselnets.com/tech/diesel\\_history.php](https://www.dieselnets.com/tech/diesel_history.php) (14 October 2015).
- 4- Tang, D. (2014). Automobile exhaust pollution and purification methods
- 5- Walke, P., Deshpande, N., & Bodkhe, R. (2008). Impact of exhaust gas recirculation on the performances of diesel engine. *Proceedings of the World Congress on Engineering*,
- 6- Bowen, C. E. (1998). An experimental investigation into the use of exhaust gas recirculation for diesel engine NO<sub>x</sub> control University of Calgary.
- 7- Cengel, Y. A., Boles, M. A., & Kanoğlu, M. (2002). *Thermodynamics: An engineering approach* McGraw-Hill New York.
- 8- Abdullah, N. R. (2011). Effects of Split Injection and Exhaust Gas Recirculation Strategies on Combustion and Emissions Characteristics in a Modern V6 Diesel Engine.
- 9- Jothithirumal, B. & Jamesgunasekaran, E, Combined impact of biodiesel and exhaust gas recirculation on NO<sub>x</sub> emissions in DI diesel engines. *Procedia Engineering*, 38, 1457-1466, 2012
- 10- Zheng, M., Reader, G. T., & Hawley, J. G, Diesel engine exhaust gas recirculation—a review on advanced and novel concepts, *Energy Conversion and Management*, 45(6), 883-900, 2004.
- 11- Walke, P., Deshpande, N., & Bodkhe, R. (2008), Impact of exhaust gas recirculation on the performances of diesel engine. *Proceedings of the World Congress on Engineering*.
- 12- AA1Car.(2010).Exhaust.gas.recirculation-EGR, <http://Www.aa1car.com/library/egr.htm> (03 june 2015).
- 13- Hebbar, G. S., & Bhat, A. K. (2013b). Control of NO<sub>x</sub> from a DI diesel engine with hot EGR and ethanol fumigation: An experimental investigation. *International Journal of Automotive Technology*, 14(3), 333-341
- 14- Roy, S., Banerjee, R., & Bose, P. K. (2014). Performance and exhaust emissions prediction of a CRDI assisted single cylinder diesel engine coupled with EGR using artificial neural network. *Applied Energy*, 119, 330-340.

- 15- Vidal, J. (2013). Diesel fumes more damaging to health than petrol engines. *The Guardian*. Retrieved 5 June 2015.
- 16- Hamza Khalifa, Abdussalam Ali Ahmed, Ayiman Abusaediyah, Aejeeliyah Yousuf, Salheen Grimida, "GAS CHROMATOGRAPHY- MASS SPECTROMETRY (GC-MS) IN ORGANIC GEOCHEMICAL INVESTIGATION OF CRUDE OILS FROM KIKINDA AND VELEBIT FIELDS IN SERBIA", *International Journal of Research – GRANTHAALAYAH*, Vol.5 (Iss.6): June, 2017.
- 17- A. A. Ahmed, J. Santhosh and F. W. Aldbea, "Vehicle Dynamics Modeling and Simulation with Control Using Single Track Model," 2020 IEEE International Women in Engineering (WIE) Conference on Electrical and Computer Engineering (WIECON-ECE), 2020, pp. 1-4, doi: 10.1109/WIECON-ECE52138.2020.9397983.

## TRAFFIC CONGESTION AND EFFICIENT WAYS TO DEAL WITH IT IN TBILISI, GEORGIA

Nino Kacharava<sup>1</sup>, Natali Maisuradze<sup>2</sup>, Nia Iskandarova<sup>3</sup>

<sup>1</sup>San Diego State University Georgia, Civil Engineering, Undergrad, Tbilisi, Georgia.

<sup>2</sup>San Diego State University Georgia, Civil Engineering, Undergrad, Tbilisi, Georgia.

<sup>3</sup>San Diego State University Georgia, Civil Engineering, Undergrad, Tbilisi, Georgia.

### Abstract

Traffic Congestion has become a new version of plague for urbanized areas. Massive breakthroughs in technology, increasing in production of motorized cars, global reduction in prices for automobiles and the rapid population growth in Tbilisi, Georgia has led to the urgency of complete rearrangement of transportation system in the city.

As a post-Soviet Union country, Georgia has had rudiments like “Marshrutkas” (privately owned minibuses) as a primary mode of transportation. Serious research and actions started in 2019 when sustainable urban mobility plan was introduced in Tbilisi; which favors public transport and pedestrians. In the course of this project one of the main avenues was converted into complete street model and hourly parking was introduced in the city centers. However, the problem regarding traffic jams still stands. This paper contributes to analyzing current situation in Tbilisi and suggesting suitable solutions. It will cover how reversible lanes, road pricing, signalized Intersections, reserved bus lanes and parking can be adapted to Tbilisi in order to reduce traffic jams.

**Key Words:** traffic congestion, transportation systems, sustainable development, civil engineering.

### INTRODUCTION

The world has changed, evolved, and adjusted to the massive breakthroughs, mainly in technology. Transportation system is not an exception; mass production of motorized cars, reduction in prices for automobiles, increasing opportunities for middle-income families to purchase, and the rapid population growth in cities has led to a new version of plague for urbanized areas – traffic jams.

Traffic congestion is a process when the vehicles are in excess of the particular road space available. This is an ongoing and increasing issue in transportation, especially during the rapid urbanization and population growth in cities. Traffic jams cause serious problems apart from wasting time and money; it allows more air pollution, accounts for more carbon dioxide emission, causes stress and rage in passengers, and increases the chance of car collisions since the spacing between vehicles is minimized. In modern days traffic jam is a part of everyday life; the reason for it is the combination of drivers' lack of attention, miscalculations in road design, accidents, and peak hours. It is evident that traffic congestion has enormous scales and affects everyone worldwide. However, the main question is why people try to reduce it and what the consequences are if they fail to do so. Traffic jams impact the quality of life in multiple ways; Congestion affects mental health negatively, increases air and noise pollution, and on top of this is extremely expensive. It also alters economic productivity; reducing traffic jams is vital for the economy. It affects both private businesses and the government sector. Billions of trailers are delivering products to the destinations on the daily basis. Restaurants, stores, construction sites, cafes, malls, service centers, and manufacturing companies are all dependent



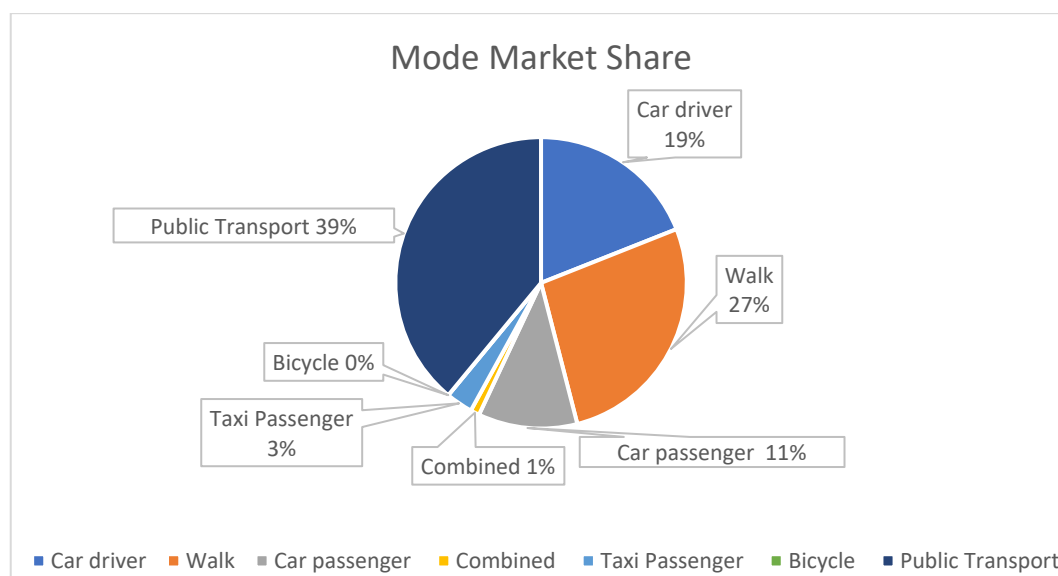
on timely distribution. If products are not delivered on time, in some cases it might cost from 100 GEL to even 1 000 000 GEL money losses per hour/day.

While traffic congestions have various reasons, Tbilisi is the victim of traffic jams by mainly two of them: social economic factors and conventional transport planning. The process of urbanization has played a vital role. Population of Tbilisi increased; consequently, the number of commuters escalated. People from villages come to the country's center to study or to work, both accumulating number of people that current transportation planning of Tbilisi cannot handle. Citizens' road destinations are rarely random; in normal cases, they travel to work, universities, shopping centers, theatres, cinemas, or amusement parks and above all they occupy roads at the same time period. Commuters do not analyze their decisions according to others' needs; they do not account for their mode of transport, departure time, or travel route to others'. As a result, the road chosen by many gets overexploited and congestion is inevitable. Tbilisi is a vivid illustration of congestions caused by the inefficiency of public transport systems. According to the 2015 Tbilisi Sustainable Urban Transportation (SUT) strategy, the city has 1,118,000 inhabitants, and the area is 616 km<sup>2</sup>. Even though Tbilisi had a well-operating transportation system in the 1960s, after the civil war of 1991, it changed completely. "Marshrutkas" became the primary mode of transportation; they were privately owned uncomfortable minibuses with doubtful sanitation (Siradze, 2018). Tbilisi Metro system opened in 1966 and nowadays it has 2 lines with 23 stations (total of 30.2 km). As public transport was not well developed and had no assigned schedule known to passengers, people preferred to save up for a private car instead. Consequently, having 1-2 cars per family got normalized in the middle-class, resulting in substantial traffic jams later. Accessibility of private cars are due to the American and Japanese websites used by most of Georgian population, where one can buy damaged cars and repair them in a much lower cost. Private cars almost never carry the amount of people it has a capacity to, usually it is a driver and a person next to them, thus it reduces the chances to the ideal situation – maximizing the efficiency of transportation. If a bus takes up more space than a car, it also carries 30 times more people. The figure below shows the number of public transports (a bus and a "marshrutka") and automobiles in the whole country and in Tbilisi in particular.

**Table 1.** Source: Ministry of internal affairs of Georgia

Quantity of Registered Vehicles (at the end of the year, in thousands)				
	Buses and "Marshrutkas" (Tbilisi)	Automobiles (Tbilisi)	Buses and "Marshrutkas" (Georgia)	Automobiles (Georgia)
2016	15.6	373.4	53.4	973.6
2018	15.3	411.5	53.8	1085.8
2020	15.7	439.1	54.5	1190.1

Poor development of public transportation and increased usage of private vehicles directly stimulates more congestions. Tbilisi Sustainable Urban Transport (SUT) strategy is a project created to redesign the transportation system in Tbilisi gradually, but completely. It was finalized in 2015 and implies multimodal approach. Its immediate actions were planned for 2017; 2021 year should have been the medium, and the long-term results will be seen in 2030. On the graph below it is visible the market shares according to the modes of transportation in Tbilisi, 2016. From the given data the city unarguably needs to take a new path towards more multimodal transportation system. Thus, the main goal of Tbilisi SUTs is to shift the focus from private cars to public transport and pedestrians' comfort by developing infrastructure for various modes of transportation.



**Figure 1.** Source: *Consulting Services for Organization of a Transportation Household Survey in Tbilisi Metropolitan Area*, Systra LLC.

Issues contributing to congestion in addition to already mentioned above are incorrect designs of urban roads and their maintenance. There are cases when even the traffic lanes are not marked accordingly, bus stops are designed in locations where the road is relatively narrow, or there are potholes on roads causing constraints. Unregulated parking also contributes to congestion; when the main arteries of the city do not provide enough number of dedicated parking spots, drivers have to leave their vehicles directly on the road, significantly interfering with the traffic flow. Thus, thorough examination is needed to assess the situation in Tbilisi and plan further steps on how to solve the on-going problem of traffic congestion in the city.

## METHODS

Based on the surveys mentioned below and the personal observation of the authors in the particular streets of Tbilisi, conclusions were made, which are discussed below.

## SOLUTIONS ALREADY APPLIED TO TBILISI, GEORGIA

### Automated Traffic Lights

The very first traffic light invented in 1868 in Britain was non-electronic. It used red and green gas lights to indicate stop and go, accordingly. Gradually, the technology evolved, and traffic lights became electronic. First traffic lights in Tbilisi, Georgia were installed in 1932, at the 2 major intersections – Shota Rustaveli ave. and Alexander Chavchavadze str, and Tamar Mepe ave. and Davit Agmashenebeli ave. Those traffic lights were electronic, and they were operated manually, by officers, based on their observation of traffic flows. Following the increasing rates of vehicle usage, control mechanisms at intersections have also been evolving and developing throughout the world.

Initially developed traffic lights were pretimed. In other words, a fixed-time signal plan was used, which implies a specific amount of time dedicated for each light. Those timing decisions were made based on man-made assessments of flow (Bretherton, 1990). Such technical decision is problematic in two ways: 1.average flow patterns change over the years, and 2.flow patterns change throughout a day (Mannering, Washburn, 1990). Not taking into account those 2 issues, leads to the even worse congestion problem, than had to be solved in the first place. In order to face these challenges, so called “smart traffic lights” were introduced.

Smart traffic lights provide optimal timing for each color of light, based on the current situation. They incorporate information obtained from several intersections and calculate the most

effective time-intervals for each color at each intersection. SCOOT (Split Cycle Offset Optimization Technique) is a system of such principle, used throughout the world since the early 1980s (Robertson, 1986).

The smart traffic light system consists of observational cameras, vehicle detector installed at the intersections, analyzing/calculating software in the computer, actual traffic lights receiving information from the software and portraying the light.

Such systems are based on CFP (cycling flow profiles), which shows average one-way flow through any chosen point during each part of the cycle of upstream signal (Robertson, 1986). SCOOT is capable of measuring CFP on its own in a live regime. Vehicle detectors installed throughout the city near intersections, measure traffic flow and send the data to the computer with analyzing software. Based on the flow profiles acquired from several intersections, the software calculates and transmits optimal timings to each traffic lights, for each color in live mode. The latest versions of smart traffic lights” are not only possible to measure the flow profile, but also predict the routes and create travelling patterns. Such predictions are made using the observational cameras.

“Smart traffic lights” were introduced in Tbilisi in 2010s and are gradually multiplying in the city since then. Until recently, the only features that Tbilisi traffic lights had were limited to the timer for the drivers and a “press and cross” button for the pedestrians at large crossroads. In 2020 the mayor of Tbilisi, Kakha Kaladze introduced a smart traffic system, which would be started to implement in the 2021. The system includes a network of smart traffic lights, observational cameras, and controllers throughout the whole city (Business Media Georgia, 2020). In 2021 the head of the transportation department of Tbilisi city hall stated that the project would start in the end of 2021 and in 3 years the city will be fully equipped with fully



**Figure 2.** Vehicle detectors installed next to the traffic lights at the intersections

smart transportation system (Business Media Georgia, 2021).

### Parking

It is impossible to utilize vehicle without the burden of finding a place to park it. Parking has been a serious issue, especially since the end of the 20th century, when the number of vehicles in the world has significantly increased. Uncontrolled parking can cause many serious problems, including a crucial contribution to congestion. Cars searching for a place to park takes about 30% of the whole traffic cycling in the city (Parking Network, n.d.). This means that about 1/3 of the whole number of vehicles “overwhelms” traffic just to find a place to park. Another issue is uncontrolled parking, which means that parked vehicles occupy lanes which can be utilized for permitting traffic. In order to reduce the contribution of parking, it is essential to make it controlled.

Parking is an acute challenge for the city of Tbilisi. After the collapse of Soviet Union, the urbanization degree of Tbilisi went and is still going up and up. At the same time, there exists no clear transportation strategy, that includes parking in particular; Until late 2010s city hall officials did not use proper parking strategy as a mean to manage congestion and encourage public transport usage over personal vehicles (Tbilisi SUTs, 2015). Until recently parking was free of charge anywhere in Tbilisi; sidewalks were and still are crowded by vehicles everywhere in the city. The study “Consulting Services for Organization of a Transportation Household Survey in Tbilisi Metropolitan Area” conducted in 2016 by Systra LLC shows, that 29%, almost



**Figure 3.** Source: *Consulting Services for Organization of a Transportation Household Survey in Tbilisi Metropolitan Area*, Systra LLC.

1/3 of drivers have problem of parking at work/study areas. The study also illustrated that 96% of all city parking is completely free at night.

As a response to the parking issue, Tbilisi City Hall introduced zonal hourly parking in 2019 (Municipal Services Development Agency, n.d). Before that the only parking strategy available in the city was annual ticket for 50 GEL, which allowed drivers to park practically anywhere anytime. Zonal hourly parking means that while parking at some specific zones, a driver must pay hourly for the lot. This parking strategy pricing is usually applied at busy, crowded streets, which would simply not be able to endure demand in case of charge-free parking. Since this type of parking is quite expensive to use for a whole day, it discourages e.g., employees to drive at work, or students to drive at universities with their private cars. Currently, hourly rate for category A vehicle is 1 GEL hour (first 15 minutes in 4 zones is free). Zonal hourly parking is free for the local residents (in 100m radius) and citizens with disabilities. The payment can be performed via mobile app, a paybox, or website (Tbilisi City Hall, 2020).

Another parking solution is underground parking. It frees up a significant amount of space, thus easing the burden of already crowded streets. Consequently, it provides more parking lots than zonal hourly parking is capable of. However, from financial point of view, it is much more difficult and expensive to implement, compared to the former, which should be taken into account when making financial decisions. As for Georgian experience, underground parking is mostly the case under large shopping malls or residential buildings. It was introduced in Georgia much earlier than hourly parking; thus, it is more familiar for the local population.

### Complete Street Model

While talking about congestion, it is crucial to understand that the problem can be translated into simple economic terms: demand is much higher than supply. The number of cars demanding a specific segment of a road at a specific time is much higher than the road is capable of offering. Considering this, incorporating different modes of mobility all together is a wise



solution. This is exactly what a complete street model is about. Complete street is a model which incorporates infrastructure for multiple types of transportation, including walking (Burlacu, 2012). In particular, complete street model includes wider sidewalks, crosswalks with pedestrian refuge islands, curb cuts and ramps, dedicated bus lanes and shelters, bike paths, center left turn lanes, lower traffic speed.

While old-school conventional planning was fully oriented on motor vehicles, and especially personal automobiles, comprehensive multi-modal planning suggests higher involvement of various means of relocation (Litman, 2015). Although conventional planning was oriented on reaching a destination as fast as possible, current reality shows that such radically straightforward approach is not a solution for contemporary challenges, considering the population and vehicle growth in the world (Litman, 2015). Besides, streets planned by conventional models often lack connectivity. This can be caused by an absence of elements such as bike lanes, pedestrian crosswalks, sidewalks, etc. Generally speaking, complete street model contributes to traffic congestion mitigation process in a way that this model is an optimal decision in terms of effective usage of the resources (Burlacu, 2012). It allows a street designed in a complete mode to move more people more effectively, compared to the same street designed in incomplete mode (Viriyincy, n.d.). Considering the distribution of all the modes of transport and some compromises made not in favor of private automobiles, average speeds of complete streets are relatively low (Litman, 2015). However, it is noteworthy that traffic efficiency is not only about high speeds. Moreover, considering the fact that average speeds at incomplete streets during peak hours are significantly lower than complete street speeds, and congestion is usually quite high scale, it is wiser to compromise and get a more stable, smooth flow.

From 2018 to 2020 one of the largest avenues of Tbilisi, Ilia Chavchavadze ave. was renovated and transformed into a complete street. All the elements of a complete street, including Reversed bus-lanes (for more effectiveness), Crosswalks with pedestrian islands, Bike paths, Ramps, Broad sidewalk were constructed and successfully commissioned.

### **Public Transportation**

According to the most recent study of Tbilisi transport mobility, conducted in 2016, the market share for public transport has decreased by almost 10% during the period of 2011-2016 with the contrast of increasing private car market share by 11%. Therefore, Tbilisi City Hall decided to begin the campaign towards the discouragement of private car ownership. As a result, in the course of Tbilisi Sustainable Urban Transport (SUT) strategy public transport development holds one of the major shares of the planned tasks.

In fact, since 2015, during immediate and medium phases of this multimodal strategy, development in the public transport sector is observable. There have been several major reforms. In 2016, old buses that were not able to provide satisfactory service were replaced by newly purchased modern busses. Additionally, during 2019-2021 dedicated bus lanes have been added to two of the most congested streets of the city. Both of them are also reversed bus lanes, which means that buses travel in the opposite direction of the flow. The total distance of added bus lanes is about 8km. Moreover, in 2021 existing “Marshrutkas” were renewed. In addition to providing better service to customers the new “Marshrutkas” are integrated in the central public transportation system along with metro and busses; they also utilize dedicated bus lanes and serve as a minibus that holds only 16 passengers.

Although it does not belong to the Tbilisi SUT strategy, when addressing advances in public transportation newly added metro station should be mentioned. Its design project dates back to 1985, however after on and off construction phases was finally finished and opened in 2017. It is a 2.6km addition to Tbilisi underground metro network (Tbilisi City Hall, 2015).

Unfortunately, no recent surveys have been found in order to analyze how these and other reforms discussed in the paper have improved the market share for public transportation. In



fact, the only mobility survey available was conducted in 2016 and it must be updated regularly in order to be able to define whether implemented solutions are effective or not.

## **WORLD PRACTICES THAT COULD BE INTRODUCED IN TBILISI, GEORGIA**

### **Reversible Lanes**

The directional demand on different roads and highways in urban areas is changing drastically throughout the day; in the morning, traffic jams are emerged because a major part of the city's workforce is rushing towards the business center, while directions to suburbs and/or residential areas are more congested and cause long delays during the evening hours. One commonly used practice for balancing directional demand depending on the period of the day is introducing reversible lanes or tidal flow as referred to by the World Road Association (n.d.). Other applications of reversible lanes include road maintenance works or vehicle accidents obstructing traffic flow. The working principle behind the reversible lanes is that specific roads permit vehicles to pass in one direction during the morning peak hours and operate in the opposite direction during evenings. With the goal of providing increased directional capacity, two-way roads could be transformed into one-way roads, the direction of vehicle movement could be reversed on single-way roads, or middle lanes could be “borrowed” from the non-peak direction.

While deciding between different solutions to traffic congestion problems real case studies could come in handy. One such case study on the implementation of reversible lane networks on several major arteries of Santiago, Chile, in 2001 (Bull, 2003) illustrates the extent of effectiveness of the tidal flow as a solution to provide increased capacity for directional peak-period flow. The average of 43% decrease in travel time was achieved with introducing reversible lanes.

However, switching directions needs to be conducted properly and carefully since it could cause confusion among drivers and could result into an increased number of car accidents, which not only becomes the source of the longer delays, but also endangers safety. Common practices for regulating traffic on reversible roads include the utilization of special signs indicating the current direction of the flow or operating with a predetermined schedule for convenience purposes (World Road Association, n.d.).

Directional peak hour demand is present in Tbilisi mainly on the roads that are connecting suburban areas to the city center. For example, Sheshelidze st. is one of the possible locations reversible lanes could be introduced. It is a 4-lane road, 2 lanes in one direction and 2 in the opposite, and most importantly it does not have a physical barrier separating the flow directions. Besides, the traditional purpose of regulating peak hour directional demand, reversible lanes could also be utilized in Tbilisi, Georgia for the sake of gathering data for mobility studies. For example, if major 2-way streets were transformed into a 1-way street throughout the entire day, the number of vehicles utilizing that road during morning and evening hours could be calculated. This data would then be useful for working on Tbilisi Sustainable Urban Transport Strategy and developing solutions to provide appropriate road capacity.

### **Road Pricing**

Roads are providing service for motorists by letting them transfer from one place to another; thus, it is only natural in the contemporary capitalist world to set a price for using them. Road pricing implies imposing fees for entering or circulating specific roads or networks of roads, especially during peak-hour periods when high demand on that particular area results in heavy congestion and extremely long delays. However, collecting the fees and effectively controlling the violations while not creating long queues with manual payments at gantries requires electronic solutions which are connected to tracking driver's locations, thus, raising privacy issues.

Regardless of the above-mentioned challenges, there are several practical methods for setting prices on roads successfully operating in different cities around the world. According to The Institute of Transportation and Development Policy (2016), the first road pricing scheme as a solution for controlling traffic flows was implemented in Singapore in 1975. At first, the manual system of Area Licensing Scheme (ALS) was introduced, which implied paying for a license that would grant the motorists access to specific roads controlled at monitoring units at the entrances. However, later Electronic Road Pricing (ERP) was implemented; this scheme operates on a cordon as well as point basis and charges different amounts of fee for utilizing different roads at varying times throughout the day. The working principle of ERP includes an in-vehicle unit with an integrated smart card that has to be installed in every vehicle (The Institute of Transportation and Development Policy, 2016). This unit receives information about the location of vehicle from satellite and automatically calculates the distance covered in the priced zone. The unit deducts appropriate amount of fee from the smart card and sends the transaction to central computer system via cellular communication. The system also has solution for controlling violations. Roadside cameras capture the images of every vehicle passing, sends the pictures of violators to the central system and immediately deletes all other images (Tan, 2013). Results of incorporating ALS and ERP systems in Singapore include a significant increase in the usage of public transportation, maintaining optimal speeds during peak-hour traffic flows, and reductions in carbon dioxide emissions.

Tbilisi, Georgia could use Singapore example and introduce road pricing to some of the most congested streets in the city-center. As Tbilisi becomes more and more congested with the number vehicles daily, implementing road pricing would discourage citizens from utilizing personal cars. Moreover, since Georgia is a developing country collecting funds for mobility plans and transportation system is also very crucial aspect to consider while deciding between solutions. Road pricing promises accumulation of budget for improvement of city's transportation network.

## RESULTS

Implementing Reversible lanes and Road Pricing will benefit the correct development of Tbilisi in terms of transportation.

## CONCLUSION

In conclusion this paper discusses traffic congestion problems and efficient ways to deal with it in Tbilisi, Georgia. It presents solutions already implemented in Tbilisi, such as complete street model, smart traffic light system, and parking. The paper illustrates reversible lanes and road pricing as possible solutions to be implemented. Noteworthy, Tbilisi is still a developing city and is actively working for bettering transportation systems. There is a lack of mobility studies in the city, the current most recent one is dated back to 2016. Since then, in the course of Tbilisi Sustainable Urban Transportation strategy many reforms have been taken for upgrading and repairing transportation system and its infrastructure. Consequently, updating existing mobility studies and initiating such surveys on the roads connecting city centers to the surrounding constantly evolving suburban areas are of crucial importance for evaluating existing solutions and adjusting them to the needs of citizens of Tbilisi.

## REFERENCES

- Tbilisi City Hall, (2015, July 28), *Construction of Metro station "University" has begun in Tbilisi*. Retrieved from <https://tbilisi.gov.ge/news/1361?lang=ge>
- Tan, Ch., (2013, November 13), *ERP II Tender May be Called in Early 2014*. Retrieved from <https://www.straitstimes.com/singapore/erp-ii-tender-may-be-called-in-early-2014>
- Bretherton R.D. (1989) *Scout Urban Traffic Control System-Philosophy and Evaluation*, Retrieved from <https://www.sciencedirect.com/science/article/pii/S1474667017526762>

- Burlacu A. (2012, November) Complete Streets Design Concept, Retrieved from [https://www.researchgate.net/publication/340394318\\_Complete\\_Streets\\_design\\_concept](https://www.researchgate.net/publication/340394318_Complete_Streets_design_concept)
- Business Media Georgia, August 12, 2020, “*Smart*” Transportation System to be implemented in Tbilisi, Retrieved from <https://bm.ge/ka/article/tbilisshi-chkviani-satransporto-sistema-dainergeba-/62008/>
- Giely J. M., December 2015, *Tbilisi Sustainable Urban Transport Strategy*, Retrieved from [http://mdf.org.ge/storage/assets/file/documents%202016/murtazi/Strategic%20Paper%20Report%20PDF%20Geo\(18\\_03\\_2016\)/Strategic%20Paper%20Report%20PDF%20Geo.pdf](http://mdf.org.ge/storage/assets/file/documents%202016/murtazi/Strategic%20Paper%20Report%20PDF%20Geo(18_03_2016)/Strategic%20Paper%20Report%20PDF%20Geo.pdf)
- Litman T. (2015, August 24) Evaluating Complete Streets, Victoria Transport Policy Institute. Retrieved from <https://vtpi.org/compstr.pdf>
- Municipal Services Development Agency, n.d., *Zonal Hourly Parking for Mobile Application*, Retrieved from [https://parking.tbilisi.gov.ge/assets/files/zonal\\_instructions/zonalur-saatobrivi%20parkireba\\_mobail.pdf](https://parking.tbilisi.gov.ge/assets/files/zonal_instructions/zonalur-saatobrivi%20parkireba_mobail.pdf)
- Robertson D. I., 1986, *Research on the TRANSYT and SCOOT Methods of Signal Coordination*, Retrieved from <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.417.7154&rep=rep1&type=pdf>
- Systra LLC, August 5, 2016, *Consulting Services for Organization of a Transportation Household Survey in Tbilisi Metropolitan Area*
- Bull A. (2003) *Traffic Congestion, the problem and how to deal with it*, United Nations Publication. Retrieved from [https://repositorio.cepal.org/bitstream/handle/11362/37898/1/LCG2199P\\_en.pdf](https://repositorio.cepal.org/bitstream/handle/11362/37898/1/LCG2199P_en.pdf)
- Siradze N. (2018, May 29) *Transportation and Smart Mobility Systems in Tbilisi*, Retrieved from <https://iglus.org/transportation-and-smart-mobility-systems-in-tbilisi/?fbclid=IwAR2Pv0cqAY6LtsOA7ZmOcVAAM8ehL19BjRCR7ZNiem20gXNZ5XOGparPQg>
- Steg L. (2003) *Can Public Transport compete with the private car?* Department of Psychology, University of Groningen, Groningen, The Netherlands Retrieved from [https://doi.org/10.1016/S0386-1112\(14\)60141-2](https://doi.org/10.1016/S0386-1112(14)60141-2)
- Highway Traffic Management*, (n.d.), Retrieved from <https://rno-its.piarc.org/en/network-control-traffic-management-traffic-control-measures/highway-traffic-management>
- Institute of Transportation Development Policy, (2016, May 18). *The Case of Electronic Road Pricing*. Retrieved from <https://development.asia/case-study/case-electronic-road-pricing>

## DETERMINATION OF THE RELATIONSHIP BETWEEN CYP1A1 T1101C (rs 1048943) GENE VARIATION AND SERUM COPPER LEVELS IN COLORECTAL CANCER PATIENTS

Assist. Prof. Dr. Arzu Ay<sup>1\*</sup>

<sup>1\*</sup>Trakya University, Faculty of Medicine, Department of Biophysics, Edirne, Turkey

ORCID Number: 0000-0002-8412-091X

### Abstract

Colorectal cancer is a neoplastic process that occurs in colon tissue. Colorectal cancer which affects the quality of life of individuals causes serious morbidity and mortality. Colorectal cancer is a multifactorial disease in which genetic and environmental factors play a role together. The CYP1A1 gene, one of the important members of the CYP1 enzyme family, participates in the activation of procarcinogens and thus plays an important role in susceptibility to various cancer types. The CYP1A1 gene is an effective gene in colorectal cancer susceptibility through various exogenous factors. Several genetic variations have been identified in the CYP1A1 gene which is localized on chromosome 15 (15q22.2-q24). Protein function alteration occur as a result of CYP1A1 T1101C (rs 1048943) gene variation. Trace elements are effective environmental factor in the pathogenesis of colorectal cancer. Trace elements play an important role in biological processes necessary for the fulfillment of functions such as antioxidant enzyme activity, cell division and differentiation. The effects of trace elements may vary depend on cancer types. Copper one of the trace elements is an effective trace element in antioxidant defense, protein synthesis and DNA repair. Imbalances in trace element levels such as copper have been associated with colorectal cancer development and progression. The aim of our study was to investigate the relationship between CYP1A1 T1101C (rs 1048943) gene variation and serum copper levels in patients with colorectal cancer. Our study was performed with patients diagnosed with colorectal cancer and healthy controls. CYP1A1 T1101C (rs 1048943) gene variation genotype distributions were determined using the Real-Time Polymerase Chain Reaction method. Measurement of serum copper levels was carried out by atomic absorption spectrophotometer method. In our study, serum copper levels were determined to be significantly higher in colorectal cancer patients carrying CT heterozygous and TT homozygous genotypes of the CYP1A1 T1101C (rs 1048943) gene variation compared to healthy controls ( $p < 0.05$ ). According to the results of our study, the evaluation of CYP1A1 T1101C (rs 1048943) gene variation and serum copper levels together is extremely important in terms of early diagnosis, development and progression of colorectal cancer.

**Keywords:** Colorectal cancer, CYP1A1 T1101C (rs 1048943) gene variation, trace elements levels, serum copper levels, Real-Time polymerase chain reaction, atomic absorption spectrophotometer

### INTRODUCTION

CRC is a multifactorial disease and is one of the main causes of morbidity and mortality. Genetic factors and environmental factors play a role together in the pathogenesis of CRC (Tavassoli et al., 2014; Buyukdogan et al., 2009; Kaya, 2008). CRC is recognized as a heterogeneous disease and is the second leading cause of death (Rašić et al., 2018). CRC has been reported as the leading cause of cancer-related death in the West, and the incidence of CRC has increased in Eastern and other Asian countries (Ribeiro et al., 2016; Sohrabi et al., 2018).

Cytochrome P450 (CYP) plays an important role in the pathogenesis of CRC. Cytochrome P450 is one of the Phase I enzymes and is effective in metabolizing endogenous and exogenous substances. It also plays a role as a catalyst in the oxidation of endogenous and exogenous compounds (Altunkol et al., 2018). Metabolic enzymes include Phase I and Phase II enzymes and these enzymes play a role in the activation and detoxification of xenobiotics that may be effective in the pathogenesis of CRC (Nebert, 1991). The CYP1 enzyme family consists of CYP1A1 and CYP1B1 enzymes. CYP1A1 is

one of the Phase I enzymes and plays a role in the activation of procarcinogens (Zhu et al., 2019). The human CYP1A1 gene is effective in activating procarcinogens and has been associated with genetic susceptibility to various types of cancer (Altunkol et al., 2018). Therefore, the CYP1A1 gene plays an important role in CRC susceptibility (Murtaugh et al., 2005; Wang et al., 2008).

The CYP1A1 gene is localised on chromosome 15 (15q22-q24) and various single nucleotide variations have been identified in the CYP1A1 gene (Zamanı and Yıldırım, 2014). CYP1A1 gene variations play an important role in predisposition to various types of cancer, such as colorectal cancer (Zhu et al., 2019; Naif et al., 2018; Ding et al., 2018). CYP1A1 T1101C (rs: 1048943) gene polymorphism is a polymorphism characterized by the nucleotide exchange of Adenine / Guanine (A/G). This alteration in codon 462 of the gene leads to the change of Ile-Val amino acid in exon 7 (Sivaraman et al., 1994). Various CYP450 isoforms are play role in activating the procarcinogens to carcinogens (Elfaki et al., 2018).

Trace elements are one of the environmental factors that play a role in the pathogenesis of CRC. Trace elements are effective in biological processes such as activation of antioxidant enzymes, cell division and cell differentiation. They also play an important role in cell stabilization, enzymatic and hormonal activities. Oxidative stress has been associated with the pathogenesis of CRC. Superoxide dismutase, glutathione peroxidase and lipid peroxidation products have been detected in cancer tissues related to trace element levels. Alterations in trace element levels have been associated with cell damage and mutagenesis. In addition, trace element levels may be affected as a result of carcinogenesis (Sohrabi et al., 2018).

Trace elements are effective in various metabolic pathways of cells and tissues, and excessive concentrations of trace elements have been associated with toxic damage. In addition, imbalances in trace element levels have been associated with the development and progression of various types of cancer, such as CRC (Cavusoglu et al., 2008; Cobanoglu et al., 2010). In some studies, the significant relationship has been determined between the development of various types of cancer such as colon cancer and copper trace element levels (Sohrabi et al., 2018). Cu absorbed in the duodenum is bound to proteins that act in a variety of biological activities such as the formation, maturation, stabilization of the connective tissues, and the structure of the extracellular matrix. It also participates in the detoxification of reactive oxygen species (Ribeiro et al., 2016).

A limited number of studies have been performed to determine the relationship between CYP1A1 gene variations or serum trace elements in CRC development. However, the studies have not been performed to investigate the relationship between genotype distributions of CYP1A1 T1101C (rs 1048943) gene variation and levels of serum Cu levels in CRC patients in Thrace population of Turkey. Thus, the aim of our study is to investigate the relationship between CYP1A1 T1101C (rs 1048943) gene variation genotype distributions and serum Cu levels in patients with CRC.

## **MATERIALS AND METHODS**

### **CRC Patient and Healthy Control Subjects**

Our study was carried out with 165 CRC patients and 171 healthy controls. The patient group consisted of patients diagnosed with CRC. The healthy control group consisted of healthy volunteers who were not diagnosed with colorectal cancer. Patients that have a history of malignancy or pregnant and breastfeeding women were excluded from our study.

### **DNA Isolation**

The patient with CRC and healthy control DNAs were isolated from peripheral blood containing Ethylenediaminetetraacetic Acid (EDTA). Invitrogen DNA blood kits were used for DNA isolation of patient with CRC and healthy control groups. Purity and quality for isolated DNAs' were determined with nanodrop spectrophotometer. The patient with CRC and healthy control DNA samples were checked by 0.8% agarose gel electrophoresis.



### Real Time Polymerase Chain Reaction method

Genotype distributions of CYP1A1 T1101C (rs 1048943) gene variation genotype distributions were determined between patients with CRC and healthy control groups by using Applied Biosystems 7500 fast Real-time PCR method. In real-time PCR, TaqMan SNP assay probes labeled with fluorochromes were used at the 5' and 3' ends.

### RT-PCR conditions for CYP1A1 T1101C (rs 1048943) gene variation:

<b>Initial</b>	60°C, 1 minutes	} 50 Cycle
	95°C, 10 minutes	
	92°C, 15 seconds	
	60°C, 90 seconds	
	Reading	
<b>Termination</b>	60°C, 1 minutes	

### Determination of CuTrace Element Levels

Trace element levels measurements were performed in Trakya University Faculty of Medicine Department of Biophysics. For serum trace element level measurements, blood obtained from patients with CRC and from healthy control groups were centrifuged at 5000 rpm for 5 minutes and serum was obtained from the blood. Distilled water was added to the obtained serum samples and total volume was completed of 7 ml. In addition, Standard solutions of 0.5, 1, 1.5, 2, 2.5 ppm (mg / l) were prepared for Cu trace element Cu levels were measured by Atomic Absorption Spectrophotometer (Shimadzu AA-6800). Concentration-calibration curve was drawn according to Cu trace element standards.

### Statistical analysis

Student's t test was used to compare age and body mass index values between CRC patient and control groups. Chi-square (Pearson, Yates) test was used (As applicable Fisher's test) to comparison of categorical variables (family history of cancer, hypertension, diabetes mellitus, cholesterol, smoking and alcohol). The comparison of CYP1A1 T1101C (rs 1048943) gene variation genotype distributions according to Cu levels was carried out by Mann Whitney U test. The results were expressed as number (percentage) or mean  $\pm$  standard deviation. Statistical significance was accepted as  $p < 0.05$ . The statistical analysis of the data obtained in our study was performed using SPSS 20.0 (Statistics Package of Social Science) statistical program.

## RESULTS

In our study, the significant difference was determined between CRC patient and control groups in terms of age, body mass index (BMI) variables, family history of cancer, diabetes mellitus, hypertension, smoking and alcohol variables ( $p < 0.05$ ). The significant difference was not determined between patient and control groups in terms of cholesterol ( $p > 0.05$ ) (Table 1).

**Table 1.** Clinical parameters of patient and control groups

Patient and control parameters	Patient Group (n=165)	Control Group (n=171)	p
Age	57,40 $\pm$ 9,78	52,10 $\pm$ 9,15	<0,001 <sup>a*</sup>
Body Mass Index (kg/m <sup>2</sup> )	27,00 $\pm$ 5,23	28,97 $\pm$ 4,96	<0,001 <sup>a*</sup>
Familial history of cancer	(23,0%)	(14,6%)	0,048 <sup>b*</sup>
Diabetes Mellitus	(15,2%)	(8,2%)	0,046 <sup>b*</sup>
Hypertension	(29,1%)	(18,7%)	0,026 <sup>b*</sup>
Cholesterol	(10,9%)	(8,8%)	0,510 <sup>b</sup>
Smoking	(44,2%)	(36,8%)	<0,001 <sup>b*</sup>
Alcohol	(41,2%)	(32,2%)	<0,001 <sup>b*</sup>

<sup>a</sup> Student's t test

<sup>b</sup>Chi-square

\*: Significance

In our study, serum Cu levels were found to be significantly higher in colorectal cancer patients carrying the TT homozygous and CT heterozygous genotypes of the CYP1A1 T1101C (rs 1048943) gene variation compared to healthy controls with the same genotypes ( $p < 0.05$ ) (Table 2). The CC homozygous genotype of the CYP1A1 T1101C (rs 1048943) gene variation was not observed.

**Table 2.** Comparison of CYP1A1 T1101C (rs 1048943) gene variation genotype distributions and serum Cu levels

CYP1A1 T1101C (rs 1048943)	Genotype Distributions	Trace Elements	Patient Group	Control Group	p
	CT	Cu (ng/ml)	181,35 ± 41,67	128,41 ± 38,25	0,009 <sup>a*</sup>
	TT	Cu (ng/ml)	185,89 ± 49,58	132,59 ± 32,96	<0,001 <sup>a*</sup>

<sup>a</sup>Mann Whitney U test; \*: Significance

CC: Cytosine-Cytosine; CT: Cytosine-Thymine; TT: Thymine- Thymine; Cu: Copper

## DISCUSSION

The development and pathogenesis of CRC has not been fully elucidated, but genetic factors such as gene variations and environmental factors such as trace elements play together a role in CRC parogenesis (Ferlay et al., 2010; Cunningham et al., 2010; Markowitz et al., 2009; Fearon et al., 2011). In a study performed with Japan population, CYP1A1 (rs 4646903) and CYP1A1 (rs 1048943) gene variations have not been associated with CRC development (Hamachi et al., 2013). In studies performed in a population in California, CYP1A1 gene variation has not been associated with colon and rectum cancer (Slattery et al., 2004). In a study carried out with Caucasian population, the effect of CYP1A1 gene variation has not been proven in CRC patients who were smokers or consuming red meat (Ishibe et al., 2000). In a study carried out with Scotland population, the significant was not determined relationship between CYP1A1 gene variation and CRC development (Little et al., 2006). In a study performed with Japan population, CYP1A1 (rs 4646903) and CYP1A1 (rs 1048943) gene variations have been associated with CRC development (Nisa et al., 2010). In the studies comparing phase I and phase II metabolism enzyme variations, carcinogenic effects of aromatic amine metabolism of CYP1A1 genes have been determined in patients with CRC (Landi et al., 2005). In various studies, the combinations of gene variations have been examined and results have been reported that do not overlap with each other in different populations. There are not many studies performed to investigate colorectal cancer development and CYP1A1 gene variations. However, the relationship between the various types of cancer and the CYP1A1 gene variations was investigated and different results were obtained in different populations. In a study performed with an Iraqi population, the C and G alleles of CYP1A1m1 (T6235C) and CYP1A1m2 (A4889G) gene variations have been determined as genetic risk factors for breast cancer development in women (Naif et al., 2018). In a meta-analysis study performed with cervical cancer patients, the C allele of CYP1A1 MspI variation and Val allele of Ile462Val variation have been associated with risk of development of the cervical cancer (Ding et al., 2018). In another meta-analysis study performed with prostate cancer patients, the variations of rs1048943 and rs4646903 of the CYP1A1 gene have been determined as genetic risk factors for the development of prostate cancer (Zhu et al., 2019). In a study performed with Turkish population, the significant relationship was determined between risk of bladder cancer development and CT genotype of CYP1A1 c.\*1189T> C gene variation (Altunkol et al., 2018).

Taking inadequate or excessive amounts of trace elements that regulate cell transplantation and gene expression, which are effective in the regulation of various biological events in organism, can affect the development of various types of cancer such as CRC by impairing body resistance (Hamachi et al., 2013; Sarmis, 2010; Ekmekci et al., 2008).

According to literature published in the last decade, impaired copper levels may play an important role in the mechanism responsible for uncontrolled cellular growth. In a study, the alterations in the concentrations of Cu trace element may play a role in the malignant transformation of the normal colonic mucosa (Sohrabi et al., 2018).

In a study performed with Iraq, population, the significant difference was determined in terms of copper trace element levels between healthy controls and patients with colorectal cancer. It was emphasized that copper and zinc levels may show prognostic significance in complex diseases such as colon cancer. In a study performed with Turkish population, an increased Cu levels were observed in the patient group with CRC. In another study, the significant increase in total Cu concentration was determined in patients with chest, lung, gastrointestinal system, gynecologic cancer. Also, the significant difference was detected between near and distant organ metastases and Cu concentrations in the gastrointestinal tract in this study (Lanzkowsky, 2000).

In our study, serum Cu levels were found to be significantly higher in colorectal cancer patients carrying the TT homozygous and CT heterozygous genotypes of the CYP1A1 T1101C (rs 1048943) gene variation compared to healthy controls with the same genotypes ( $p < 0.05$ ). The CC homozygous genotype of the CYP1A1 T1101C (rs 1048943) gene variation was not observed.

## CONCLUSION

Several limited studies were performed in terms of relationship between CYP1A1 gene variations and CRC development risk. Studies have also been performed to investigate the relationship between trace elements and development of CRC. Different results were obtained in these studies which were carried out with different races and populations. In our study, serum Cu levels were found to be significantly higher in colorectal cancer patients carrying the TT homozygous and CT heterozygous genotypes of the CYP1A1 T1101C (rs 1048943) gene variation compared to healthy controls with the same genotypes. Also, it is thought that evaluating the relationship between CYP1A1 gene variations and trace element levels in patients with cancer risk such as CRC may contribute to early diagnosis and progression of the CRC disease. In our study, it was concluded that the evaluation of CYP1A1 gene variations and serum trace element levels parameters together in cancer development such as CRC is extremely important in terms of CRC diagnosis, prognosis and progression.

## Acknowledgements

Our study was carried out in Trakya University Faculty of Medicine, Department of Biophysics, Department of Medical Oncology and Department of Radiation Oncology.

## Conflict of interest

The authors declare that they have no conflict of interest.

## Funding

This study was supported by the Trakya University Scientific Research Commission (TUBAP) with the project number 2013/14.

## REFERENCES

- Altunkol A, Savaş M, Dilmeç F, Utangaç MM, Abat D, Gümüş K, Karlıdağ İ, Yeni E 2018. Detection of CYP1A1 and GSTP1 gene polymorphisms in bladder cancer patients in a Turkish population using a polymerase chain reaction-restriction fragment length polymorphism method. *Turk J Urol*, 44(2):125-131. doi: 10.5152/tud.2018.23571.
- Buyukdogan M, Boruban MC, Artac M et al 2009. Frequency of cytochrome 450 (CYP2C9 and CYP2C19) genetic polymorphisms in patients with colorectal carcinoma. *International Journal of Hematology & Oncology*, 19(3):134-139.

- Cavusoglu K, Cakir AS, Kurtman C et al 2008. The determination of alteration in plasma trace element levels of patients with lung cancer received radiotherapy. *Firat University Medical Journal of Health Sciences*, 22(4):211-222.
- Cobanoglu U, Demir H, Sayir F, Duran M, Mergan D 2010. Some mineral, trace element and heavy metal concentrations in lung cancer. *Asian Pac J Cancer Prev*, 11(5):1383-1388.
- Cunningham D, Atkin W, Lenz HJ, Lynch HT, Minsky B, Nordlinger B, Starling N 2010. Colorectal cancer. *Lancet*, 375(9719):1030-47. doi: 10.1016/S0140-6736(10)60353-4.
- Ding B, Sun W, Han S, Cai Y, Ren M, Shen Y 2018. Cytochrome P450 1A1 gene polymorphisms and cervical cancer risk: A systematic review and meta-analysis. *Medicine (Baltimore)*, 97(13):e0210. doi: 10.1097/MD.00000000000010210.
- Elfaki I, Mir R, Almutairi FM, Duhier FMA 2018. Cytochrome P450: Polymorphisms and Roles in Cancer, Diabetes and Atherosclerosis. *Asian Pac J Cancer Prev*, 19(8):2057-2070. doi: 10.22034/APJCP.2018.19.8.2057.
- Ekmekci A, Konac E, Onen HI 2008. Gene polymorphism and genetic susceptibility to cancer. *Marmara Medical Journal*, 21(3):282-295.
- Fearon ER (2011). Molecular genetics of colorectal cancer. *Annu Rev Pathol*, 6:479-507. doi: 10.1146/annurev-pathol-011110-130235. PMID: 21090969.
- Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM 2010. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *Int J Cancer*, 127(12):2893-2917. doi: 10.1002/ijc.25516.
- Hamachi T, Tajima O, Uezono K, Tabata S, Abe H, Ohnaka K, Kono S 2013. CYP1A1, GSTM1, GSTT1 and NQO1 polymorphisms and colorectal adenomas in Japanese men. *World J Gastroenterol*, 19(25):4023-4030. doi: 10.3748/wjg.v19.i25.4023.
- Ishibe N, Stampfer M, Hunter DJ, Hennekens C, Kelsey KT 2000. A prospective study of cytochrome P450 1A1 polymorphisms and colorectal cancer risk in men. *Cancer Epidemiol Biomarkers Prev*, 9(8):855-856.
- Kaya S 2008. Kolorektal kanserli hastalarda survivin ekspresyonunun sağkalım ve histopatolojik değişkenlerle ilişkisi [Relation of survivin expression to survival and histopathological variables in colorectal cancer patients]. Dissertation, Istanbul: Kartal Dr. Lutfi Kırdar Training and Research Hospital Internal Medicine Clinic.
- Landi S, Gemignani F, Moreno V, Gioia-Patricola L, Chabrier A, Guino E, Navarro M, de Oca J, Capellà G, Canzian F; Bellvitge Colorectal Cancer Study Group 2005. A comprehensive analysis of phase I and phase II metabolism gene polymorphisms and risk of colorectal cancer. *Pharmacogenet Genomics*, 15(8):535-46. doi: 10.1097/01.fpc.0000165904.48994.3d.
- Lanzkowsky P (2000) Iron-deficiency anemia. *Manual of Pediatric Hematology and Oncology* 3rd edition. USA: Academic Press; 33–47.
- Little J, Sharp L, Masson LF, Brockton NT, Cotton SC, Haites NE, Cassidy J 2006. Colorectal cancer and genetic polymorphisms of CYP1A1, GSTM1 and GSTT1: a case-control study in the Grampian region of Scotland. *Int J Cancer*, 119(9):2155-2164. doi: 10.1002/ijc.22093.
- Markowitz SD, Bertagnolli MM 2009. Molecular origins of cancer: Molecular basis of colorectal cancer. *The New England journal of medicine*, 361(25):2449-2460.
- Murtaugh MA, Sweeney C, Ma KN, Caan BJ, Slattery ML 2005. The CYP1A1 genotype may alter the association of meat consumption patterns and preparation with the risk of colorectal cancer in men and women. *J Nutr*, 135(2):179-186. doi: 10.1093/jn/135.2.179.
- Naif HM, Al-Obaide MAI, Hassani HH, Hamdan AS, Kalaf ZS 2018. Association of Cytochrome CYP1A1 Gene Polymorphisms and Tobacco Smoking with the Risk of Breast Cancer in Women From Iraq. *Front Public Health*, 6:96. doi:10.3389/fpubh.2018.00096.
- Nebert DW 1991. Role of genetics and drug metabolism in human cancer risk. *Mutat Res*, 247(2):267-281. doi: 10.1016/0027-5107(91)90022-g.
- Nisa H, Kono S, Yin G, Toyomura K, Nagano J, Mibu R, Tanaka M, Kakeji Y, Maehara Y, Okamura T, Ikejiri K, Futami K, Maekawa T, Yasunami Y, Takenaka K, Ichimiya H, Terasaka R 2010. Cigarette smoking, genetic polymorphisms and colorectal cancer risk: the Fukuoka Colorectal Cancer Study. *BMC Cancer*, 10:274. doi: 10.1186/1471-2407-10-274.

- Rašić I, Rašić A, Akšamija G, Radović S 2018. The relationship between serum level of malondialdehyde and progression of colorectal cancer. *Acta Clin Croat*, 57(3):411-416. doi:10.20471/acc.2018.57.03.02.
- Ribeiro SM, Moya AM, Braga CB, Domenici FA, Feitosa MR, Feres O, Rocha JJ, Cunha SF 2016. Copper-Zinc ratio and nutritional status in colorectal cancer patients during the perioperative period. *Acta Cir Bras*, 1:24-28. doi: 10.1590/S0102-86502016001300006.
- Sarmis S 2010. Endometrium, over ve serviks kanser tanısı alan ve almayan kadınlarda risk faktörlerinin belirlenmesi [Determination of risk factors for women with and without endometrium, over and cervical cancer diagnosis]. Dissertion, University of Yakın Dogu.
- Sivaraman L, Leatham MP, Yee J, Wilkens LR, Lau AF, Le Marchand L 1994. CYP1A1 genetic polymorphisms and in situ colorectal cancer. *Cancer Res*, 54(14):3692-5.
- Slattey ML, Samowitz W, Ma K, Murtaugh M, Sweeney C, Levin TR, Neuhausen S 2004. CYP1A1, cigarette smoking, and colon and rectal cancer. *Am J Epidemiol*, 160(9):842-852. doi: 10.1093/aje/kwh298.
- Sohrabi M, Gholami A, Azar MH, Yaghoobi M, Shahi MM, Shirmardi S, Nikkhah M, Kohi Z, Salehpour D, Khoonsari MR, Hemmasi G, Zamani F, Sohrabi M, Ajdarkosh H 2018. Trace Element and Heavy Metal Levels in Colorectal Cancer: Comparison Between Cancerous and Non-cancerous Tissues. *Biol Trace Elem Res*, 183(1):1-8. doi: 10.1007/s12011-017-1099-7.
- Tavassoli E, Reisi M, Javadzad SH, Gharli Pour Z, Gilasi HR, Ghasemi S, Hafez AA 2014. The effect of education on the improvement of fruits and vegetables consumption aiming to preventing colorectal cancer. *Gastroenterol Hepatol Bed Bench*, 7(2):94-100.
- Wang S, Chanock S, Tang D, Li Z, Jedrychowski W, Perera FP 2008. Assessment of interactions between PAH exposure and genetic polymorphisms on PAH-DNA adducts in African American, Dominican, and Caucasian mothers and newborns. *Cancer Epidemiol Biomarkers Prev*, 17(2):405-413. doi: 10.1158/1055-9965.EPI-07-0695.
- Zamanı AG, Yıldırım A 2014. Evaluation of Cytochrome P450 Expression as a Biomarker. *Tıp Araştırmaları Dergisi (Medical Research Journal)*, 12(1):37-42.
- Zhu W, Liu H, Wang X, Lu J, Zhang H, Wang S, Yang W. 2019. Associations of CYP1 polymorphisms with risk of prostate cancer: an updated meta-analysis. *Biosci Rep*, 39(3):BSR20181876. doi: 10.1042/BSR20181876.



## TO THE INTERNAL STRUCTURE OF THE FACIAL NERVE

KERIMZADE G.E.

*Department of Human Anatomy and Medical Terminology, Azerbaijan Medical University,  
Baku, Azerbaijan*

### Abstract

The structural organization of the facial nerve in the age aspect has not received sufficient reflection in the scientific literature. Scientifically, further comprehensive studies of the external structure and structural organization is needed, both of the main trunk of this nerve, and of its individual branches, which are the conductor link of innervation. We conducted a study of the external structure and myeloarchitectonics of the nerves of mimic muscles in different age groups. The objects were the trunk and branches of the facial nerve. Pieces of nerves were removed from human corpses of different age periods, starting from prenatal ontogenesis and up to the old age of the postnatal period. The branches of the facial nerve at the stages of ontogenesis are a complex complex composed of myelin fibers and auxiliary components. In the early period of prenatal ontogenesis, there are mainly low myelinated and fine myelin fibers. Early myelination of the studied nerve is noted. At the subsequent stages of the postnatal period, further differentiation of myelin fibers occurs, an increase in the quantitative and qualitative indicators of myelin conductors occurs, their ratio changes, and a shift occurs in favor of medium and thick myelin fibers. In the elderly and senile age, due to involutive processes, the number of myelin conductors in all branches of the facial nerve decreases. Based on the data obtained, it follows that the myelin component of the branches of the facial nerve at all stages of ontogenesis is subject to dynamic variability. For animal branches, the characteristic spectrum of myelin fibers was medium and large caliber fibers. The presence of a large number of myelinated nerve fibers of medium and large diameter in the branches of the facial nerve, undoubtedly, provide physiological parameters for the conduction of impulses along the nerve fiber, which are necessary for rapid reactions of facial muscles.

**Key words:** facial nerve, myeloarchitectonics, myelin fibers.

### INTRODUCTION

The developing neurology, neurosurgery makes requests of morphologists and physiologists for further detailed studies of the nervous apparatus of various areas and organs. In the literature, issues related to the study of the intra-trunk structure of peripheral nerves are widely covered [1,3,4]. However, the structural organization of the facial nerve in the age aspect has not received sufficient reflection in the scientific literature [2,6]. In scientific terms, further comprehensive studies of the external structure and structural organization of both the main trunk of the facial nerve and its individual branches, which are the conductor link of the innervation of facial muscles, are necessary.

Using a complex of macromicroscopic methods, a study of the external structure and myeloarchitectonics of the nerves of mimic muscles in different age groups was carried out.

### MATERIAL AND METHODS.

The objects were the trunk and branches of the facial nerve. Pieces of nerves were removed from human corpses of different age periods, starting from prenatal ontogenesis and up to senile age of the postnatal period. The total number of nerves was 64. To accomplish the assigned tasks, a complex of anatomical and histological methods, conventional and fine

preparation according to Vorobiev were used. In microscopic examination, the methods of transverse sections of nerves were used with subsequent staining according to Weigert-Pal and Krutsai.

## RESULTS.

The branches of the facial nerve at the stages of ontogenesis are a complex complex composed of myelin fibers and auxiliary components. In the early period of prenatal ontogenesis, there are mainly low myelinated and fine myelin fibers. Early myelination of the studied animal nerves is noted. So, in three-, four-month-old fetuses, the first myelin fibers appear. By the end of the prenatal and early postnatal period, the level of myelinated fibers increases, on average, the total number of myelin fibers in a newborn is 2650, which is 35-45% compared to the first adult period. In these age groups, they are mainly represented by small and medium-sized varieties. The thickness of the epineurial membrane in a newborn and in early childhood varies from 45 to 65 microns. The number of bundles in the middle part of the nerve is 6-10 with a tendency to increase towards the muscles innervated by them. Each is surrounded by a perineurium, with an average thickness of 14.5 mkm. In the facial nerve, myelinated nerve fibers are the main structural elements of the nerve trunk. A slightly lower percentage of myelin fibers on the left. In absolute terms, the total number of all myelin nerve fibers in the right facial nerve is  $5982.5 \pm 413.1$ , in the left  $5277.3 \pm 513.5$ . At the same time, the vast majority of myelinated nerve fibers belong to medium and large nerve fibers. Very large nerve fibers are dissipated among medium and large myelinated nerve fibers. Occasionally they form small clusters of medium or small bundles. At the subsequent stages of the postnatal period, further differentiation of myelin fibers occurs, an increase in the quantitative and qualitative indicators of myelin conductors occurs, their ratio changes, and a shift occurs in favor of medium and thick myelin fibers. In the elderly and senile age, due to involutive processes, the number of myelin conductors in all branches of the facial nerve decreases.

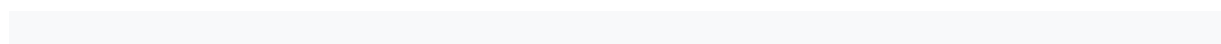
## CONCLUSIONS.

The asymmetry of the branches of the facial nerve manifests itself at the macro- and microscopic levels. Macroscopically traced the appearance of additional nerve branches, which can be connected both with each other to form small- and large-loop extramuscular plexuses, and with the surrounding nerves, in particular with the first branch of the trigeminal nerve. Based on the data obtained, it follows that the myelin component of the branches of the facial nerves at all stages of ontogenesis is subject to dynamic inconstancy. For animal branches, the characteristic spectrum of myelin fibers was medium and large caliber fibers. The presence of a large number of myelinated nerve fibers of medium and large diameter in the branches of the facial nerve undoubtedly provides the physiological parameters for the conduction of impulses along the nerve fiber, which are necessary for the rapid reactions of facial muscles.

## REFERENCES

1. Gaivoronsky I.V., Dubovik E.I., Kraynik I.V. Morphometric indicators of the asymmetry of the facial skull of an adult // Morphology, 2009, v.135, v.2, pp.74-79
2. Shadlinsky V.B., Askerov R.A. and other Structural and informational analysis of some peripheral nerves in terms of age / Materials of the scientific conference, dedicated. To the 100th anniversary of the birth of A.S. Hasanov. Baku: Tebib, 2000, p. 144-145
3. Lowe J., Cohen M., Hunter D., Mackinnon S. Analysis of the nerve branches to the

- orbicularis oculi muscle of the lower eyelid in fresh cadavers // Plast. Reconstr. Surg. - 2005, v. 116. -No 6. - P.1743-1749
4. Mavrikakis I. Facial nerve palsy: anatomy, etiology, evaluation, and management // Orbit. - 2008, v. 27 - No 6. P. 466-474
  5. Salinas N., Jackson O., Dunham B., Bartlett S. Anatomical dissection and modified Sihler stain of the lower branches of the facial nerve // Plast. Reconstr. Surg., 2009, v. 124, No 6, p.1905-1915
  6. Wang R., Barber A., Ditmyer M., Vantine P. Distal facial nerve exposure: a key to partial parotidectomy // Otolaryngol. Head. Neck. Surg., 2009, v. 140, No 6, p.875-879



















## INVESTIGATION OF PLASMA TOTAL HOMOCYSTEINE LEVELS IN ISCHEMIC STROKE PATIENTS AND PATIENT SUBGROUPS

Assist. Prof. Dr. Nevra Alkanli<sup>1\*</sup>, Assist. Prof. Dr. Alev Bakir<sup>2</sup>

<sup>1\*</sup>*Haliç University, Faculty of Medicine, Department of Biophysics, Istanbul, Turkey*

<sup>2</sup>*Haliç University, Faculty of Medicine, Department of Biostatistics and Medical Informatics, Istanbul, Turkey*

ORCID Number: 0000-0002-3745-8838

ORCID Number: 0000-0003-0664-5822

### Abstract

Ischemic stroke occurs focal or global as a result of obstruction of blood flow in any region of the brain. Ischemic stroke is classified by TOAST in five subgroups as large vessel disease, small vessel disease, cardioembolic, cryptogenic and other unclassified ischemic stroke. Homocysteine plays an important role in metabolic pathways of thiol compounds. Total homocysteine levels in blood plasma are classified into four groups. 5-15  $\mu\text{mol/L}$  values are considered as normal, 15-30  $\mu\text{mol/L}$  values are considered as middle, 30-100  $\mu\text{mol/L}$  values are considered as interval and above 100  $\mu\text{mol/L}$  values are considered as severe. Hyperhomocysteinemia may develop as a result of genetic disorders in metabolism, chronic diseases, vitamin deficiencies and nutritional disorders, individual differences, and various drugs. The aim of our study is to investigate plasma total homocysteine levels in ischemic stroke patients and ischemic stroke patient subgroups selected from the Thrace region population. Our study consists of ischemic stroke patient group and healthy control group. The patient group is classified into five subgroups. Peripheral venous bloods containing ethylenediaminetetraacetic acid of ischemic stroke patients and healthy control groups was centrifuged at 4000xg for 10 minutes. Plasma of centrifuged blood was separated and stored at  $-86^{\circ}\text{C}$ . Plasma total homocysteine levels were measured using the Immulite 2000XPi homocysteine kit for ischemic stroke patients and healthy control groups. Measurements of plasma total homocysteine levels were carried out in Trakya University Faculty of Medicine, Department of Biochemistry Central Laboratory. The significant difference was not determined in terms of plasma total homocysteine levels between ischemic stroke patients and control groups ( $p>0.05$ ). The significant difference was determined between ischemic stroke patient subgroups in terms of plasma total homocysteine levels ( $p<0.05$ ). The significant difference was not determined between the ischemic stroke patients and control groups in the comparison of normal, middle and interval homocysteine levels ( $p>0.05$ ). However, the significant difference was detected in the comparison of normal, middle and interval homocysteine levels in ischemic stroke patient subgroups ( $p<0.05$ ). Based on the results of our study, hyperhomocysteinemia is considered as an important risk factor for ischemic stroke subgroups and especially small vessel disease subgroup selected from the Thrace population and classified in subgroups.

**Keywords:** Cerebrovascular diseases, ischemic stroke, ischemic stroke subgroups, plasma total homocysteine levels, hyperhomocysteinemia

### INTRODUCTION

Cerebrovascular diseases (CVD) are sudden onset focal or global neurological symptoms and occur due to ischemia or hemorrhage in cerebral tissue (Alkanli et al., 2017). Ischemic stroke, one of the CVDs, accounts for approximately 85% of all strokes. Ischemic stroke, known as one of the most important causes of morbidity and mortality worldwide, is characterized by a high incidence (Zhang et al., 2020). Large vessel disease, small vessel disease and cardioembolism can cause brain tissue

ischemia, and these ischemic stroke subtypes have different pathogenesis mechanisms. Pathogenesis in the great cerebral arteries has been associated with atherothrombosis of the carotid, vertebral and proximal cerebral arteries. Small vessel disease pathogenesis has been associated with lacunar infarction in the brain. Cardioembolism may develop as a result of embolic thrombus. Cerebral blood flow decreases and cell damage occurs as a result of these pathogenesis mechanisms. Besides these ischemic stroke subtypes, the cryptogenic ischemic stroke subtype has been associated with hematological disorders. The other unclassified ischemic stroke subtype represents 5% of all ischemic strokes (Alkanli et al., 2017). Ischemic stroke may occur as a result of multifactorial pathogenesis of atherosclerosis, cardioembolic stroke, large vessel disease, small vessel disease subgroups (Larsson et al., 2019). Homocysteine is a sulfur-containing amino acid produced during the metabolism of methionine. Homocysteine is effective in metabolic pathways of thiol compounds (Alkanli et al., 2017). Homocysteine is also recognized as a prothrombotic factor that can affect coagulation and fibrinolytic cascades. Homocysteine can cause endothelial damage through toxicity and apoptosis. Thus, endothelium-dependent dilatation of blood vessels may be impaired and endothelial dysfunction may occur (Omer Sultan et al., 2020). Excessive homocysteine can inhibit DNA synthesis and alter the expression of proteins that regulate the endothelial reticulum stress response (Gungor et al., 2018). Plasma total homocysteine levels are classified into four groups. Values of 5-15  $\mu\text{mol/L}$  are considered normal plasma total homocysteine levels. Values of 15-30  $\mu\text{mol/L}$  are considered moderate, values of 30-100  $\mu\text{mol/L}$  are considered high, and values above 100  $\mu\text{mol/L}$  are considered severe. Due to the decrease in total plasma concentration in women dependent on estrogen, higher plasma total homocysteine levels are detected in men than in women and increase with age. Hyperhomocysteinemia is considered an important risk factor for ischemic stroke. Factors such as metabolic and chronic diseases, vitamin deficiency, genetic nutritional disorders, and various drugs have been associated with hyperhomocysteinemia (Alkanli et al., 2017). Hypertension, diabetes mellitus, smoking and hyperhomocysteinemia are important risk factors for cardiovascular diseases and CVD. As a result of metabolic disorders of homocysteine, high homocysteine levels have been associated with hypertension, myocardial infarction, peripheral arterial occlusive disease, hemorrhagic and ischemic stroke. Various studies have been performed to investigate the relationship between hyperhomocysteinemia and ischemic stroke risk (Zhang et al., 2020). Severe homocysteine levels have been associated with disturbances in methionine metabolism (Omer Sultan et al., 2020). In addition, high homocysteine levels have been associated with thrombotic, embolic, lacunar and hemorrhagic strokes in several studies (Gungor et al., 2018).

The small vessel disease subtype of ischemic stroke has been associated with hyperhomocysteinemia. In several studies, increased total homocysteine levels have been identified as a stronger risk factor in the small vessel disease subtype compared to other ischemic stroke subtypes. In addition, total homocysteine levels were determined as higher in the ischemic stroke patient group with the small vessel disease subtype compared to the healthy control group (Larsson et al., 2019). Hyperhomocysteinemia is recognized as an independent risk factor for ischemic stroke subtypes. Therefore, it is important to routinely measure of total homocysteine levels in patients with ischemic stroke. There are studies about a significant relationship between increased plasma total homocysteine levels and vascular diseases. Especially moderate elevated homocysteine levels have been identified as a risk factor for atherosclerotic vascular diseases. In addition, in some studies, significantly higher total homocysteine levels were determined in large vessel disease and small vessel disease subtypes (Parnetti et al., 2004). In addition, hyperhomocysteinemia has been identified as an important risk factor for cardiovascular diseases and vascular dementia. Mild to moderate elevated plasma total homocysteine levels have been associated with an increased risk of ischemic stroke in some studies (Ashjzadeh et al., 2013).

## **MATERIALS AND METHODS**

### **Ischemic stroke patient, healthy control groups and patient subgroups**

Ethics committee approval was obtained for our study from the Trakya University Faculty of Medicine Non-Invasive Ethics Committee. Signed consent forms were collected from ischemic stroke patients and healthy controls. Our study was carried out in Trakya University Faculty of Medicine, Biophysics Department, Trakya University Faculty of Medicine, Neurology Department and Trakya University Faculty of Medicine, Biochemistry Department Central Laboratory. Our study was carried out with 82 ischemic stroke patients and 92 healthy controls. In our study, the patient group consisted of patients diagnosed with ischemic stroke. The healthy control group consisted of healthy volunteers who were not diagnosed with ischemic stroke. Patients diagnosed with any other central nervous system disease, malignancy, coronary ischemia, coagulation disorders, heart attack, pregnant and breastfeeding women were excluded from our study. In addition, the ischemic stroke patient group was classified into five groups as large vessel disease, small vessel disease, cardioembolism, cryptogenic and other unclassified. The ischemic stroke patient group and the healthy control group consisted of individuals selected from Edirne and its surroundings.

### Determination of plasma total homocysteine levels

Blood samples taken from ischemic stroke patients and healthy controls for routine examinations were centrifuged at 4000xg for 10 minutes. Plasma of centrifuged blood was separated and stored at  $-86^{\circ}\text{C}$  until measurements of plasma total homocysteine levels were performed. Plasma total homocysteine levels of ischemic stroke patient group, healthy control group and ischemic stroke patient subgroups were measured in Trakya University Biochemistry Department Central Laboratory. Immulite 2000XPi homocysteine kit was used to measure plasma total homocysteine levels. Considering the kit content, 5-15  $\mu\text{mol/L}$  values were accepted as normal plasma total homocysteine levels. Values above 15  $\mu\text{mol/L}$  were considered as hyperhomocysteinemia.

### Statistical analysis

The results were expressed as mean  $\pm$  standard deviation for continuous and frequency for categorical variables. Comparison of clinical parameters between ischemic stroke patient and healthy control groups was performed using the Chi-square test, Mann-Whitney U test, Independent samples test. Plasma total homocysteine levels were compared between ischemic stroke patient and healthy control groups using the Mann-Whitney U test. Plasma total homocysteine levels were compared among ischemic stroke patient subgroups using the Kruskal-Wallis test. The classification of plasma total homocysteine levels (normal, middle, interval) between ischemic stroke patient and healthy control groups was compared using the Chi-Square test. Plasma total homocysteine levels classification (normal, middle, interval) in ischemic stroke patient subgroups were compared using Chi-Square test. Statistical analysis of the data obtained in our study was performed using SPSS (Statistics Package of Social Science) V 20 program. Statistical significance was accepted as  $p < 0.05$ .

## RESULTS

The significant difference was determined between ischemic stroke patient and healthy control groups in terms of hypertension, diabetes mellitus, CVD history, smoking, alcohol, heart diseases, fasting blood glucose, cholesterol and high-density lipoprotein (HDL) parameters ( $p < 0.05$ ). However, the significant difference was not determined between the patient and control groups in terms of triglyceride and low-density lipoprotein (LDL) parameters ( $p > 0.05$ ) (Table 1).

**Table 1.** Clinical results and parameters between patient and control subjects

<i>Clinical results and parameters</i>	<i>Groups</i>		<i>p</i>
<i>Clinical results</i>	<i>Patients (n = 82)</i>	<i>Controls (n = 92)</i>	<i>&lt;0.001<sup>a*</sup></i>
Hypertension, (+)	55 (67.0%)	36 (39.0%)	<i>0.008<sup>a*</sup></i>
Diabetes mellitus, (+)	24 (29.0%)	11 (12.0%)	<i>&lt;0.001<sup>a*</sup></i>

History of CVD, (+)	26 (32.0%)	0 (0.0%)	<b>0.009<sup>a*</sup></b>
Smoking, (+)	20 (24.0%)	8 (9.0%)	<b>0.007<sup>a*</sup></b>
Alcohol, (+)	15 (18.0%)	4 (4.0%)	<b>&lt;0.001<sup>a*</sup></b>
Heart diseases, (+)	18 (22.0%)	1 (1.0%)	<b>&lt;0.001<sup>a*</sup></b>
<b>Clinical parameters</b>	<b>Mean ± SD</b>	<b>Mean ± SD</b>	<b>p</b>
Fasting blood glucose (mg/dL)	122.72 ± 57.38	90.91 ± 18.36	<b>&lt;0.001<sup>b*</sup></b>
Triglyceride (mg/dL)	141.41 ± 82.69	124.94 ± 49.70	0.790 <sup>b</sup>
HDL (mg/dL)	40.20 ± 10.21	49.10 ± 12.61	<b>&lt;0.001<sup>c*</sup></b>
LDL (mg/dL)	121.58 ± 35.59	128.71 ± 35.31	0.271 <sup>c</sup>

<sup>a</sup>Chi-squared test; <sup>b</sup>Mann–Whitney test; <sup>c</sup>Independent samples test; \* significant differences; (+): existent

**CVD:** cerebrovascular diseases; **LDL:** low density lipoprotein; **HDL:** high density lipoprotein; **SD:** standard deviation

Plasma total homocysteine levels were observed as higher in the ischemic stroke patient group compared to the healthy control group, but the significant difference was not detected between the ischemic stroke patient and healthy control groups in terms of plasma total homocysteine levels ( $p > 0.05$ ). Plasma total homocysteine levels were determined as higher in the small vessel disease subgroup compared to other ischemic stroke subgroups. The significant difference was determined among ischemic stroke patient subgroups in terms of plasma total homocysteine levels ( $p < 0.05$ ) (Table 2).

**Table 2.** Comparison of homocysteine levels between patient and control, patient subtypes

	<b>n</b>	<b>Homocysteine Mean ± SD</b>	<b>Median</b>	<b>p</b>
Patient	82	20.21 ± 10.47	16.65	0.818 <sup>a</sup>
Control	92	18.59 ± 7.42	17.15	
<b>Patient Subtypes</b>				
Large Vessel Disease	18	20.70 ± 11.84	16.80	<b>0.015<sup>*b</sup></b>
Other Unclassified	5	15.04 ± 6.69	13.50	
Cardioembolic	34	18.04 ± 9.76	15.35	
Small Vessel Disease	12	27.75 ± 10.91	26.15	
Cryptogenic	13	20.26 ± 8.58	16.50	

<sup>a</sup>Mann-Whitney U Test

<sup>b</sup>Kruskal-Wallis Test

\* Statistically significant  $p < 0.05$

Interval plasma total homocysteine levels were observed as more in ischemic stroke patient group compared to healthy controls. The significant difference was not determined between ischemic stroke patient and healthy control groups in terms of plasma total homocysteine classification (normal, middle, interval) ( $p > 0.05$ ) (Table 3).

**Table 3.** Comparison of homocysteine levels between patient and control groups

<b>Normal</b>		<b>Middle</b>		<b>Interval</b>		<b>Total</b>	<b>p</b>
<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>		

<b>Control</b>	33	35.9%	53	57.6%	6	6.5%	92	0.087 <sup>a</sup>
<b>Patient</b>	32	39.0%	37	45.1%	13	15.9%	82	

<sup>a</sup>Chi-Square Test

In the large vessel disease subgroup, normal plasma total homocysteine levels were determined as more than middle and interval plasma total homocysteine levels. In the other unclassified subgroup, normal plasma total homocysteine levels were detected more than middle plasma total homocysteine levels. The interval plasma total homocysteine levels were not observed in this subgroup of patients. In the cardioembolic patient subgroup, normal and middle plasma total homocysteine levels were observed as more than interval plasma total homocysteine levels. In the small vessel disease patient subgroup, middle plasma total homocysteine levels were observed as more than interval plasma total homocysteine levels. Normal plasma total homocysteine levels were not observed in this ischemic stroke patient subgroup. In the cryptogenic ischemic stroke subgroup, normal and middle plasma total homocysteine levels were observed as more than interval plasma total homocysteine levels. The significant difference was not determined among patient subgroups in the comparison of plasma total homocysteine levels (normal, middle, interval) according to ischemic stroke patient subgroups ( $p < 0.05$ ) (Table 4).

**Table 4.** Comparison of homocysteine levels between patient and control groups

	Normal		Middle		Interval		Total	p	p <sup>b</sup>
	n	%	n	%	n	%			
Large Vessel Disease	8	44.4%	6	33.3%	4	22.2%	18		
Other Unclassified	4	80.0%	1	20.0%	0	0.0%	5		
Cardioembolic	1	44.1%	15	44.1%	4	11.8%	34	<b>0.016<sup>aa</sup></b>	0.553 <sup>b</sup>
	5								
Small Vessel Disease	0	0.0%	10	83.3%	2	16.7%	12		
Cryptogenic	5	38.5%	5	38.5%	3	23.1%	13		

<sup>a</sup>Chi-Square Test

<sup>b</sup>Chi-Square Test when excluded patients with Small Vessel Disease

\* Statistically significant  $p < 0.05$

## DISCUSSION

Ischemic stroke is a focal or global neurological disorder that occurs as a result of blockage of cerebral blood flow in any region of the brain. Ischemic stroke can lead to long-term disability and death. Hyperhomocysteinemia is considered as an important risk factor for ischemic stroke. Various studies have identified a significant relationship between hyperhomocysteinemia and cerebral thromboembolism. Moderate hyperhomocysteinemia has been associated with obstructive vascular diseases, cancer types and brain diseases. High plasma total homocysteine levels have been associated with stimulation of endothelial dysfunction. High total homocysteine levels are associated with susceptibility to ischemic stroke and hemorrhagic stroke. In a previous meta-analysis study, high total homocysteine levels were associated with an increased atherosclerotic vascular disease risk. In a cohort study performed with the Turkish population, a significant relationship has been reported between early infarction, coronary artery disease and increased homocysteine levels. In another study, significantly higher plasma total homocysteine levels were determined in large vessel disease and small vessel disease subtypes compared to other ischemic stroke subtypes. In a meta-analysis study performed with the Chinese population, increased plasma total homocysteine levels have been associated with ischemic stroke and ischemic stroke subtypes. In a study performed with the Asian population, hyperhomocysteinemia was determined as an important risk factor for ischemic stroke (Alkanli et al., 2017). Endothelial damage plays an important role in the pathogenesis of small vessel disease. In various experimental studies, changes occur in the wall of blood vessels as a result of high total homocysteine levels. Increased oxidative stress and endothelial damage are the main mechanisms of these modifications. In several studies, oxidative stress has been associated with



increased endothelial dysfunction caused by hyperhomocysteinemia. Endothelium-dependent nitric oxide signaling and cerebral vascular function are impaired as a result of oxidative stress caused by hyperhomocysteinemia (Larsson et al., 2019). Another study showed a significant relationship between hyperhomocysteinemia and large vessel disease. In a study performed with the Italian population, mild hyperhomocysteinemia was identified as an independent risk factor for ischemic stroke subtypes. In a study performed with the Korean population, a significant correlation was determined between increased plasma total homocysteine levels and cerebral vascular disease (Parnetti et al., 2004). In a study performed with the Indian population, hyperhomocysteinemia was determined as an important risk factor for acute ischemic stroke. In another study performed with the Swedish population, hyperhomocysteinemia was reported in all subtypes of ischemic stroke in patients with ischemic stroke. In a study with Iranian Persian population, high homocysteine levels were associated with the risk of ischemic stroke, and increased homocysteine levels were identified as an important risk factor for the cardioembolic subtype (Ashjazadeh et al., 2013).

Increased homocysteine levels have also been associated with stroke severity, poor prognosis, and stroke recurrence. In a study performed with the Turkish population, higher homocysteine levels were detected in the large vessel disease and cardioembolic subgroup compared to other ischemic stroke subgroups (Gungor et al., 2018). In several studies, significantly higher homocysteine levels were found in ischemic stroke subtypes compared to healthy controls, but very high homocysteine levels were detected in small vessel disease and large vessel disease subtypes. High homocysteine levels have been reported in the small vessel disease subtype in studies with white populations (Khan et al., 2008). In a study carried out with the Chinese population, increased total homocysteine levels were determined in the large vessel disease subtype (Shi et al., 2018). In a study performed with the Dutch population, high homocysteine levels were associated with the risks of stroke and heart attack. In studies performed with Taiwanese and Italian populations, increased homocysteine levels have been associated with endothelial dysfunction and atherosclerosis (Omer Sultan et al., 2020). In a South London population study, significantly higher homocysteine levels were determined in small vessel disease and cardioembolic subgroups compared to other ischemic stroke subgroups (Zhang et al., 2020). In our study performed with the Thrace population, plasma total homocysteine levels were observed as higher in the ischemic stroke patient group compared to the healthy control group, but the significant difference was not determined between ischemic stroke patients and healthy control groups in terms of plasma total homocysteine levels. Plasma total homocysteine levels were determined as higher in the small vessel disease subgroup compared to other ischemic stroke subgroups. The significant difference was determined among the subgroups of patients with ischemic stroke in terms of plasma total homocysteine levels. In the ischemic stroke patient group, interval plasma total homocysteine levels were observed as more than in healthy controls. The significant difference was not determined between ischemic stroke patient and healthy control groups in terms of plasma total homocysteine classification (normal, middle, interval). In the large vessel disease subgroup, normal plasma total homocysteine levels were observed as more than middle and interval plasma total homocysteine levels. In the other unclassified subgroup, normal plasma total homocysteine levels were observed more than middle plasma total homocysteine levels. In the cardioembolic patient subgroup, normal and middle plasma total homocysteine levels were observed as more than interval plasma total homocysteine levels. In the small vessel disease patient subgroup, middle plasma total homocysteine levels were observed as more than interval plasma total homocysteine levels. In the cryptogenic ischemic stroke subgroup, normal and middle plasma total homocysteine levels were observed as more than interval plasma total homocysteine levels. The significant difference was determined among patient subgroups in the classification of plasma total homocysteine levels (normal, middle, interval) according to ischemic stroke patient subgroups ( $p < 0.05$ ).

## CONCLUSION

Different results were found in studies performed to determine the relationship between hyperhomocysteinemia and ischemic stroke, ischemic stroke subgroups. These different results may

be due to different selection criteria and population sizes for ischemic stroke patient and healthy control groups. In our study, plasma total homocysteine levels were determined as higher in the small vessel disease subgroup compared to other ischemic stroke subgroups. The significant difference was determined among the subgroups of patients with ischemic stroke in terms of plasma total homocysteine levels. The significant difference was determined among patient subgroups in the classification of plasma total homocysteine levels (normal, middle, interval) according to ischemic stroke patient subgroups ( $p < 0.05$ ). Based on the results of our study, hyperhomocysteinemia is considered to be an important risk factor for ischemic stroke subgroups and especially small vessel disease subgroup. More comprehensive studies based on different selection criteria are needed to confirm these results. Determining the relationship between hyperhomocysteinemia and ischemic stroke ischemic and regulating high homocysteine levels in ischemic stroke patients at risk are extremely important in terms of preventing ischemic stroke and developing new therapeutic strategies for ischemic stroke.

## REFERENCES

- Alkanli N, Sipahi T, Ay A, Guldiken B, Bakir A, Alkanli SS, Celebi C, Atilgan E 2017. Calcitonin related polypeptide alpha gene polymorphisms according to plasma total homocysteine levels in ischemic stroke patients of Trakya Region, *Biotechnology & Biotechnological Equipment*, 31(6):1184-1191. doi:10.1080/13102818.2017.1372218.
- Ashjazadeh N, Fathi M, Shariat A 2013. Evaluation of Homocysteine Level as a Risk Factor among Patients with Ischemic Stroke and Its Subtypes. *Iran J Med Sci*, 38(3):233-239.
- Gungor L, Polat M, Ozberk MB, Avci B, Abur U 2018. Which Ischemic Stroke Subtype Is Associated with Hyperhomocysteinemia? *J Stroke Cerebrovasc Dis*, 27(7):1921-1929. doi: 10.1016/j.jstrokecerebrovasdis.2018.02.033.
- Khan U, Crossley C, Kalra L, Rudd A, Wolfe CD, Collinson P, Markus HS 2008. Homocysteine and its relationship to stroke subtypes in a UK black population: the south London ethnicity and stroke study. *Stroke*, 39(11):2943-2949. doi: 10.1161/STROKEAHA.107.513416.
- Larsson SC, Traylor M, Markus HS 2019. Homocysteine and small vessel stroke: A mendelian randomization analysis. *Ann Neurol*, 85(4):495-501. doi: 10.1002/ana.25440.
- Omer Sultan M, Farooque U, Javed R et al 2020. Correlation of Homocysteine Level and Age in Patients with Ischemic Stroke. *Cureus*, 2020;12(4):e7785. doi:10.7759/cureus.7785.
- Parnetti L, Caso V, Santucci A, Corea F, Lanari A, Floridi A, Conte C, Bottiglieri T 2004. Mild hyperhomocysteinemia is a risk-factor in all etiological subtypes of stroke. *Neurol Sci*, (1):13-17. doi: 10.1007/s10072-004-0219-5.
- Shi Z, Liu S, Guan Y et al 2018. Changes in total homocysteine levels after acute stroke and recurrence of stroke. *Sci Rep*, 8:6993. doi.org/10.1038/s41598-018-25398-5.
- Zhang T, Jiang Y, Zhang S, Tie T, Cheng Y, Su X, Man Z, Hou J, Sun L, Tian M, Zhang Y, Li J, Ma Y 2020. The association between homocysteine and ischemic stroke subtypes in Chinese: A meta-analysis. *Medicine (Baltimore)*, 99(12):e19467. doi: 10.1097/MD.00000000000019467.

**AİLE DEĞERLERİNİN AŞI KABUL VE REDDİNE ETKİSİ****THE EFFECT OF FAMILY VALUES ON VACCINATION ACCEPTANCE AND REJECTION****Ömer ABİÇ<sup>2\*\*</sup>, Doç. Dr. Rabia SOHBET<sup>1\*</sup>***\*1-Gaziantep Üniversitesi, Sağlık Bilimleri Enstitüsü, Hemşirelik Anabilim Dalı, Halk Sağlığı Hemşireliği Programı, Gaziantep, Türkiye**\*\*2-Gaziantep Üniversitesi, Sağlık Bilimleri Enstitüsü, Hemşirelik Anabilim Dalı, Halk Sağlığı Hemşireliği Programı, Gaziantep, Türkiye**\*1-Gaziantep University, Institute of Health Sciences, Department of Nursing, Public Health Nursing Program, Gaziantep, Turkey**\*\*2-Gaziantep University, Institute of Health Sciences, Department of Nursing, Public Health Nursing Program, Gaziantep, Turkey**\*<sup>1</sup>ORCID No: 0000-0002-1835-8479**\*\*<sup>2</sup>ORCID No: 0000-0002-5276-57481***Özet**

**Amaç:** Çalışma aşı kararsızlığına - aşı reddine götüren nedenlerin tespiti, aile değerlerinin aşı karşıtlığına etkisini saptamak için yapılmıştır.

**Gereç ve Yöntem:** Gaziantep Cengiz Gökçek Kadın Doğum ve Çocuk Hastalıkları Poliklinikleri'ne başvuran 0-24 ay arası çocuğu olan, Türkçe bilen ebeveynle yüz yüze görüşme ile yapılmıştır. Çocuk polikliniklerine başvuran 8433 kişi evreni oluşturmuş çalışmaya katılmayı kabul eden 930 kişi örneklemi oluşturmuştur. Veriler literatürden yararlanılarak oluşturulan “Kişisel Bilgi Formu” ve “Aile Değerleri Ölçeği (ADÖ)” ile toplanmış, Verilerin değerlendirilmesinde SPSS 25.0 (Statistical Package for Social Science) paket programı kullanılmıştır. Bağımsız değişkenlerin karşılaştırılmasında  $\chi^2$  testi kullanılmıştır.

**Bulgular:** Katılımcıların %78'inin memleketi Gaziantep'tir. Araştırmaya katılan annelerin %74,7'si ev hanımıdır. Katılımcıların %68'inin geliri gidere denktir. Katılımcılardan %87,4'ü aşı kartına sahipken, aşı kartı olmayanların oranı %12,6'dır. Katılımcıların %90,1'i aşığı gerekli bulup %61,8'i mikropalara karşı direnç kazandırdığını, %9,9'u aşının gereksiz olduğunu söylemiştir. Katılımcıların %89,9'u çocuklarına aşı yaptırırken %10,1'i yaptırmamaktadır. Katılımcıların %91,9'u aşılardan yan etkisi vardır, %8,1'i aşılardan yan etkisi yoktur demiştir.

Aşı yaptırmayan katılımcılar aşı yaptırmama nedeni olarak %5,7'si ise Aşısı yapılan hastalıklar zaten artık görünmüyor, %5,2'si Sağlık kurumları evime uzak, %4,4'ü Doğal bağışıklığa inanıyorum, %4,1'i Bebekler aşılama için küçük, %4,1'i Aşıya götüreceğim zamanım yok, %3,2'si Aşılar güvenli değil, %2,6'sı Dini inançlar, %1,7'si Aşılar otizme yol açar, %1'i Aşılar aşı firmalarını zengin etmek için yapıyor, %0,5'i Çocuğumun kısır olmasından korkuyorum ve %0,1'i Sağlık Personellerinin davranışlarından memnun değilim demiştir.

**Sonuç:** Aşılamayı yaptırmama nedenlerinden en önemlisi ebeveynlerin iş sahibi olmasından kaynaklı olarak aşı yaptırmaya zaman bulamaması olarak ortaya çıkmıştır ayrıca önemli bir kısmın aşılardan yan etkisi olduğuna inandığı ortaya çıkmıştır.

**Anahtar Kelimeler:** Aşı, Aşı Reddi, Aile, Aile Değerleri, Ebeveyn

**Abstract**

**Objective:** The study was conducted to determine the reasons leading to vaccine hesitancy - vaccine rejection, and to determine the effect of family values on anti-vaccination.

**Materials and Methods:** The study was conducted with a face-to-face interview with a Turkish-speaking parent with a child aged 0-24 months who applied to Gaziantep Cengiz Gökçek

Gynecology and Pediatrics Polyclinics. 8433 people who applied to pediatric outpatient clinics formed the universe and 930 people who agreed to participate in the study formed the sample. The data were collected with the “Personal Information Form” and “Family Values Scale (FAS)” created using the literature, and the SPSS 25.0 (Statistical Package for Social Science) package program was used to evaluate the data. The  $\chi^2$  test was used to compare the independent variables.

**Results:** The hometown of 78% of the participants is Gaziantep. 74.7% of the mothers participating in the study are housewives. The income of 68% of the participants is equal to the expenses. While 87.4% of the participants have a vaccination card, the rate of those who do not have a vaccination card is 12.6%. 90.1% of the participants found the vaccine necessary, 61.8% said it gave resistance to microbes, and 9.9% said that the vaccine was unnecessary. While 89.9% of the participants have their children vaccinated, 10.1% do not. 91.9% of the participants said that vaccines have side effects, 8.1% said that vaccines have no side effects.

5.7% of the participants who did not get vaccinated as the reason for not getting vaccinated Vaccinated diseases are not seen anymore, 5.2% Health institutions are far from my home, 4.4% I believe in natural immunity, 4.1% Babies vaccination too young, 4.1% I do not have time to vaccinate, 3.2% Vaccines are not safe, 2.6% Religious beliefs, 1.7% Vaccines cause autism, 1% Vaccines vaccines It is done to enrich their companies, 0.5% said I am afraid of my child being infertile, and 0.1% said they are not satisfied with the behavior of the Health Personnel.

**Conclusion:** The most important reason for not vaccinating was that the parents could not find time to get vaccinated due to their employment.

**Keywords:** Vaccine, Vaccine Rejection, Family, Family Values, Parent

## GİRİŞ ve AMAÇ

Aşıların, uzun zamandır enfeksiyon hastalıkları ile mücadelede en etkili korunma yöntemi olduğu kabul edilmektedir (2).

Dünyada 20 yıl önce, “aşı kararsızlığı-aşı reddi” kavramları ortaya atılmış olup giderek artan aşı reddi vakaları, aşılama oranlarında düşümlere neden olmuş ve aşı ile korunabilir hastalıkları artırmıştır. Dünyada 2018 yılında görülen toplam kızamık vaka sayısı 324.277 iken, 2019 yılının ilk iki ayında 74.338 kızamık vakası görülmüştür (3).

Ülkemizde son sekiz yıldır “aşı karşıtlığı” hareketi başlamıştır. Önceleri çok az sayıda olan aşı reddi vakaları, 2015 yılında “aşı uygulaması için ebeveynlerden onam alınması” ile ilgili bir davanın kazanılması ve aşı karşıtı söylemlerin sık sık medyada yer alması ile hızla artış göstermiştir. Çocuklarına aşı yaptırmak istemeyen ailelerin sayısı; 2011’de 183 iken, 2013’te 980, 2015’te 5 bin 400, 2016’da 12 bin düzeyine yükselmiş, aşı reddi ile ilgili vaka sayısı 2018 yılı itibari ile 23 bin düzeyine ulaşmıştır. Türkiye’de 2016 yılında %98 olan aşılama oranı 2017 yılında %96’ya gerilemiştir. Ülke genelinde 2017 yılında 85 çocukta kızamık görülürken, 2018’in ilk üç ayında kızamık vaka sayısı 44’e ulaşmıştır. Böylelikle kızamık insidansı 2016 yılında yüz bin nüfusta 0,01 iken, günümüzde yüz binde 0,10 düzeyine yükselerek on kat artış göstermiştir. Aşı reddi vakalarının 50 bine ulaşması durumunda salgın meydana gelmesi olasılığı oldukça yüksektir (7).

## GEREÇ ve YÖNTEM

Tanımlayıcı tipte tasarlanan bu araştırma aşı kararsızlığına - aşı reddine götüren nedenlerin tespiti, aile değerlerinin aşı karşıtlığına etkisini saptamak amacıyla yapılmıştır. Gaziantep Cengiz Gökçek Kadın Doğum ve Çocuk Hastalıkları Hastanesine Çocuk Sağlığı ve Hastalıkları Poliklinikleri’nden çocuk polikliniklerine başvuran yaklaşık 8433 kişi evreni oluşturmuştur. Hastaneye başvuran Türkçe okuma-yazma bilen ve 0-24 ay arası çocuğa sahip olan ebeveynlerden çalışmaya katılmayı kabul eden 930 kişi örneklemini oluşturmuştur. Araştırmada literatürden yararlanılarak oluşturduğumuz “Kişisel Bilgi Formu” ve “Aile Değerleri Ölçeği (ADÖ)” kullanılmıştır.

## İSTATİKSEL YÖNTEMLER

Verilerin kodlanmasında ve değerlendirilmesinde SPSS 25.0 (Statistical Package for Social Science) paket programı kullanılmıştır. Verilerin değerlendirilmesinde "Aile Değerleri Ölçeği" kullanılarak aile değerleri belirlenmiştir. Çalışmanın bağımlı değişkeni ebeveynin Sağlık Bakanlığı rutin aşı takvimi ve çocuk aşılama hakkındaki bilgi düzeyi, çalışmanın bağımsız değişkenleri annenin yaşı, mesleği, eğitim düzeyi, babanın yaşı, mesleği, eğitim düzeyi, ailenin geliri ve sosyal güvence durumu, ücretli aşı yaptıurma durumu olarak belirlenmiştir. Değerlendirmede frekans analizi kullanılmıştır. Bağımsız değişkenlerin karşılaştırılmasında  $\chi^2$  testi kullanılmıştır. Sonuçlar anlamlılık  $p < 0.05$  düzeyinde değerlendirilmiştir.

**Tablo 1.**

<b>Bebek Yaşı</b>	<b>Sayı</b>	<b>%</b>
1 ve 5 ay arası	133	14,3
6 ve 10 ay arası	280	30,1
11 ve 15 ay arası	263	28,3
16 ve 20 ay arası	190	20,4
21 ve üzeri	64	6,9
<b>Cinsiyet</b>	<b>Sayı</b>	<b>%</b>
Kadın	455	48,9
Erkek	475	51,1
<b>Anne Yaşı</b>	<b>Sayı</b>	<b>%</b>
19 ve 23 yaş arası	136	14,6
24 ve 28 yaş arası	340	36,6
29 ve 33 yaş arası	291	31,3
34 ve 38 yaş arası	145	15,6
39 yaş ve üzeri	18	1,9
<b>Baba Yaşı</b>	<b>Sayı</b>	<b>%</b>
19 ve 23 yaş arası	20	2,2
24 ve 28 yaş arası	206	22,2
29 ve 33 yaş arası	299	32,2
34 ve 38 yaş arası	280	30,1
39 yaş ve üzeri	125	13,4
<b>Memleket</b>	<b>Sayı</b>	<b>%</b>
Gaziantep	725	78,0
Suriye	131	14,1
Diğer	74	8,0
<b>Anne Mesleği</b>	<b>Sayı</b>	<b>%</b>
Ev Hanımı	695	74,7
İşçi	65	7,0
Memur	94	10,1
Serbest	59	6,3
Diğer	17	1,8
<b>Baba Mesleği</b>	<b>Sayı</b>	<b>%</b>
İşsiz	15	1,6
İşçi	317	34,1
Memur	224	24,1
Esnaf	282	30,3
Diğer	92	9,9
<b>Anne Öğrenimi</b>	<b>Sayı</b>	<b>%</b>
Okuryazar	186	20,0
Okuryazar değil	145	15,6
İlkokul	125	13,4
Ortaokul	184	19,8
Lise	210	22,6
Üniversite	80	8,6
<b>Baba Öğrenimi</b>	<b>Sayı</b>	<b>%</b>
Okuryazar	172	18,5
Okuryazar değil	13	1,4
İlkokul	91	9,8
Ortaokul	145	15,6
Lise	329	35,4
Üniversite	180	19,4
<b>Ailenin Geliri</b>	<b>Sayı</b>	<b>%</b>
Gelir giden az	187	20,1
Gelir gidere denk	632	68,0
Gelir giden fazla	111	11,9
<b>Kardeş Sayısı</b>	<b>Sayı</b>	<b>%</b>
Hiç kardeşi olmayan	85	9,1
1-2 kardeşi olan	479	51,5
3-4 kardeşi olan	308	33,1
5 kardeş ve üzeri	58	6,2
<b>Kaçıncı Çocuk</b>	<b>Sayı</b>	<b>%</b>



1. veya 2 çocuk	309	33,2
3 veya 4. Çocuk	486	52,3
5. veya üzeri çocuk	135	14,5
<b>Toplam</b>	<b>930</b>	<b>100</b>

**Tablo 2.**

<b>Bebek Yaşı</b>	<b>Sayı</b>	<b>%</b>
1 ve 5 ay arası	133	14,3
6 ve 10 ay arası	280	30,1
11 ve 15 ay arası	263	28,3
16 ve 20 arası	190	20,4
21 ve üzeri	64	6,9
<b>Cinsiyet</b>	<b>Sayı</b>	<b>%</b>
Kadın	455	48,9
Erkek	475	51,1
<b>Anne Yaşı</b>	<b>Sayı</b>	<b>%</b>
19 ve 23 yaş arası	136	14,6
24 ve 28 yaş arası	340	36,6
29 ve 33 yaş arası	291	31,3
34 ve 38 yaş arası	145	15,6
39 yaş ve üzeri	18	1,9
<b>Baba Yaşı</b>	<b>Sayı</b>	<b>%</b>
19 ve 23 yaş arası	20	2,2
24 ve 28 yaş arası	206	22,2
29 ve 33 yaş arası	299	32,2
34 ve 38 yaş arası	280	30,1
39 yaş ve üzeri	125	13,4
<b>Memleket</b>	<b>Sayı</b>	<b>%</b>
Gaziantep	725	78,0
Suriye	131	14,1
Diğer	74	8,0
<b>Anne Mesleği</b>	<b>Sayı</b>	<b>%</b>
Ev Hanımı	695	74,7
İşçi	65	7,0
Memur	94	10,1
Serbest	59	6,3
Diğer	17	1,8
<b>Baba Mesleği</b>	<b>Sayı</b>	<b>%</b>
İşsiz	15	1,6
İşçi	317	34,1
Memur	224	24,1
Esnaf	282	30,3
Diğer	92	9,9
<b>Anne Öğrenimi</b>	<b>Sayı</b>	<b>%</b>
Okuryazar	186	20,0
Okuryazar değil	145	15,6
İlkokul	125	13,4
Ortaokul	184	19,8
Lise	210	22,6
Üniversite	80	8,6
<b>Baba Öğrenimi</b>	<b>Sayı</b>	<b>%</b>
Okuryazar	172	18,5
Okuryazar değil	13	1,4
İlkokul	91	9,8
Ortaokul	145	15,6
Lise	329	35,4
Üniversite	180	19,4
<b>Ailenin Geliri</b>	<b>Sayı</b>	<b>%</b>
Gelir gidenden az	187	20,1
Gelir gidere denk	632	68,0
Gelir giderden fazla	111	11,9
<b>Kardeş Sayısı</b>	<b>Sayı</b>	<b>%</b>
Hiç kardeşi olmayan	85	9,1
1-2 kardeşi olan	479	51,5
3-4 kardeşi olan	308	33,1
5 kardeş ve üzeri	58	6,2
<b>Kaçıncı Çocuk</b>	<b>Sayı</b>	<b>%</b>
1. veya 2 çocuk	309	33,2
3 veya 4. Çocuk	486	52,3
5. veya üzeri çocuk	135	14,5
<b>Toplam</b>	<b>930</b>	<b>100</b>

## SONUÇ

Aşılamayı yaptırmama nedenlerinden en önemlisi ebeveynlerin iş sahibi olmasından kaynaklı olarak aşı yaptırmaya zaman bulamaması olarak ortaya çıkmıştır ayrıca önemli bir kısmın aşıların yan etkisi olduğuna inandığı ortaya çıkmıştır.

Aile geliri ücretsiz ve ücretli aşı yaptırmaya üzerinde en önemli etkiye sahip değişken olmuştur öyle ki aile geliri gidere denk veya geliri giderden düşük olan ailelerde ücretli aşı yaptırmaya oranı oldukça düşük çıkmıştır.

Araştırmada aşı bilgisi ile öğrenim düzeyi karşılaştırmasında Pnömonokok, Oral Polio, BCG, Rota virüs ve Meningokok en az biline aşılar arasında yer alırken Hepatit aşıları, Tetanoz, Suçiçeği, Kabakulak, Kızamık ve Kızamıkçık aşıları eğitim düzeyi ayırmaksızın en çok bilinen aşılar olmuştur.

Araştırmada aşı yaptırmaya durumu ile aşıların yan etkisinin olup olmadığı sorusu arasında anlamlılık bulunmamıştır. Bu durum aşı yaptırmayanlar kadar aşı yaptıranların da aşıların yan etkisi olduğunu düşünmesinden kaynaklanmıştır ancak yine de bunu aşı yaptırmaya engel bir durum olarak görmemişlerdir.

## TARTIŞMA

Araştırmaya katılan annelerin meslekleri %74,7 ile ev hanımı olup %7'si işçi, %10,1 Memur, %6,3'ü serbest ve %1,8'i diğer meslek gruplarında çalışmaktadır. Ankete katılan babaların meslek dağılımı ise şöyledir; %1,6'sı işsiz, % 34,1'i işçi, %24,1'i memur, %30,3'ü esnaf, %9,9'u diğer meslek gruplarında çalışmaktadır. Tezol, Erkasar ve Çitak'ın çalışmasında meslek grupları anneler için %51,7 oranında ev hanımı olurken babalarda %42 oranında memur olarak ortaya çıkmıştır. (9)

Araştırmaya katılan annelerin %20'si okuryazar, %15,6'sı okuryazar değil, %13,4'ü ilköğretim, %19,8'i ortaokul, %22,6'sı lise, %8,6'sı ise üniversite mezunu. Baba meslekleri ise şöyle gruplanmıştır; %18,5'i okuryazar, %1,4'ü okuryazar değil, %9,8'i ilköğretim, %15,6'sı ortaokul, %35,4'ü lise, %19,4'ü ise üniversite mezunudur. Yapılan başka bir çalışmada annelerin %36,8'i lise mezunu, babaların %49,5'i üniversite mezunu olarak ortaya çıkmıştır. (5)

Anket çalışmasına katılan kişilerin sahip olduğu ailenin gelir durumu %20,1'i gelir giderden az, %68'i gelir gidere denk, %11,9'u gelir giderden fazladır. Çalışmaya yakın bir başka çalışmada ailelerin gelir durumu %57,9 ile gelir gidere denk olarak sonuçlanmıştır. (8)

Katılımcıların %90,1'i aşıyı gerekli bulup %61,8 oranında mikroplara karşı direnç kazandığını düşünmektedir, %9,9'u aşının gereksiz olduğu kanaatindedir. Aras'ın çalışmasına göre katılımcıların %63,7'si aşıyı gerekli bulmuştur. (1) Katılımcıların birden fazla seçeneği işaretleyebildiği "Bildiğiniz aşıları hangileridir" sorusuna verdikleri cevaplar şöyledir; %70 hepatit, %84 tetanoz, %66 kabakulak, %73,5 kızamık, %59,1 su çiçeği olmuştur. İnci'nin çalışmasında benzer soruya verilen cevaplar %61,2 hepatit, %36,3 kabakulak olmuştur. (6) Katılımcıların aşı yapılırken ne olur sorusuna verdikleri cevaplar şöyledir; Hastalıklardan korur %82,7, Aşı yerinde ağrı %62,4, Ateş %52, Otizme neden olur %3,9, Felce neden olur %6,9 olmuştur. Beyazova'nın yaptığı çalışmada %96,7 oranında aşıların koruyuculuk yaptığı belirlenmiştir. (4)

Katılımcıların %89,9'u çocuklarına aşı yaptırmaya %10,1'i yaptırmamaktadır. Aşı yaptırmayanların, aşı yaptırmama nedenleri ise şöyledir; %5,2'si Sağlık kurumları evime uzak, %3,2'si Aşılar güvenli değil, %0,1'i Sağlık Personellerinin davranışlarından memnun değilim, %4,1'i Aşıya götüreceğim zamanım yok, %1,7'si Aşılar otizme yol açar, %0,5'i Çocuğumun kısır olmasından korkuyorum, %2,6'sı Dini inançlar, %4,4'ü Doğal bağışıklığa inanıyorum, %4,1'i Bebekler aşılama için küçük, %1'i Aşılar aşı firmalarını zengin etmek için yapılıyor ve %5,7'si ise Aşısı yapılan hastalıklar zaten artık görünüyor şeklinde cevaplamıştır. Yapılan başka bir çalışmada çocuklarına aşı yaptıranların oranı %92,3 olmuştur. (10)

**KAYNAKÇA**

1. Aras A. Aile Hekimlerinin Aşı Reddi Konusunda Bilgi ve Tutumlarının Değerlendirilmesi
2. Badur S. 2011. “Aşı Karşıtı Gruplar ve Aşılarla Karşı Yapılan Haksız Suçlamalar” ANKEM, 25(Ek 2) : 82-86
3. Bazin H. “The Ethics of Vaccine Usage in Society: Lesson From the Past”, Current Opinion in Immunology, 2001;13:505-510
4. Beyazova U, Aktağ F. Çocukluk çağı aşılamaları. Gazi Tıp Dergisi 2007;18(2)
5. Çevik C, Güneş S, Ersan İ, Özdemir A, Eser S. Balıkesir İl Merkezindeki İki ASM Bölgesindeki 0-14 Yaş Çocuğu Olan Ebeveynlerin Aşı Tereddüdü, Aşıya İlişkin Bilgi, Tutum ve Davranışları ve Etkili Faktörler. İçinde: 3International 21National Public Health Congress [Internet]. 2019 [a.yer 14 Mart 2020].
6. İnci A. Bir Devlet Hastanesi Sağlık Çalışanlarının Hepatit B Hakkında Bilgi Düzeyleri. Journal of Clinical and Analytical Medicine. 2015;6(1):18-20.
7. Riedel S. Edward Jenner and the history of smallpox and vaccination. BUMC Proceedings 2005;18:21-25
8. Topçu S, Almış H, Başkan S, Turgut M, Orhon FŞ, Ulukol B. Evaluation of Childhood Vaccine Refusal and Hesitancy Intentions in Turkey. Indian J Pediatr. Ocak 2019;86(1):38-43
9. Tezol Ö, Erkasar F, Çitak EÇ. Pediatrik Kanser Hastalarının Ebeveynlerinin Sürekli Kaygı Düzeyleri ve Aşı Karşıtlığı. Osmangazi Journal Of Medicine. 19 Mart 2020;51-7.
10. Üzümlü Ö, Eliaçık K, Örsdemir HH, Öncel EK. Ebeveynlerin aşı yaklaşımlarını etkileyen faktörler: Bir eğitim araştırma hastanesine ilişkin değerlendirme.

## EVALUATION OF THE IMPORTANCE OF GRANULOSA CELLS AND CASPASE-3, TNF- IMMUNE ACTIVITY IN IVF FERTILIZATION SUCCESS

Işıl Sezen Ermiş<sup>1\*</sup>, İlhan Özdemir<sup>2\*\*</sup>, Engin DEVECİ<sup>3\*\*\*</sup>

<sup>1\*</sup>, *Harran University Faculty of Medicine, Department of Obstetrics and Gynecology, Şanlıurfa, Turkey.*

000-00029714-4670

<sup>2</sup> *Atatürk University Faculty of Medicine, Department of Obstetrics and Gynecology, Erzurum, Turkey.*

0000-0001-9957-0211

<sup>3</sup> *Dicle University Faculty of Medicine Histology and Embryology Department, Diyarbakır, Turkey.*

0000-0002-23531184

### Abstract

Granulosa cells (GCs) are important in the development of ovarian follicles and oocyte maturation. In this study, it has been suggested that signal pathways have an effect on follicle development in the density differentiation and functional properties of granulosa cells during in-vitro fertilization (IVF) of human oocytes. When we evaluated the findings we obtained in this study, the amount of Anti-Müllerian Hormone (AMH) in the blood and the diameter of approximately 20 granulosa cells taken from different areas in the follicle fluid and the cell nucleus diameters were measured, and degeneration scoring and Kaspas-3, TNF- $\alpha$  expressions were evaluated in the granulosa cells ( $p < 0.01$ ). In PCOS and infertile patients, Caspas-3 and TNF- $\alpha$  reactions were significantly increased in Granulosa cells compared to control group patients. In conclusion, in this study, it was thought that TNF- $\alpha$  reaction is a marker of cytokine activity in granulosa cells and may affect cell degeneration, considering that it may be an indicator of the effect of granulosa cells on the formation of quality eggs that can be fertilized.

**Keywords:** Granulosa cells, IVF, TNF- $\alpha$ , Caspas-3, Fertilization

### INTRODUCTION

Polycystic ovary syndrome (PCOS) is the most common cause of ovulatory infertility. Inflammation may be involved in the pathogenesis and development of PCOS. Granulosa cells are essential for the maturation of oocytes because germ cell development, meiotic progression, and the global transcriptional pattern are regulated by granulosa cells (Matzuk, Burns, Viveiros, & Eppig, 2002; Yazdanpanah, Khalili, Eftekhari, & Karimi, 2013). The maturation process in oocytes has been reported to involve significant nuclear and cytoplasmic changes that are closely linked to the coordinated development of granulosa and theca cells. It has a significant impact on the development of a cryopreservation program, which is an effective method for immature oocytes. In vitro fertilization, especially in female fertility, in clinical practice, the risk of polycystic ovary syndrome, have shown its effect in ovarian hyper-stimulation syndrome. There are three main signaling pathways for the development of apoptosis in granulosa cells (Hsueh, Kawamura, Cheng, & Fauser, 2015). First, high cAMP levels induced by growth factor via granzyme B; second, mitochondrial function through Bcl2 family member activation; and third, it uses tumor necrosis factor alpha (TNF $\alpha$ ) and Fas ligand (FasL)-Fas and other death receptors; all of which result in caspase-induced DNA fragmentation

The aim of this study was to investigate the TNF- and caspase-3 activity in granulosa cells that affect the fertilization success of human oocytes during in vitro fertilization (IVF) and in PCOS patients.

## MATERIAL AND METHOD

### *Experimental procedure*

This study was performed between June 2020 and March 2021 in the IVF center of Buhara Hospital Obstetrics and Gynecology Clinic including 20 patients in the assisted reproduction programme with the complaint of not having children, in addition to diagnosis of primary or secondary infertility, polycystic ovary syndrome (PCOS), male factor and unexplained infertility diagnosis when starting the Ovum-Pick-Up (OPU) procedure, the patient was first sedated. Before the procedure, the bladder was emptied in order to reach the ovaries more easily during transvaginal oocyte collection and to avoid possible bladder injury. After sedation, the patient was placed in the lithotomy position and covered sterile. Patients with a body mass index of between 18 and 35 kg/m<sup>2</sup> were selected for IVF or intracytoplasmic sperm injection for various indications between 20 and 46 years of age. When the mean diameter of the prominent follicle reached 18 mm, the final matured follicle was induced with 1000 IU of urinary Hcg or 250 mcg of recombinant hcg, and oocyte collection was planned after 34-48 hours. A gel was placed on the ultrasound probe and a sterile plastic sheath is passed before starting the OPU. A biopsy clip was inserted over the sheath, where the needle was passed and guided during aspiration. 16 or 17 gauge needles designed for OPU operation were used. The ideal aspiration pressure for the procedure was 100-150 mmHg.

The follicle fluids and granulosa cells that came with these fluids were examined by histopathological and immunohistochemical methods

### *Histopathologic procedure*

The granular cells obtained from the patients were preserved at + 4 ° C. Materials were sent to the histology laboratory for routine histological procedures. For each sample, the fluid with granular cells was subjected to high-speed centrifugation, the supernatant was discarded then 10% neutral formaldehyde was added (pellet:formaldehyde, 1: 3). After a fixation of 2 h, the supernatant was discarded again and tube was reversed to filter paper. The pellet was placed on a filter paper using a spatula and Eosin staining solution was added using a Pasteur pipette. After the cell aggregate turned into red, it was wrapped in the filter paper and placed in a cassette (Çavus & Deger, 2020). After routine histological follow-up, 4-5 µm sections were cut from the paraffin blocks with a microtome (Leica, Germany). Harris Hematoxylin and Eosin staining was applied to sections and examined under light microscope .

### *Immunohistochemical staining*

Samples were fixed with 10% formaldehyde solution, decalcified with 5% ethylene-diamine-tetraacetic acid (EDTA), dehydrated in a graded series of ethanol, and then embedded in paraffin wax. Then, 4–5 µm thick sections were cut with a microtome (Leica, Germany) and placed on coated slides. Sections were brought to distilled water and washed three times for 5 min in phosphate buffered saline (PBS, pH 7.4) (catalogue number # 10010023, Thermo Fisher Scientific, US). To unmask antigen sites, slides were incubated with EDTA solution in microvawe for 110 minutes at 2x90°C. The sections were washed in three times for 5 min in PBS and incubated with hydrogen peroxide (catalogue # TA-015-HP, Thermo Fisher Scientific, US) for 15 min. Ultra V block (TA-125-UB, Thermo Fisher Scientific, US) was applied to the sections for 8 min prior to the addition of the primary antibodies, which were left on overnight Caspase-3 monoclonal antibody 1:100, TNF-α monoclonal antibody 1:100. The sections were washed three times for 5 min in PBS and then were incubated with biotinylated secondary antibody for 15 min. After washing with PBS, streptavidin peroxidase was applied to the sections for 15 min. The sections were washed three times for 5 min in PBS. Diaminobenzidine was applied to sections for up to 20 min as a



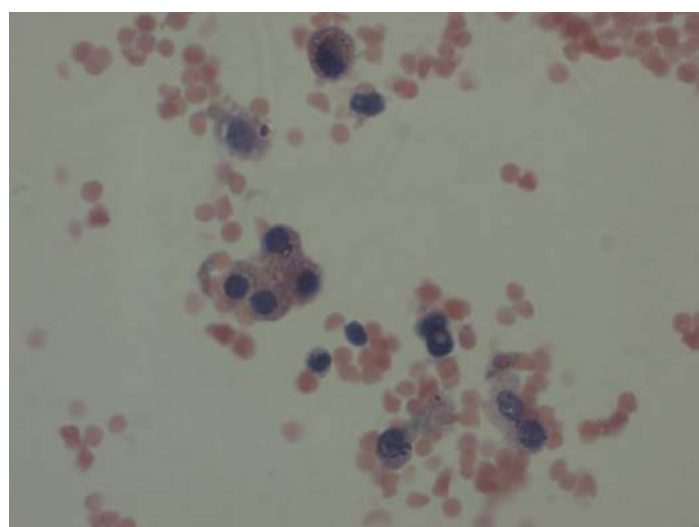
chromogen. Control slides were prepared using the same procedure, without primary antibodies. Counterstaining was done using Harris's haematoxylin for 45 s, dehydrated through ascending alcohol and cleared in xylene. Slides were mounted with Entellan® (lot: 107961, Sigma-Aldrich, St. Louis, MO, USA) and examined under a light microscope.

## RESULT

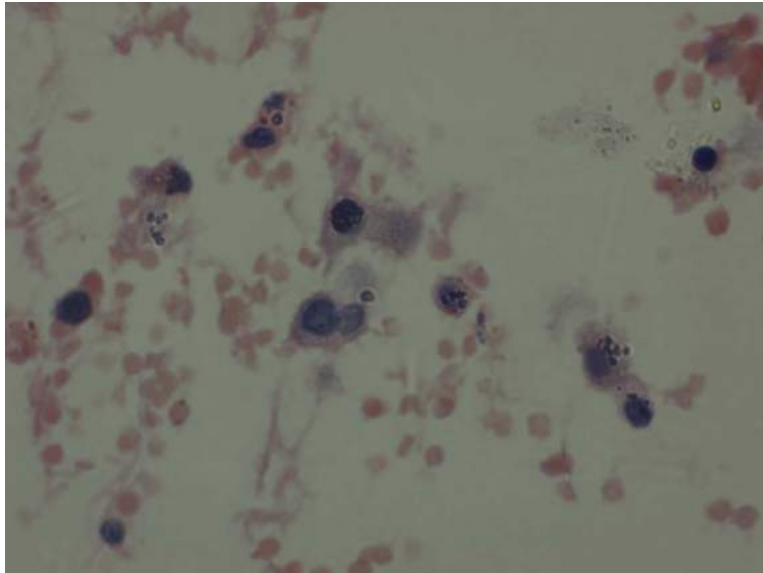
**Table 1.** Statistical evaluation of parameters.

<i>Parameter</i>	<i>Groups</i>	<i>N</i>	<i>Mean</i>	<i>Std. Error Mean</i>	<i>p value</i>
<b>Granulosa cell diameter</b>	<i>Control</i>	20	10,78	0,32	<0,01
	<i>Experimental</i>	20	6,75	0,29	
<b>Diameter of granulosa cell nucleus</b>	<i>Control</i>	20	5,79	0,21	<0,01
	<i>Experimental</i>	20	2,99	0,18	
<b>Degeneration in granulosa cell</b>	<i>Control</i>	20	1,08	0,18	<0,01
	<i>Experimental</i>	20	3,27	0,19	
<b>Caspase -3 expression</b>	<i>Control</i>	20	0,98	0,18	<0,01
	<i>Experimental</i>	20	3,14	0,17	
<b>AMH</b>	<i>Control</i>	15	5,19	0,15	<0,01
	<i>Experimental</i>	15	1,47	0,12	
<b>Age</b>	<i>Control</i>	15	29,08	0,51	<0,01
	<i>Experimental</i>	15	38,39	0,79	

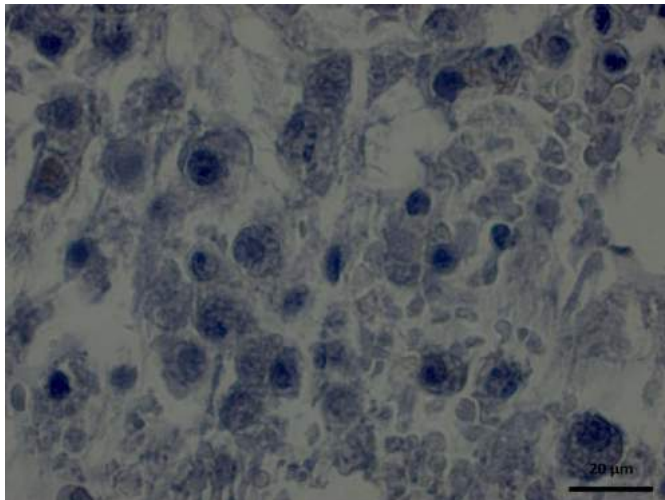
<b>TNF-<math>\alpha</math> expression</b>	<i>Control</i>	15	1,88	0,16	<0,05
	<i>Experimental</i>	15	2,87	0,25	



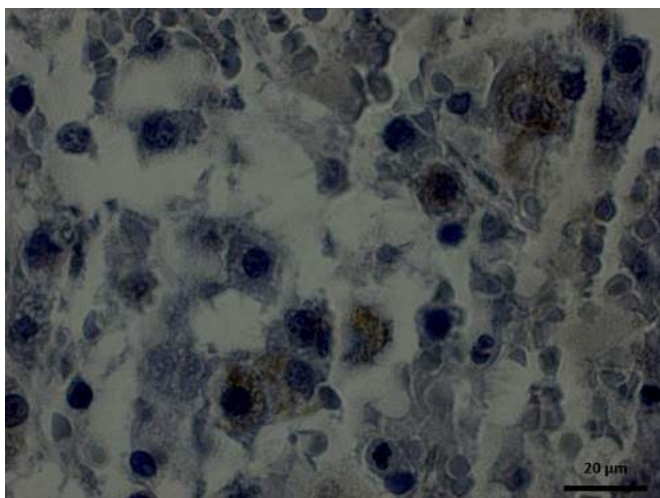
**Figure1a**-In the control group sections, granulosa cells were seen with eosinophilic structure, oval-shaped nuclei and chromatin-rich appearance. HE staining



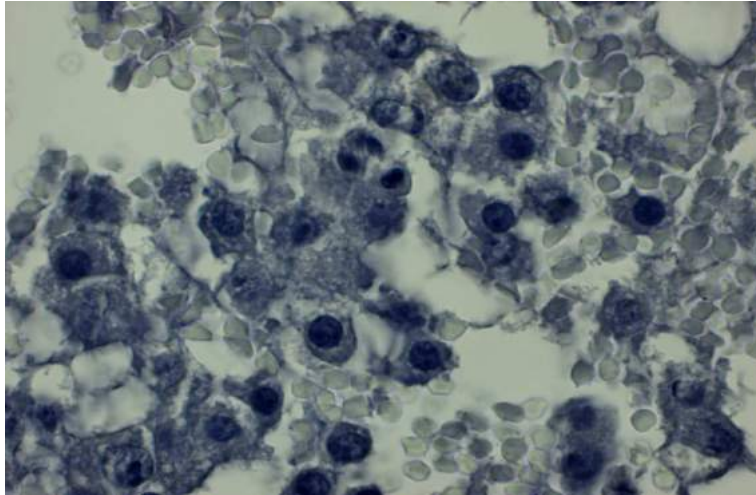
**Figure1b PCOS group:** Degenerative changes in the cytoplasm and pycnotic nuclei were observed in granulosa cells aspirated from PCOS patients. HE staining



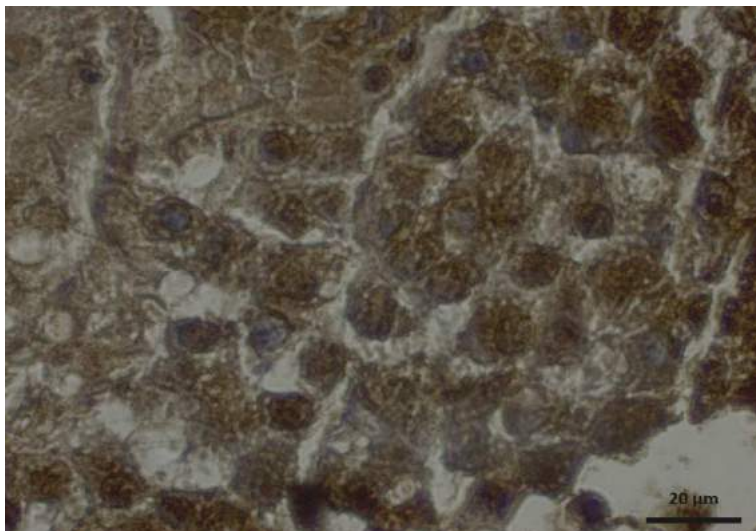
**Figure2a-Control group:** Caspase-6 expression was negative in granulosa cells and cytoplasm nuclei aspirated from normal patients. Caspase-6 Immun-staining



**Figure2b PCOS group:** Caspase-6 expression was positive in the nucleus and cytoplasm of most of the granulosa cells in the fluid aspirated from PCOS patients. Caspase-6 Immun-staining



**Figure3a-Control group:** Negative TNF- $\alpha$  expression was observed in granulosa cells in the fluid taken from the normal patient group. TNF- $\alpha$  Immun-staining



**Figure3a-PCOS group** In the aspirated fluid from PCOS patients, TNF- $\alpha$  expression was significantly increased in the periphery of the granulosa cell cytoplasm and in some nuclei. TNF- $\alpha$  Immun-staining

## DISCUSSION

Ovarian granulosa cells (GCs) play a crucial role in oocyte maturation through the release of paracrine factors that create a favorable growth environment around the oocyte (Hennet & Combelles, 2012).

One of the features of polycystic ovary syndrome (PCOS) is the presence of cystic follicles at various stages of growth and atresia. The latter has been reported to be the result of apoptosis and tissue remodeling. Granulosa cells (GC) apoptosis may cause ovarian atresia, and GC dysfunction may play a role in PCOS pathology. The increased increase in apoptotic granulosa cells may result in poor oocyte quality and poor oocyte quality and negative consequences for embryo development. Caspase-3 is an effector protein that acts at the end of the apoptosis cascade. It can initiate endonucleases to initiate the DNA cleavage process that leads to apoptosis. In one study, Caspase-3 expression levels in aspirated GCs were not predictive of IVF failure, but could be an indirect signal of programmed cell death in human

preovulation follicles, with a negative impact on follicular growth and oocyte yield (Lobach et al., 2019). In our study, it was observed that caspase-3 expression increased in the nuclei of granulosa cells aspirated from PCOS patients. It was predicted that this may be due to the initiation of endonucleases due to the induction of signal pathway influx due to increased inflammation reaction. TNF $\alpha$  has important in vitro effects on steroidogenesis and folliculogenesis. In vitro TNF has been reported to inhibit gonadotropin-induced granulosa cell and theca cell steroidogenesis (Terranova & Rice, 1997). It has been reported that chronic 'low grade' inflammation may contribute to the pathogenesis of polycystic ovary syndrome (PCOS), a common disorder associated with ovarian hyperandrogenism, stopped follicle development and subfertility in humans. A decrease in AMH levels may be associated with defects in granulosa cells and was thought to be associated with significantly lower levels of AMH-secreting granulocytes and increased levels of inflammation than in healthy people. Reported that caspase-3 expression in aspirated GC cells can be used as an indirect marker to indicate apoptosis in human preovulatory follicles, as it negatively affects follicular growth and oocyte yield (Lobach et al., 2019). They also predicted future research showing all the mechanisms of apoptosis in pre-ovulation follicles and explaining the reason for the high cell loss that leads to a poor ovarian response.

It was thought that TNF- $\alpha$  reaction is a marker of cytokine activity in granulosa cells and may affect cell degeneration, considering that it may be an indicator of the effect of granulosa cells on the formation of quality eggs that can be fertilized.

## CONCLUSION

The development of granulosa cells is essential for the maturation of oocytes. This is because germ cell development, meiotic progression, and global transcriptional formation are regulated by granulosa cells. In addition, granulosa cells (GCs) are of great importance in the development of follicles in the ovary and maturation of the oocyte. In this study, it was suggested that signaling pathways have an effect on follicle development in density differentiation and functional properties of granulosa cells during in vitro fertilization. It is thought to be an indicator of the effect of granulosa cells in the formation of quality eggs with the ability to be fertilized.

## REFERENCES

- 1- Çavus, Y., & Deger, U. (2020). Investigation of ADAMTS-1, BAX and IL-10 Expressions in Granulosa Cells Determinant of Fertilization Success in IVF. *International Journal of Morphology*, 38(2).
- 2- Hennet, M. L., & Combettes, C. M. (2012). The antral follicle: a microenvironment for oocyte differentiation. *Int J Dev Biol*, 56(10-12), 819-831. doi:10.1387/ijdb.120133cc
- 3- Hsueh, A. J., Kawamura, K., Cheng, Y., & Fauser, B. C. (2015). Intraovarian control of early folliculogenesis. *Endocr Rev*, 36(1), 1-24. doi:10.1210/er.2014-1020
- 4- Lobach, V. N., Casalechi, M., Dela Cruz, C., Pereira, M. T., Del Puerto, H. L., & Reis, F. M. (2019). Caspase-3 gene expression in human luteinized granulosa cells is inversely correlated with the number of oocytes retrieved after controlled ovarian stimulation. *Hum Fertil (Camb)*, 22(1), 33-38. doi:10.1080/14647273.2017.1356474
- 5- Matzuk, M. M., Burns, K. H., Viveiros, M. M., & Eppig, J. J. (2002). Intercellular communication in the mammalian ovary: oocytes carry the conversation. *Science*, 296(5576), 2178-2180. doi:10.1126/science.1071965
- 6- Terranova, P. F., & Rice, V. M. (1997). Review: cytokine involvement in ovarian processes. *Am J Reprod Immunol*, 37(1), 50-63. doi:10.1111/j.1600-0897.1997.tb00192.x
- 7- Yazdanpanah, F., Khalili, M. A., Eftekhari, M., & Karimi, H. (2013). The effect of vitrification on maturation and viability capacities of immature human oocytes. *Arch Gynecol Obstet*, 288(2), 439-444. doi:10.1007/s00404-013-2777-0





## EVALUATION OF THE EFFECTS OF OXIDATIVE STRESS-INDUCED CHANGE IN OVARIAN GERM CELLS IN INFERTILITY

İlhan Özdemir<sup>1\*</sup>, Engin DEVECİ<sup>2\*\*</sup>, Cenap EKİNCİ<sup>3\*\*\*</sup>, Şamil ÖZTÜRK<sup>4\*\*\*\*</sup>

*1\* Atatürk University Faculty of Medicine, Department of Obstetrics and  
Gynecology, Erzurum, Turkey, 0000-0001-9957-0211*

*2, Dicle University Faculty of Medicine Histology and Embryology Department, Diyarbakır,  
Turkey. 0000-0002-23531184*

*3, Dicle University Faculty of Medicine Histology and Embryology Department, Diyarbakır,  
Turkey.*

*4, Çanakkale Onsekiz Mart University, Vocational School of Health Services, Çanakkale,  
Turkey. 0000-0002-9435-8139*

### Abstract

Free radicals are reactive oxygen radicals (ROS) formed during the production of energy by using oxygen from food as a result of aerobic respiration. Antioxidant enzymes inactivate ROS and protect cells from various damage. However, the inability of antioxidant enzymes to inactivate all ROS causes a significant increase in ROS levels. Oxidative stress is thought to cause the development of pathological events such as ischemia-reperfusion injury, phagocyte-dependent inflammatory damage and neurodegenerative diseases-aging. It is known that oxidative stress causes a number of biochemical and histological defects in the reproductive system. As a result of these defects, spermatogenesis and oogenesis may be adversely affected, and accordingly, infertility may occur. The negative effects of oxidative stress on the formation of germ cells in the ovary and how to eliminate the sources of oxidative stress and the effects of antioxidants on the reproductive system are investigated.

**Keywords:** Oxidative stress, oxygen radicals, ovary, oogenesis, infertility.

### INTRODUCTION

The rate of formation of free radicals in the organism and the rate of their elimination are in balance. As long as this condition called oxidative balance exists, the organism is not affected by free radicals. However, if there is an increase in the rate of formation of free radicals or a decrease in the rate of elimination, the balance in the metabolism is disrupted and oxidative stress occurs. Oxidative stress results from an imbalance between free radical formation and antioxidant defense mechanisms. Cell and tissue damage occurs as a result of oxidative stress (Ortega et al., 2021).

Free oxygen radicals cause disturbances in cell structure and functions due to the deterioration of the antioxidant metabolism of the cell through their interaction with various cell components. If free radicals cannot be neutralized inside or outside the cell, they prevent cell function, cross the nuclear membrane and cause DNA breaks and mutations by affecting the genetic material in the nucleus. Free radicals appear in many diseases such as cancer, rheumatic diseases, aging, toxin exposure, physical damage, infection and inflammation (Al-Gubory, Fowler, & Garrel, 2010).

It is thought that oxidative stress has effects on the reproductive organs in affecting the formation of germ cells. Knowing the mechanisms to counter the effects of antioxidants or being able to treat them with antioxidants has a great therapeutic potential in infertility (Barati, Nikzad, & Karimian, 2020).

Today, infertility is one of the important problems in terms of human health. Infertility is the absence of pregnancy even though the couples want a child within a year and do not use contraception. About 15% of couples in Turkey and around the world have infertility problems. In 40-50% of couples, the cause of infertility is due to female factors (Agarwal, Mulgund, Hamada, & Chyatte, 2015; Gong et al., 2021).

## DISCUSSION

Reactive oxygen species (ROS) are involved in the regulation of gamete quality and gamete interactions. ROS formation is spontaneous in spermatozoa and infectious leukocytes. ROS affects spermatozoa, oocytes, embryos and their environment (Adeoye, Olawumi, Opeyemi, & Christiania, 2018).

Many animal and human studies have elucidated the role of ROS in oocyte development and maturation, follicular atresia (occlusion), corpus luteum function, and luteolysis. Oxidative stress-mediated triggering of pathologies in the female reproductive system is similar to those associated with male infertility. ROS affects oocyte and embryo quality and therefore fertilization rates. ROS appear to play an important role in the regulation of gamete interactions and also in successful fertilization. ROS in the culture medium can affect post-fertilization development. For example, division rates, blastocyte yield and quality (markers of supported reproductive output). Oxidative stress has been reported to affect both natural and enhanced fertility (Chaudhary et al., 2019; Prasad, Tiwari, Pandey, Shrivastav, & Chaube, 2016).

ROS affects the oocyte, the embryo and their environment. Information on the effects of ROS in the female reproductive system is still in the accumulating stage. Many animal and human studies have focused on the effects of ROS on maturation of oocyte development and their relationship with follicular atresia, corpus luteum function and luteolysis. The precipitation of oxidative stress-induced pathologies is similar in the female reproductive tract as in the male. ROS affects oocyte and embryo quality and accordingly fertilization rate. ROS has important effects on modulation of gamete interaction and fertilization (Chaudhary et al., 2019).

ROS in the cultural environment has an important role in the development (cleavage rate, blastocyst yield (indicators of assisted reproduction outcomes)) after fertilization. Reactive oxygen species derange luteinizing hormone receptor adenylate cyclases and inhibit steroidogenesis by blocking mitochondrial cholesterol transport. In addition, free radicals are produced in the follicle during ovulation, as in the corpus luteum, and leukocytes are the main source. Antioxidants block meiosis, whereas production of reactive oxygen species induces oocyte maturation in the follicle. Oxygen radicals exhibit important physiological conditions in the ovary (Basini, Simona, Santini, & Grasselli, 2008).

In the reproductive system, in many pathological conditions such as endometriosis, polycystic ovary syndrome, tubal obstruction, inflammatory cytokines (TNF-alpha, IFN-gamma, IL-1) and high levels of free radicals damage biological molecules (lipids, proteins, and DNA). Membrane lipids are oxidized and some of their products (malondialdehyde, acetaldehyde, hydroxynonenal) chemically modify proteins. These modified proteins change their functions and show immunological reactions such as inflammation and autoimmunity due to their entigenic properties. Changing protein structures can form different proteins such as malondialdehyde binding proteins and these proteins can disrupt the structure of membrane surface antigens in the reproductive system, including receptor proteins. This explains how sperm capacitation, oocyte fertilization, embryo implantation are inhibited and linked to conditions of oxidative stress and chronic inflammation (Tiwari et al., 2016).

Multivitamin support can be applied to women undergoing IVF treatment and thought to be caused by oxidative stress infertility. In a study, the effect of multivitamin and mineral supplementation on lipid peroxidation, low glutathione, glutathione peroxidase, vitamin A, vitamin C and vitamin E values in the follicular fluid of 56 women undergoing IVF and in the control group of 13 age-matched women were investigated. concluded that multivitamin and

mineral supplementation in the follicular fluid of women can strengthen the antioxidant defense system by reducing oxidative stress (Lu, Wu, Wang, & Cheng, 2018).

## CONCLUSION

Oxidative stress is effective in male infertility as well as in female infertility. Oxidative stress parameters (Free radicals - ROS) are newly accumulating with studies on female infertility. As a result of the studies carried out; It has been observed that ROS affects follicle development, corpus luteum, and oocyte development and causes follicular atresia. Therefore, after fertilization, ROS affects gamete development, blastocyte yield and quality, and fertilization. The effects of oxidative stress on embryo development after fertilization may cause miscarriage and require treatment. For this reason, multivitamin and mineral support with antioxidant content such as vitamins A, C, and E should be provided for the application of antioxidants for the elimination of oxidative stress.

## REFERENCES

- 1- Adeoye, O., Olawumi, J., Opeyemi, A., & Christiania, O. (2018). Review on the role of glutathione on oxidative stress and infertility. *JBRA Assist Reprod*, 22(1), 61-66. doi:10.5935/1518-0557.20180003
- 2- Agarwal, A., Mulgund, A., Hamada, A., & Chyatte, M. R. (2015). A unique view on male infertility around the globe. *Reprod Biol Endocrinol*, 13, 37. doi:10.1186/s12958-015-0032-1
- 3- Al-Gubory, K. H., Fowler, P. A., & Garrel, C. (2010). The roles of cellular reactive oxygen species, oxidative stress and antioxidants in pregnancy outcomes. *Int J Biochem Cell Biol*, 42(10), 1634-1650. doi:10.1016/j.biocel.2010.06.001
- 4- Barati, E., Nikzad, H., & Karimian, M. (2020). Oxidative stress and male infertility: current knowledge of pathophysiology and role of antioxidant therapy in disease management. *Cell Mol Life Sci*, 77(1), 93-113. doi:10.1007/s00018-019-03253-8
- 5- Basini, G., Simona, B., Santini, S. E., & Grasselli, F. (2008). Reactive oxygen species and antioxidant defences in swine follicular fluids. *Reprod Fertil Dev*, 20(2), 269-274. doi:10.1071/rd07147
- 6- Chaudhary, G. R., Yadav, P. K., Yadav, A. K., Tiwari, M., Gupta, A., Sharma, A., . . . Chaube, S. K. (2019). Necroptosis in stressed ovary. *J Biomed Sci*, 26(1), 11. doi:10.1186/s12929-019-0504-2
- 7- Gong, Q. Q., Wang, X., Dou, Z. L., Zhang, K. Y., Liu, X. G., Gao, J. G., & Sun, X. Y. (2021). A novel mouse line with epididymal initial segment-specific expression of Cre recombinase driven by the endogenous Lcn9 promoter. *PLoS One*, 16(7), e0254802. doi:10.1371/journal.pone.0254802
- 8- Lu, X., Wu, Z., Wang, M., & Cheng, W. (2018). Effects of vitamin C on the outcome of in vitro fertilization-embryo transfer in endometriosis: A randomized controlled study. *J Int Med Res*, 46(11), 4624-4633. doi:10.1177/0300060518786918
- 9- Ortega, M. A., Sánchez-Trujillo, L., Bravo, C., Fraile-Martínez, O., García-Montero, C., Saez, M. A., . . . García-Hondurilla, N. (2021). Newborns of Mothers with Venous Disease during Pregnancy Show Increased Levels of Lipid Peroxidation and Markers of Oxidative Stress and Hypoxia in the Umbilical Cord. *Antioxidants (Basel)*, 10(6). doi:10.3390/antiox10060980
- 10- Prasad, S., Tiwari, M., Pandey, A. N., Shrivastav, T. G., & Chaube, S. K. (2016). Impact of stress on oocyte quality and reproductive outcome. *J Biomed Sci*, 23, 36. doi:10.1186/s12929-016-0253-4
- 11- Tiwari, M., Prasad, S., Tripathi, A., Pandey, A. N., Singh, A. K., Shrivastav, T. G., & Chaube, S. K. (2016). Involvement of reactive oxygen species in meiotic cell cycle regulation and apoptosis in mammalian oocytes. *Reactive Oxygen Species*, 1(2), 110-116.

## EVALUATION OF IL-10, CASPAS-6 EXPRESSION IN STEM VILLUS STRUCTURE IN THE CONNECTING ROOT IN NORMOTENSIVE AND PLACENTA PREVIA PATIENTS

**Işıl Sezen Ermiş<sup>1\*</sup>, İlhan Özdemir<sup>2\*\*</sup>, Engin DEVECİ<sup>3\*\*\*</sup>**

<sup>1\*</sup>, *Harran University Faculty of Medicine, Department of Obstetrics and Gynecology, Şanlıurfa, Turkey.  
000-00029714-4670*

<sup>2</sup> *Atatürk University Faculty of Medicine, Department of Obstetrics and Gynecology, Erzurum, Turkey.  
0000-0001-9957-0211*

<sup>3</sup> *Dicle University Faculty of Medicine Histology and Embryology Department, Diyarbakır, Turkey.  
0000-0002-23531184*

### Abstract

In our study, it is emphasized that the cytokine interleukin-10 (IL-10) has the potential to be an important immunosuppressant in response to many inflammatory events in patients diagnosed with placenta previa, and its effect on the development of the caspas-6 reaction in the root villi during the apoptotic process. If we refer to the findings obtained in this study; Significant increase in fibrinoid tissue in root villi, significant dilatation and congestion in blood vessels, hyperplasia in endothelial cells were observed. An increase in IL10-expression in inflammatory cells in syncytial areas around blood vessels, and Caspas-6 expression in syncytial knots and cytotrophoblast cells were observed to increase significantly. It is thought that placenta previa, which causes closure of the cervix, may cause an increase in inflammation in stem villus development and a significant negativity in fetal development, as it accelerates the apoptotic process due to the lack of oxygen after significant bleeding.

**Keywords:** Stem villus, Placenta Previa, IL-10, Caspase-6 Expression

### INTRODUCTION

Placenta previa occurs when the placenta attaches to the inside of the uterus, near or above the cervical opening. It affects about 0.5% of pregnancies. Placenta previa is also associated with the development of pregnancy complications associated with placental insufficiency, such as pregnancy-induced hypertension, preeclampsia (Sheiner et al., 2001), IL-10 is the main regulator of the inflammatory process and is present as a major immunomodulatory agent in the fetomaternal interface. The trophoblasts (Roth et al., 1996), decidua macrophages (Heikkinen, Möttönen, Komi, Alanen, & Lassila, 2003), produce IL-10. It is most expressed at the fetomaternal interface of the extra villous cytotrophoblasts during the early pregnancy and villous cytotrophoblasts in late pregnancy (Toole, 2004). In this study, it was aimed to investigate how an immunosuppressor cytokine IL-10 signaling affects the apoptotic process in placenta previa and its role in placenta previa therapy.

### MATERIALS AND METHODS

This study was performed at Atatürk University, Department of Obstetrics and Gynecology, between September 2020 and April 2021.. The study included 10 pregnant patients with placenta previa and 10 healthy pregnant patients between 28 and 38 weeks

gestational age. The gestational weeks of the women were determined according to the last date of menstruation and/or ultrasonographic measurements. For groups PP and Normotensive, portions of connecting rod region of placenta were collected

Table 1 shows the clinical features of both control women and women with placenta previa.

Samples of placental tissue obtained from healthy pregnant women and women with Placenta previa immediately after caesarean deliveries were cut out from the maternal side around the umbilical cord in sterile conditions. Immediately after birth, normal (n=10) and Placenta previa (n=10) tissues were moved from the delivery room to the laboratory and, after preliminary histopathological examination, two series of tissue samples were obtained. Samples of placental tissue were immersed in 10% buffered formaldehyde. Then, 4-6 µm thick sections were cut and made into slides for routine histopathological examination.

### ***Immunohistochemistry staining***

Sections were brought to distilled water and washed in 3x5 min phosphate buffered saline (PBS). Antigen retrieval was done in a microwave (Bosch®, 700 watt) for 2 min x 90°C. They were subjected to a heating process in a microwave oven at 700 watts in a citrate buffer (pH 6) solution for proteolysis. Sections were washed in 3x3 min PBS and incubated with hydrogen peroxide Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) [Dortmudt+Germany, MERCK] (3ml %30 Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) + 27ml methanol) for 10 min. Sections were washed in 3x3 min PBS and blocked with Ultra V Block for 6 min. After draining, primary antibodies Caspase-6 antibody, mouse monoclonal (1/100) and Interleukin-10 antibody, mouse monoclonal (1/100) were applied. Sections were incubated and left overnight at 4°C. Sections were washed in 3x3 min PBS and then incubated with secondary antibody (Histostain-Plus Kit, Invitrogen, Carlsbad, CA) applied for 20 minutes. After washing with PBS, Streptavidin Peroxidase was applied to sections for 15 min. Sections were washed in 3x5 min PBS and DAB was applied to the sections for up to 5 min. Slides showing reaction were stopped in PBS. Counter staining was done with Harris's Haematoxylin for 20 sec, dehydrated through ascending alcohol, and cleared in xylene. Slides were mounted with Entellan® and examined under light microscopy.

### **Statistical Analysis**

Statistical analyses were carried out using the statistical package SPSS 15.0 for Windows (SPSS Inc., Chicago, IL, USA). The Mann-Whitney U test was performed to compare data from control and preeclampsia patients.

### **Result**

Nonparametric Mann-Whitney U test used to analyze significance between groups. Mean Ranks of each group and p value evaluated. Statistically p<0,05 means significant difference between groups.

	Control	Placenta Previa	p=	St. Dev.
Age	10,71	20,87	0,004	3,48
Gravida	8,00	23,18	0,000	1,29
Parity	8,00	23,00	0,000	0,59
Gestational age (week)	23,89	8,00	0,000	1,22
Diameters of Floating Small Villus	20,98	10,87	0,002	0,88
Epithelial thickness in villi	15,86	15,78	0,852	0,32
Diameter of Blood Vessels in Villi	23,54	8,25	0,000	1,68



Diameter of Decidua Cells	23,01	8,01	0,000	3,10
Sinsistial Knot	8,00	23,00	0,000	1,42
Congestion in Blood Vessels	8,00	23,00	0,000	1,66
Fibrinoid Accumulation	8,00	23,00	0,000	1,55
Inflammation	8,00	23,00	0,000	1,63
Degeneration in Decidua	8,00	23,00	0,000	1,58

**Table 1:** Mann-Whitney U test results. Mean Ranks of groups, p values and Standard Deviations as shown. Statistically  $p < 0,05$  means difference between control and placenta previa groups.

### Histopathologic finding

**Control group:** Lumens of blood vessels were regular and endothelial cells were seen as flat in the connecting stem region. It was observed that syncytial nuclei where connective tissue cells were regularly distributed in the stromal area, flat fibroid structures were less, and the intervillous area between freely distributed villi was normal (Figure-1a).

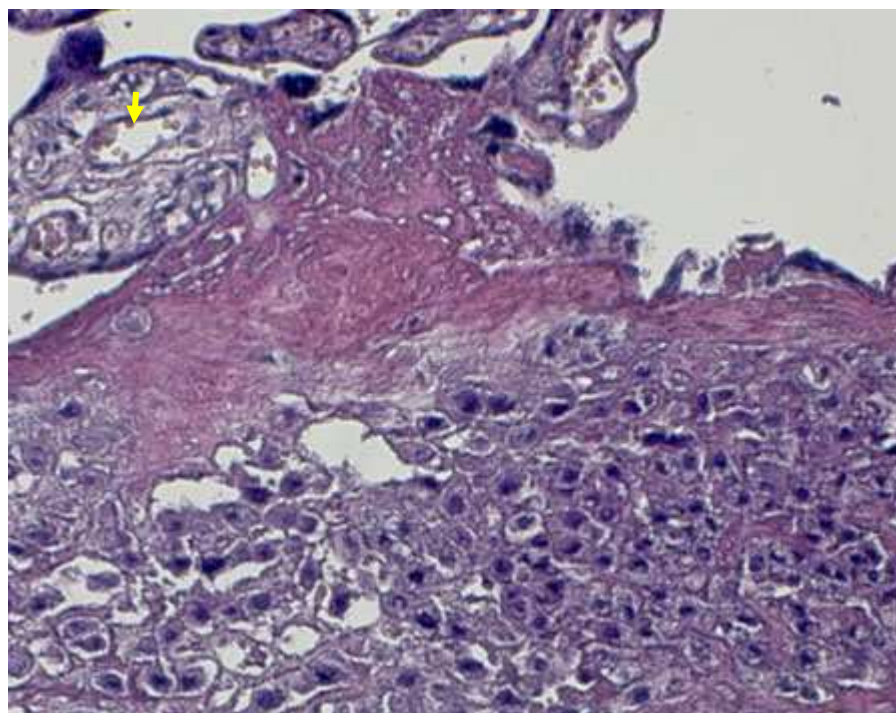
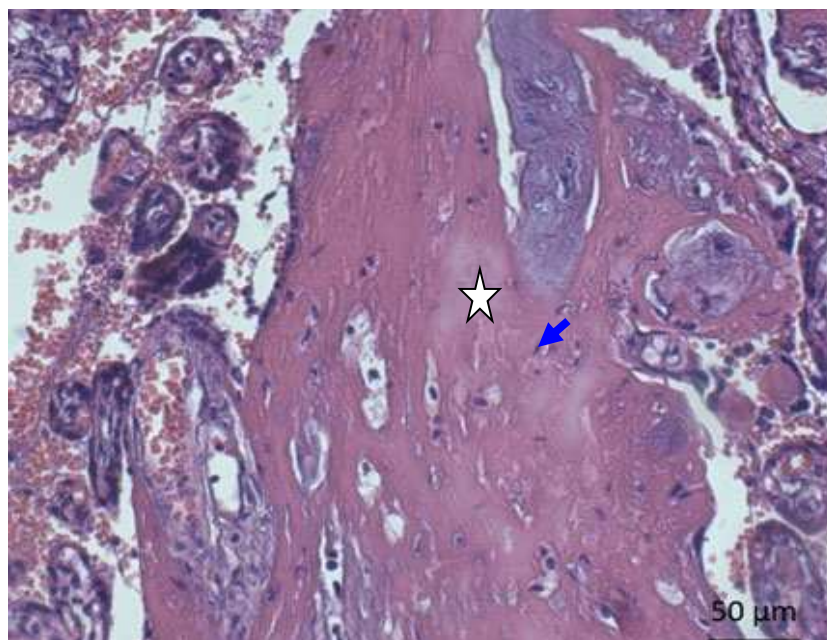
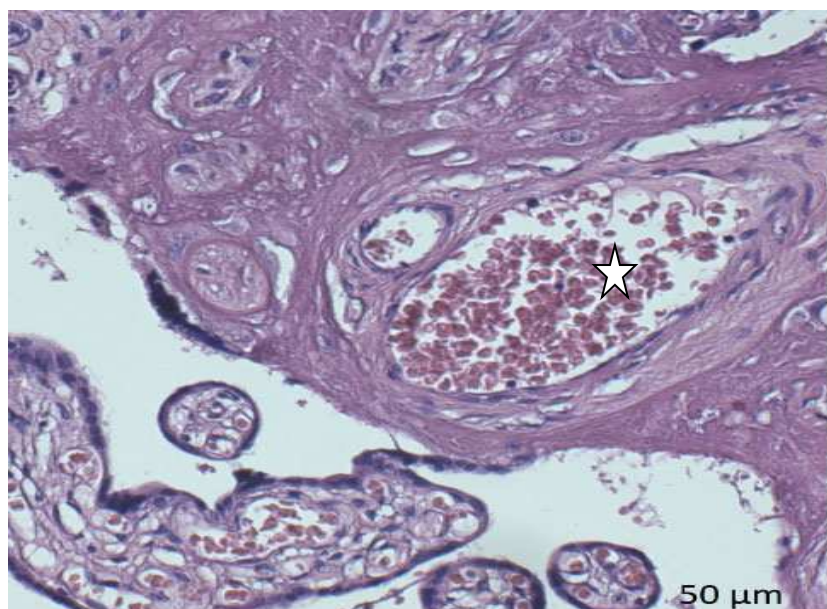


Figure 1a: Control group: Lumens of blood vessels are regular and endothelial squamous endothelial cells H-E staining

**Placenta previa group:** Significant degeneration and increase in fibrinoid structures in syncytial cells of root villi, apoptotic changes in stromal cells, excessive enlargement and occlusion of blood vessels and hyperplastic endothelial cells were observed. increased syncytial nodes, accumulated fibroid accumulation between syncytial bridges, and increased infiltration of dense erythrocytes and inflammatory cells were observed. (Figure-1b).



**Figure1b Placenta previa:**Significant degeneration and increase in fibrinoid structures(star) in syncytial cells of root villi, apoptotic changes in stromal cells(arrow) H-E staining

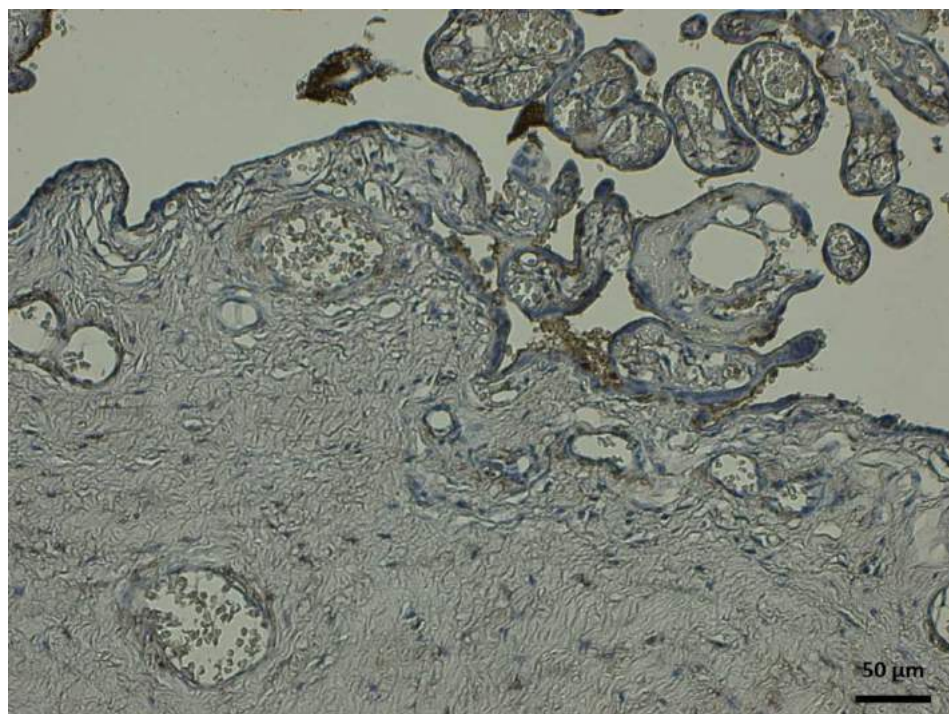


**Figure1b Placenta previa** Dilatation and congestion in root villus vessels(star) H-E staining  
**Immunohistochemical finding**

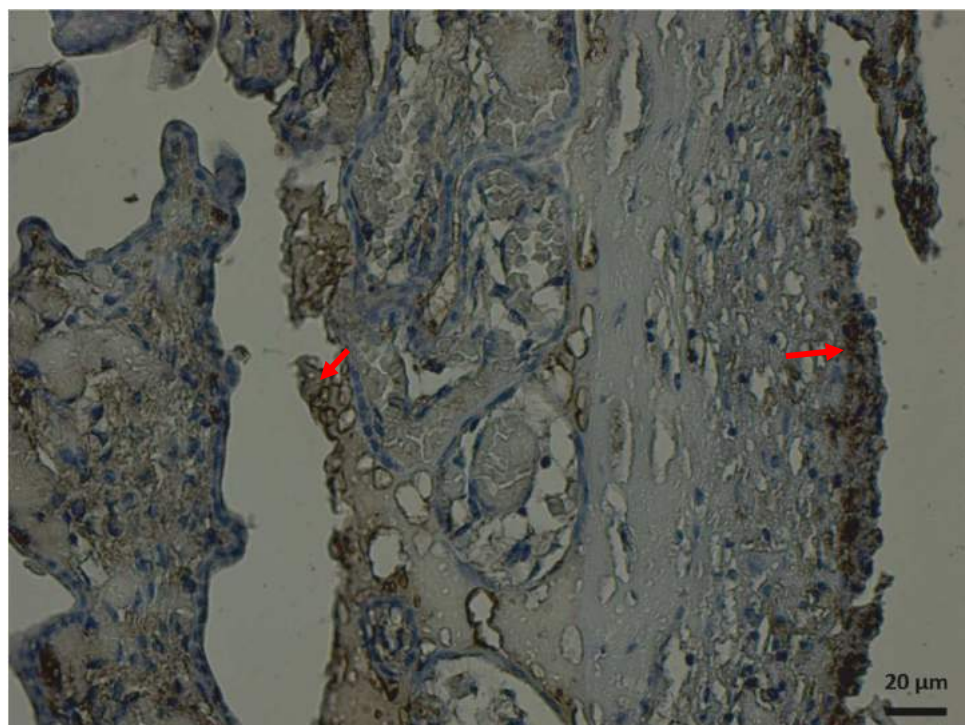
**Control group:** Negative caspase-6 expression was observed in most of the syncytial cells in root villi in the connecting stem region, and mild caspase-6 reaction was observed in decidua cells and some stromal cells.

**Placenta previa group:.** Kaspas-6 expression was positive in decidua cells located in the periphery of root villi, blood vessel endothelial cells and some syncytial nodes.





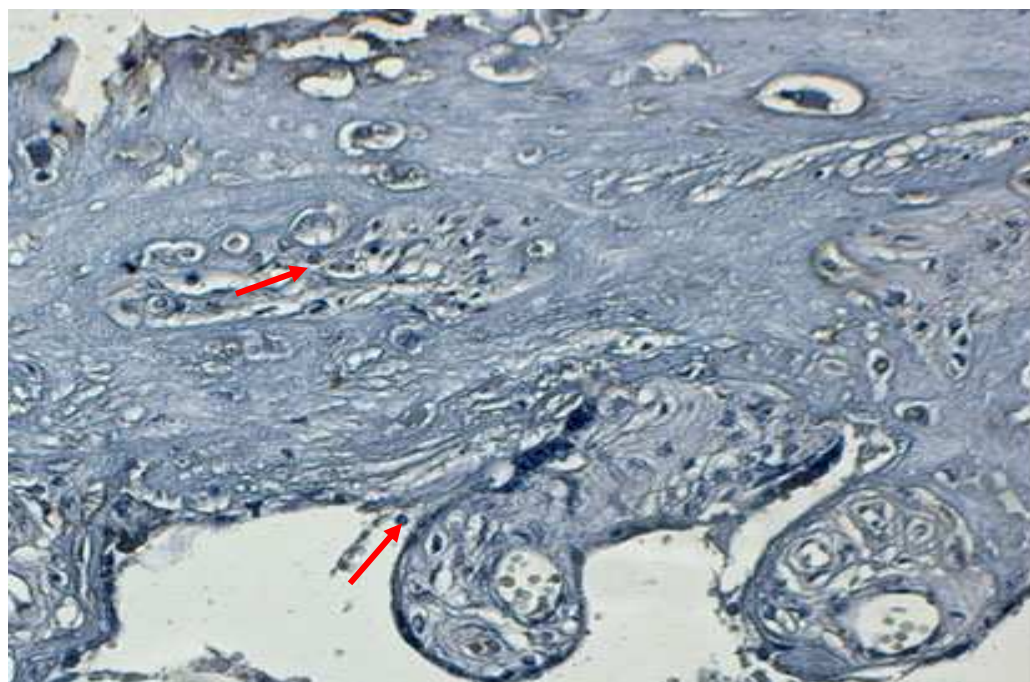
**Figure 2b Control group:** Negative caspase-6 expression in syncytial cells of root villi in the connecting stem region, Caspase-6 Immun-staining



**Figure 2b-Placenta previa group:** Positive Caspase-6 expression in deciduas cells and endotel cells ,syncytial knots Caspase-6 Immun-staining

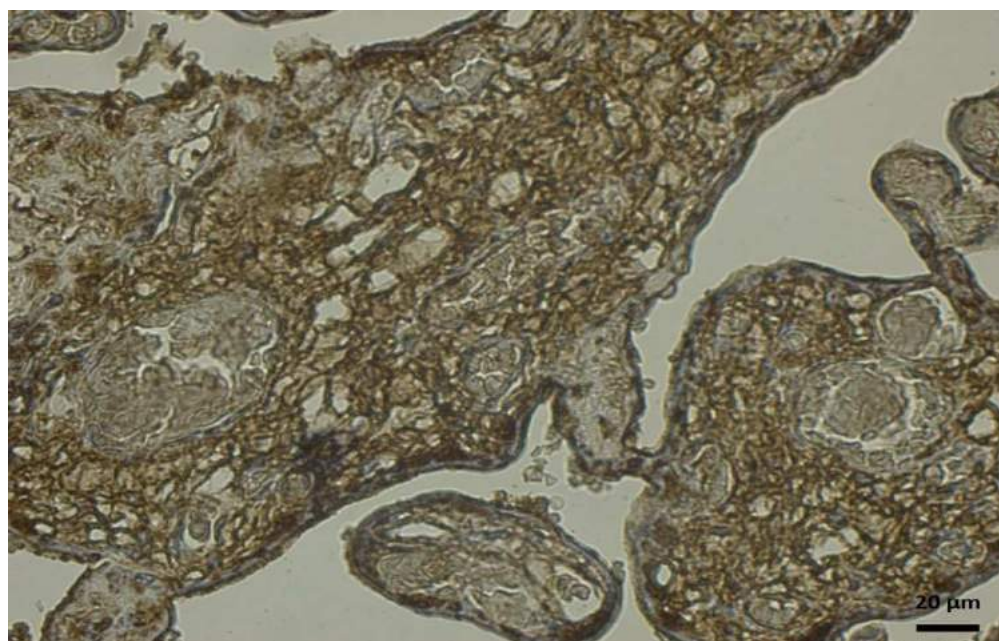
#### IL-10 immunactivity

**Control group :** Negative IL-10 expression was observed in the syncytial area and decidua cells of the root villi. In addition, mild IL-10 expression was observed in the endothelial cells and macrophage cells in the umbilical artery branches.



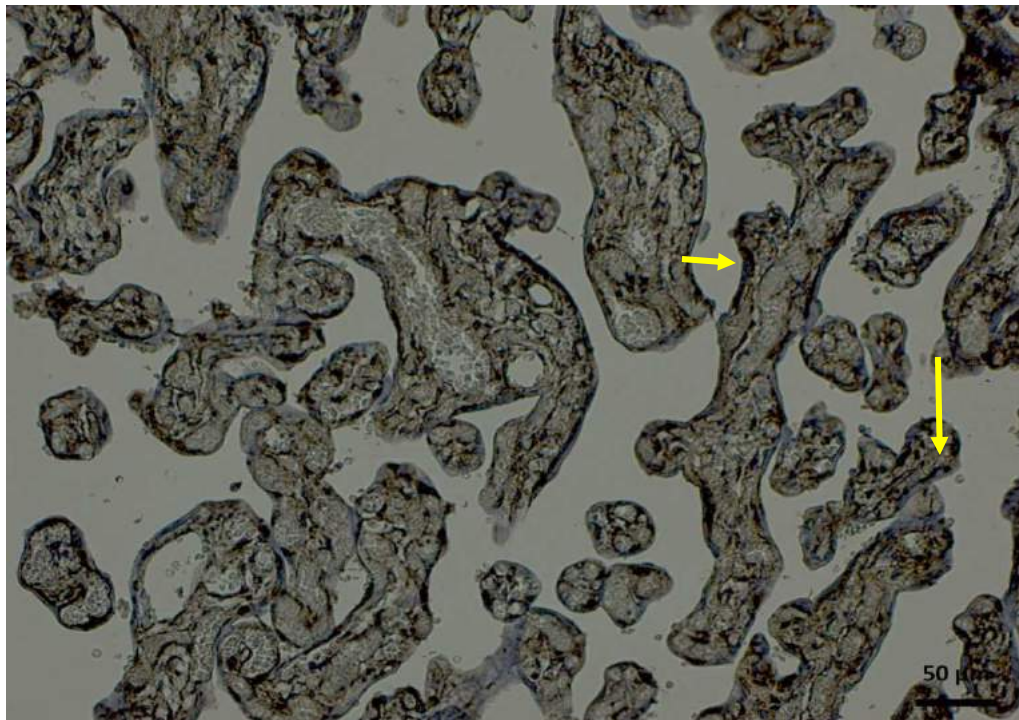
**Figure 3a-Control group:** Negative IL-10 expression in the syncytial area and decidua cells of the root villi IL-10 immunostaining

**Placenta previa group:** An increase in IL-10 expression was observed in the endothelial cells in the branches of the umbilical vessels in the connecting stem region and in the cells in the stromal area around it. Diffuse IL-10 expression was observed in the decidua cells and syncytial region.



**Figure 3b-placenta previa group:** An increase in IL-10 expression in the endothelial cells in the branches of the umbilical vessels in the connecting stem IL-10 immunostaining





**Figure3c- placenta previa group:**An increase in syncytial knots and macrophages of chorionic villi(arrow) IL-10 immunostaining

## DISCUSSION

Few studies have been reported on the molecular mechanisms underlying placenta previa. Recently, there have been studies on the molecular regulation of trophoblast cell infiltration and placental angiogenesis (Xie et al., 2017). Hypotheses including the pathogenesis of placenta previa, abnormal interaction between the decidua and invasive extravillous trophoblast have been proposed. Hypoxia-induced placental oxidative stress activates apoptosis. Apoptosis by hypoxia is activated by the mitochondrial pathway (da Cunha Castro & Popek, 2018). Caspase-6 is a member of the caspase family and has a teratogenic effect due to increased inflammation. It has a similar effect after caspase-3 induction. It has been reported that caspase-3 and 6.7 are activated via cytokine signaling. There is no study on the effect of caspase-6 activity in placenta previa complication. Mitochondrial damage in caspase-3 (Arroyo et al., 2010) and endoplasmic reticulum damage in caspase-12 are shown.

In our study, it was shown that caspase-6 activity of decidual cells towards the periphery of the maternal region was evident especially in the placenta previa group, and this could affect decidual development.. In our study, clinical findings and cell diameter changes in placenta previa showed significant differences compared to the control group.

It has been shown that women diagnosed with placenta previa in the third trimester have significantly higher chorionic plate diameters, chorionic plate areas and marginal cord insertion in their placentas (Jung et al., 2018). High levels of the pro-inflammatory cytokine TNF- $\alpha$  and decreased levels of the anti-inflammatory cytokine IL-10 have been shown to have a central role in the pathogenesis of preterm labor (Romero et al., 2006). There is a decrease in placental IL-10 in preeclampsia. It has been reported that the ratio of IL-10 to other cytokines in preeclampsia may be critical in determining the degree of placental acceptance by the uterine tissues and therefore in determining the degree of placental development and invasion. However, no explanatory result regarding IL-10 expression in placenta previa has



been reported. In our study, it was observed that the IL-10-reaction was significantly increased in the placenta previa group compared to the control group. Deterioration of trophoblastic defense due to severe bleeding effect caused placental destruction by affecting angiogenesis and increasing apoptosis. Placental invasion is among an essential feature of cytotrophoblast fusion and syncytiotrophoblast function. It also potentially plays a role in maternal immune tolerance in decidual development.

It has been observed that it can start with various stimuli, including placental apoptosis, hypoxia and oxidative stress, that the cytokine activity increases the cell signal as a result of abnormal placenta development placenta previa and that the resulting cell degeneration accelerates maternal decidua and trophoblast apoptosis. It is thought that IL10 pathways, one of the key proteins involved in the regulation of placental apoptosis, may be a pioneer in the development of future therapeutic strategies in understanding the role of placenta previa. It has been observed that it may adversely affect the vital risk and fetal development by inducing.

## CONCLUSION

Placenta previa occurs when the placenta attaches to the inside of the uterus, near or above the cervical opening. It affects about 0.5% of pregnancies. Placenta previa is also associated with the development of pregnancy complications associated with placental insufficiency, such as pregnancy-induced hypertension, preeclampsia. IL-10 is the main regulator of the inflammatory process and is present as a major immunomodulatory agent in the feto-maternal interface. In line with the findings obtained in this study, there was a significant increase in fibrinoid tissue in root villi, a significant enlargement and obstruction in blood vessels was observed, and hyperplasia was observed in endothelial cells. As a result, when we look at; It is thought that placenta previa, which causes the closure of the cervix, accelerates the apoptotic process due to oxygen deficiency after significant bleeding, and may cause an increase in inflammation in root villus development and a marked negativity in fetal development.

## REFERENCES

- 1- Arroyo, J. A., Li, C., Schlabritz-Loutsevitch, N., McDonald, T., Nathanielsz, P., & Galan, H. L. (2010). Increased placental XIAP and caspase 3 is associated with increased placental apoptosis in a baboon model of maternal nutrient reduction. *Am J Obstet Gynecol*, 203(4), 364.e313-368. doi:10.1016/j.ajog.2010.05.021
- 2- da Cunha Castro, E. C., & Popek, E. (2018). Abnormalities of placenta implantation. *Apmis*, 126(7), 613-620. doi:10.1111/apm.12831
- 3- Heikkinen, J., Möttönen, M., Komi, J., Alanen, A., & Lassila, O. (2003). Phenotypic characterization of human decidual macrophages. *Clin Exp Immunol*, 131(3), 498-505. doi:10.1046/j.1365-2249.2003.02092.x
- 4- Jung, E. J., Cho, H. J., Byun, J. M., Jeong, D. H., Lee, K. B., Sung, M. S., . . . Kim, Y. N. (2018). Placental pathologic changes and perinatal outcomes in placenta previa. *Placenta*, 63, 15-20. doi:10.1016/j.placenta.2017.12.016
- 5- Romero, R., Espinoza, J., Kusanovic, J. P., Gotsch, F., Hassan, S., Erez, O., . . . Mazor, M. (2006). The preterm parturition syndrome. *Bjog*, 113 Suppl 3(Suppl 3), 17-42. doi:10.1111/j.1471-0528.2006.01120.x
- 6- Roth, I., Corry, D. B., Locksley, R. M., Abrams, J. S., Litton, M. J., & Fisher, S. J. (1996). Human placental cytotrophoblasts produce the immunosuppressive cytokine interleukin 10. *J Exp Med*, 184(2), 539-548. doi:10.1084/jem.184.2.539

- 7- Sheiner, E., Shoham-Vardi, I., Hallak, M., Hershkowitz, R., Katz, M., & Mazor, M. (2001). Placenta previa: obstetric risk factors and pregnancy outcome. *J Matern Fetal Med*, 10(6), 414-419. doi:10.1080/714052784
- 8- Toole, B. P. (2004). Hyaluronan: from extracellular glue to pericellular cue. *Nat Rev Cancer*, 4(7), 528-539. doi:10.1038/nrc1391
- 9- Xie, H., Qiao, P., Lu, Y., Li, Y., Tang, Y., Huang, Y., . . . Ying, H. (2017). Increased expression of high mobility group box protein 1 and vascular endothelial growth factor in placenta previa. *Mol Med Rep*, 16(6), 9051-9059. doi:10.3892/mmr.2017.7682

## EXAMPLES OF REGRESSION AND CORRELATION ANALYSIS IN ECONOMETRIC STUDIES

EKONOMETRIK TƏDQIQATLARDA REQRESSIYA VƏ KORRELYASIYA TƏHLİLİ  
NÜMUNƏLƏRİ

**GULARA RAHIMOVA**

*Baku State University, Associate professor*

*ORCID NO: 0000-0003-3084-9091*

**NARMIN GULIYEVA**

*Baku State University, Master ORCID NO: 0000-0002-3181-5523*

### Introduction

The theoretical basis of econometrics is mathematical statistics and economic cybernetics. The aim of econometrics is to obtain point and interval forecasts of the functioning of economic systems. Therefore, the following basic principles of econometrics should be taken into account in the design of arbitrary econometric models.

- Basic principles of the theoretical model of econometrics;
- Criteria and principles of econometrics;
- Features of theoretical models of econometrics;
- Model evaluation based on information data;
- The aim of the observations is to identify the problem;
- Determining the efficiency of the model;
- Establishment and improvement of an alternative model;
- Carrying out numerous observations;
- Use of the model for forecasting and implementation of economic policy.

One of the most important prerequisites for econometric modeling is the randomness of events and experiments. The adequacy of the result obtained depends largely on the fulfillment of this condition. This condition is not a coincidence in the simplest sense. If a process or event occurs without external influences, regardless of its internal nature or regularities, then it is considered to be accidental. Each quantity is divided into two parts, fixed and random. Accidental part may be due to technical equipment errors in measurements and calculations, errors made by the human brain or eyesight. It has been proved in sampling theory that all the characteristics of the random part of a quantity apply to the quantity itself. The results of econometric modeling, including the principles and laws of sampling theory, can be used to assess people's performance in public life.

Based on what it was said, in this article we have looked at examples of the application of regression and correlation analysis in econometric modeling. The results of the analysis show that the main task of correlation analysis is to identify the relationship between the variables and evaluate its relationship density. To check for a linear relationship between variables, the correlation coefficient must first be checked. Regression analysis is an analysis method used to determine the shape of the relationship between two or more variables. Regression analysis is completed by performing steps such as selecting the model type, calculating the parameters, constructing the model, and assessing its adequacy and accuracy. The level of accuracy of the model characterizes the degree of inclination of the actual values of the dependent variable from the values obtained on regression models. Estimates such as average relative error, average absolute error, standard error are used to assess the level of accuracy of the model.

**Keywords:** Regression and correlation analysis, alternative models, model accuracy level, Sampling theory, econometric models

**GİRİŞ.** Ekonometrikanın nəzəri bazasını riyazi statistika və iqtisadi kibernetika təşkil edir. Ekonometrikanın məqsədi iqtisadi sistemlərin fəaliyyətinin nöqtəvi və interval proqnozlarını əldə etməkdən ibarətdir. Buna görə də ixtiyari ekonometrik modellərin tərtibində ekonometrikanın aşağıdakı əsas prinsipləri nəzərə alınmalıdır.

- Ekonometrikanın nəzəri modelinin əsas prinsipləri;
- Ekonometrikanın kriteriya və prinsipləri;
- Ekonometrikanın nəzəri modellərinin xüsusiyyətləri;
- İnformasiya verilənləri əsasında modelin qiymətləndirilməsi;
- Müşahidələrin aparılmasında məqsəd problemin qoyuluşudur;
- Modelin səmərəliliyinin təyin edilməsi;
- Alternativ modelin qurulması və təkmilləşdirilməsi;
- Çoxsaylı müşahidələrin aparılması;
- Proqnoz üçün modeldən istifadə və iqtisadi siyasətin həyata keçirilməsi.

Ekonometrik modelləşdirmədə ən vacib ilkin şərtlərdən biri hadisə və sınaqların təsadüfi xarakter daşmasıdır. Alınmış nəticənin adekvatlığı bu şərtin ödənilməsindən xeyli dərəcədə asılıdır. Bu şərt heç də bəsit mənada başa düşülən təsadüflilik deyil. Əgər proses və ya hadisə kənar təsirlər olmadan, asılı olmayaraq öz daxili mahiyyəti və ya qanunauyğunluqları ilə baş verirsə, onda onun təsadüfi olması qəbul edilir. Hər bir kəmiyyət sabit və təsadüfi olan iki hissəyə bölünür. Təsadüfi hissə ölçmə və hesablamalarda texniki avadanlıqların səhvi, insan beyninin və ya gözün görməsinin buraxdığı səhvlərlə əlaqədar ola bilər. Seçmə nəzəriyyəsində sübut olunmuşdur ki, kəmiyyətin təsadüfi hissəsinin bütün xarakteristikaları elə kəmiyyətin özünə də aiddir. Ekonometrik modelləşdirmənin nəticələrindən, o cümlədən seçmə nəzəriyyəsinin prinsip və qanunlarından ictimai həyatda insanların fəaliyyətinin qiymətləndirilməsində istifadə etmək mümkündür.

Bu dediklərimizi əsas götürərək, biz məqalədə ekonometrik modelləşdirmədə, reqressiya və korrelyasiya analizinin tətbiqi nümunələrinə baxmışıq. Təhlil nəticəsi göstərir ki, Korrelyasiya analizinin əsas məsələsi dəyişənlər arasındakı əlaqənin üzə çıxarılması və onun əlaqə sıxlığının qiymətləndirilməsindən ibarətdir. Dəyişənlər arasında xətti asılılığın mövcud olub-olmadığını yoxlamaq üçün, ilk növbədə korrelyasiya əmsalını yoxlamaq lazımdır. Reqressiya analizi isə iki ya da daha çox dəyişən arasındakı asılılığın şəklinin müəyyən edilməsi üçün aparılan analiz metodudur. Reqressiya analizi model növünün seçilməsi, parametrlərinin hesablanması, modelin qurulması, onun adekvatlıq və dəqiqliyinin qiymətləndirilməsi kimi mərhələlərin icrası ilə tamamlanır. Modelin dəqiqlik səviyyəsi asılı dəyişənin faktiki qiymətlərinin reqressiya modelləri üzrə alınmış qiymətlərdən meyletmə dərəcəsini xarakterizə edir. Modelin dəqiqlik səviyyəsinin qiymətləndirilməsi üçün orta nisbi xəta, orta mütləq xəta, standart xəta kimi qiymətləndirmələrdən istifadə edilir.

**Açar sözlər:** Reqressiya və korrelyasiya analizi, alternativ modellər, modelin dəqiqlik səviyyəsi, Seçmə nəzəriyyəsi, ekonometrik modellər

**Reqressiya və korrelyasiya təhlilinin mahiyyəti.** Aşağıda qurduğumuz ekonometrik modellərlə reqressiya və korrelyasiya təhlilinin mahiyyətini açıqlayaq.

Məsələ 1. Region üzrə verilənlər 2020-ci il üçün cədvəl 1-də göstərilib. Tələb olunur:

1.  $y$ -in  $x$ -dən asılılığının xətti cüt reqressiya tənliyini qurmalı.
2. Xətti cüt korrelyasiya əmsalını və approksimasiyanın orta səhvinə hesablamalı.
3. Reqressiya və korrelyasiya parametrlərinin statistik əhəmiyyətliyini qiymətləndirməli.
4. Orta səviyyədə 107% fərqlənən  $x$  orta adambaşı yaşam minimumunun proqnoz qiymətində  $Y$  əmək haqqı proqnozunu hesablamalı.

5. Proqnoz səhvinə və onun inamlı intervalını hesablamaqla proqnozun dəqiqliyini qiymətləndirməli.

Cədvəl 1.

Regionun nömrəsi	Bir əməkqabiliyyətli insanın həftə ərzində orta adambaşı yaşam minimumu, manat, x	Ortahəftəlik əmək haqqı, manat, y
1	80	136
2	80	151
3	90	132
4	76	152
5	91	164
6	104	197
7	70	137
8	85	156
9	75	155
10	85	165
11	78	157
12	113	171

Məsələnin həlli.

1. Xətti regressiya tənliyi parametrlərinin hesablanması üçün aşağıdakı cədvəli quraq. Cədvəl 2.

Cədvəl 2.

	Y	X	Yx	x <sup>2</sup>	y <sup>2</sup>	$\hat{y}_x$	$y - \hat{y}_x$	A <sub>i</sub>
1	136	80	10880	6400	18496	155,714	-19,7	14,5
2	151	80	12080	6400	22801	155,714	-4,7	3,11
3	132	90	11880	8100	17424	155,697	-23,7	17,95
4	152	76	11552	5776	23,104	155,7208	-3,72	2,45
5	164	91	14924	8281	26896	155,6953	8,30	5,06
6	197	104	20488	10816	38809	155,6732	41,33	20,98
7	137	70	9590	4900	18769	155,731	-18,731	13,67
8	156	85	13260	7225	24336	155,7055	0,29	0,19
9	155	75	11625	5625	24025	155,7225	-0,72	0,46
10	165	85	14025	7225	27225	155,7055	9,29	5,63
11	157	78	12246	6084	24649	155,7174	1,28	0,82
12	171	113	19323	12769	29421	155,6579	15,34	8,97
Yekun	1027	1873	161873	89601	295955	-	4,559	93,79
Orta qiymət	85,6	156	13489,4	7466,8	24663	-	-	7,8
$\sigma$	11,8	18						
$\sigma^2$	1139,44	327						

$$b = \frac{\overline{y \cdot x} - \bar{y} \cdot \bar{x}}{\sum x^2 - (\bar{x})^2}$$

$$b = \frac{13489,4 - 156 \cdot 85,6}{89601 - 7323,36} = \frac{13489,4 - 13353,6}{82273,64} = \frac{135,8}{82273,64} = 0,0017$$

$$a = \bar{y} - b \cdot \bar{x}$$

$$a = 156 - 0,0017 \cdot 85,6 = 156 - 0,146 = 155,85$$



Belə bir regressiya tənliyi alınır:

$$\hat{y}_x = 155,85 - 0,0017 \cdot x.$$

Tənlikdən görünür ki, orta adambaşı yaşam minimumunu 1 manat artırmaqla orta günlük əmək haqqı orta hesabla 0,0017 manat artır.

2. Korrelyasiya əmsalı xətti əlaqələrin sıxlığını qiymətləndirir [4]:

$$r_{xy} = b \frac{\sigma_x}{\sigma_y};$$

$$r_{xy} = 0,0017 \cdot \frac{11,8}{18} = 0,001;$$

$$r_{xy}^2 = 0,000001$$

$$\sigma_x^2 = \overline{x^2} - \bar{x}^2;$$

$$\sigma_y^2 = \overline{y^2} - \bar{y}^2$$

$$\sigma_x^2 = 7466,8 - 7327,36 = 139,44$$

$$\sigma_x = 11,8$$

$$\sigma_y^2 = 24663 - 24336 = 327$$

$$\sigma_y = 18$$

Bu o deməkdir ki, 0,0001% əmək haqqının variyasiyası (y) - x faktorunun variyasiyası ilə - orta adambaşı yaşam minimumu ilə izah olunur. Modelin keyfiyyəti aproksimasiyanın orta səhvini müəyyən edir:

$$\bar{A} = \frac{1}{n} \sum A_i; \quad \bar{A} = \frac{1}{12} \cdot 93,79 = 7,8\%.$$

Qurulmuş modelin keyfiyyəti yaxşı qiymətləndirilir, belə ki,  $\bar{A}$  8-10% -i aşmır.

3. Regressiya parametrlərinin əhəmiyyətliyinin statistik qiymətləndirilməsi Studentin -t kriteriyası və hər bir göstəricinin inamlı intervalının hesablanması yolu ilə aparılır.

0-dan fərqli göstəricilərin statistik əhəmiyyətsizliyi haqqında  $H_0$  hipotezini irəli sürək:  $a=b=r_{xy}=0$ .

$t_{\text{cəd}} d f = n-2 = 12-2 = 10$  sərbəstlik dərəcəsi və  $\alpha = 0,05$  üçün 2,23 təşkil edir.

Təsadüfi səhvləri təyin edək- $m_a$ ,  $m_b$ ,  $m_{rxy}$ :

$$m_a = \sqrt{\frac{\sum \left( y - \hat{y}_x \right)^2}{n-2} \cdot \frac{\sum x^2}{n \cdot \sum (x - \bar{x})^2}}$$

$$m_a = \sqrt{\frac{4,559^2}{12-2} \cdot \frac{89601}{12 \cdot 11,8}} = \sqrt{1315} = 36,3$$

$$m_b = \sqrt{\frac{\sum \left( y - \hat{y}_y \right)^2}{n-2} \cdot \frac{1}{\sum (x - \bar{x})^2}}$$

$$m_b = \sqrt{\frac{4,559/10}{11,8}} = \sqrt{0,038} = 0,19$$

$$m_{r_{xy}} = \sqrt{\frac{1-r^2}{n-2}}, \quad m_{r_{xy}} = \sqrt{\frac{1-0,000001}{10}} = \sqrt{\frac{0,999999}{10}} = 0,316,$$

Onda

$$t_a = \frac{a}{m_a}; \quad t_b = \frac{b}{m_b}; \quad t_r = \frac{r}{m_r};$$

$$t_a = \frac{155,85}{36,3} = 4,3 \quad t_b = \frac{0,0017}{0,19} = 0,0089 \quad t_r = \frac{0,001}{0,316} = 0,003$$

$t_a$ -statistikanın faktiki qiyməti onun cədvəl qiymətini aşır.

Belə ki,  $t_a = 4,3 > t_{cad} = 2,3$ , onda reqressiya əmsalının  $-a$ - statistik əhəmiyyətliyi sübut olunmuş olur (bu əmsalın 0-ra bərabər olması haqqında hipotez rədd edilir).

Belə ki,  $t_b = 0,0089 < t_{tab} = 2,3$ ,  $t_{r_{xy}} = 0,003 < t_{cad} = 2,3$ , onda  $b$  reqressiya əmsalının statistik əhəmiyyətli olması sübut oluna bilmir, (bu əmsalın 0-ra bərabər olması haqqında hipotezi rədd edə bilmərik).  
 $a$  və  $b$  üçün inamlı intervalı hesablayaq. Bu məqsədlə hər bir göstərici üçün limit səhvini təyin edək:

$$\Delta_a = t_{tab} \cdot m_a;$$

$$\Delta_a = 2,23 \cdot 36,3 = 80,9,$$

$$\Delta_b = t_{tab} \cdot m_b$$

$$\Delta_b = 2,23 \cdot 0,19 = 0,42$$

İnamlı interval:

$$\gamma_a = a \pm \Delta_a = 155,85 \pm 80,9,$$

$$\gamma_{a_{min}} = 155,85 - 80,9 = 74,95,$$

$$\gamma_{a_{max}} = 155,85 + 80,9 = 236,75$$

$$\gamma_b = b \pm \Delta b = 0,0017 \pm 0,42,$$

$$\gamma_{b_{min}} = 0,0017 - 0,42 = -0,4183,$$

$$\gamma_{b_{max}} = 0,0017 + 0,42 = 0,4217.$$

İnamlı intervalın yuxarı və aşağı sərhədlərinin analizi bizə belə bir nəticəyə gəlməyə imkan verir:  $\rho = 1 - \alpha = 0,95$  ehtimalı ilə verilmiş sərhəddə yerləşən  $a$  parametri 0 qiymətini almır, başqa sözlə, statistik əhəmiyyətli hesab olunmur və əhəmiyyətli dərəcədə 0-dan fərqlənir [3].

İnamlı intervalın yuxarı və aşağı sərhədlərinin analizi bizə belə bir nəticəyə gəlməyə imkan verir:  $\rho = 1 - \alpha = 0,95$  ehtimalı ilə verilmiş sərhəddə yerləşən  $b$  parametri 0 qəbul edilir, başqa sözlə, eyni zamanda mənfə və müsbət qiymətlər ala bilmir.

4. Reqressiya tənliyinin alınmış qiymətləri proqnoz vermək üçün istifadə olunur. Əgər yaşam minimumunun orta qiymətləri:

$$x_p = \bar{x} \cdot 1,07 = 85,6 \cdot 1,07 = 91,6$$

min manat təşkil edirsə, onda yaşam minimumunun proqnoz qiyməti:

$$\hat{y}_p = 155,85 + 0,0017 \cdot 91,6 = 156 \text{ manat təşkil edir.}$$

5. Proqnoz səhvi aşağıdakı kimidir :

$$m_{\hat{y}_\rho} = \sqrt{\frac{\sum (y - \hat{y})^2}{n - m - 1}} \cdot \sqrt{1 + \frac{1}{n} + \frac{(x_\rho - \bar{x})^2}{\sum (x - \bar{x})^2}}$$

$$m_{\hat{y}_\rho} = \sqrt{\frac{(4,559)^2}{9}} \cdot \sqrt{1 + \frac{1}{12} + \frac{(91,6 - 85,6)^2}{12 \cdot (11,8)^2}} = \sqrt{\frac{20,78}{9}}$$

$$\sqrt{1 + \frac{1}{12} + \frac{36}{1670,88}} = \sqrt{2,3} \cdot \sqrt{1 + \frac{1}{12} + 0,022} = 1,5 \cdot \sqrt{1,105} = 1,575 \text{ min manat.}$$

95% hallarda aşağıdakı qiymətləndirmələri aşmayan limit səhvinin proqnozu:

$$\Delta_{\hat{y}_\rho} = t_{tab} \cdot m_{\hat{y}_\rho},$$

$$\Delta_{\hat{y}_\rho} = 2,23 \cdot 1,575 = 3,51$$

kəmiyyəni təşkil edir. Proqnozun inamlı intervalı:

$$\gamma_{\hat{y}_\rho} = 91,6 \pm 3,51.$$

$$\gamma_{\hat{y}_{\rho\min}} = 91,6 - 3,51 = 88,09 \quad \text{man;}$$

$$\gamma_{\hat{y}_{\rho\max}} = 91,6 + 3,51 = 95,11 \quad \text{man.}$$

Alınmış orta həftəlik əmək haqqı proqnozu ümidvericidir ( $\rho = 1 - \alpha = 0,95$ ), lakin dəqiq deyil, beləki,  $D_\gamma$  inamlı intervalın yuxarı və aşağı sərhədinin diapazonu 1,08-i təşkil edir:

$$D_\gamma = \frac{\gamma_{\hat{y}_{\max}}}{\gamma_{\hat{y}_{\min}}};$$

$$D_\gamma = \frac{95,11}{88,09} = 1,08.$$

Məsələ 3. 30 region üzrə verilənlər cədvəl-8 də göstərilmişdir.

Cədvəl 8.

Əlamət	Orta qiymət	Orta kvadratik meyl	Cüt korrelyasiyanın xətti əmsali
Adambaşına düşən həftəlik orta gəlir, y	88,8	8,44	
Adambaşına düşən həftəlik orta əmək haqqı manat, $x_1$	52,9	7,86	$r_{yx_1} = 0,8605$
İşsizliyin orta yaşı, il, $x_2$	35,5	-1,42	$r_{yx_2} = -0,2401$ $r_{x_1x_2} = -0,096$

Tələb olunur:

1. Standart və təbii formada cəm regressiyanın tənliyini qurmalı; xüsusi elastiklik əmsallarını hesablamaq, onları  $\beta_1$  və  $\beta_2$  ilə müqaisə etməli, aralarındakı fərqi müəyyənləşdirməli.
2. Xüsusi korrelyasiya əmsallarını və cəm korrelyasiya əmsallarını hesablamaq, onları cəm korrelyasiyanın xətti əmsalları ilə müqaisə etməli və aralarındakı fərqi müəyyənləşdirməli.
3. Ümumi və xüsusi Fişerin F- kriteriyasını hesablamaq.

*Məsələnin həlli.*

1.  $x_1$  və  $x_2$ -dən asılı  $y$  cəm reqressiyasının forması [1]:

$$y = a + b_1 \cdot x_1 + b_2 \cdot x_2$$

şəkildədir. Onun parametrlərinin hesablanması üçün dəyişənlərin standartlaşması metodunu tətbiq edək və axtarılan tənliyi standartlaşdırılmış məşəbda quraq:

$$t_y = \beta_1 \cdot t_{x_1} + \beta_2 \cdot t_{x_2}$$

$\beta$  - əmsallarının hesablanmasını aşağıdakı düsturlarla aparaq:

$$\beta_1 = \frac{r_{yx_1} - r_{yx_2} r_{x_1x_2}}{1 - r_{x_1x_2}^2}$$

$$\beta_2 = \frac{r_{yx_2} - r_{yx_1} r_{x_1x_2}}{1 - r_{x_1x_2}^2}$$

$$\beta_1 = \frac{0,8605 - (-0,2401) \cdot (-0,096)}{1 - (-0,096)^2} = \frac{0,8375}{0,9908} = 0,845$$

$$\beta_2 = \frac{-0,2401 - 0,8605 \cdot (-0,096)}{1 - (-0,096)^2} = \frac{-0,1571}{0,9908} = -0,159$$

Aşağıdakı tənliyi alırıq:

$$t_y = 0,845 \cdot t_{x_1} - 0,159 \cdot t_{x_2}$$

Təbii formada tənliyin qurulması üçün  $b_1$  və  $b_2$  əmsallarını hesablayaq, bu məqsədlə  $\beta_1$  -dən  $b_1$ -ə keçmək üçün aşağıdakı düsturlardan istifadə edək [2]:

$$\beta_i = b_i \frac{\sigma_{x_i}}{\sigma_y}; \quad b_i = \beta_i \frac{\sigma_y}{\sigma_{x_i}};$$

$$b_1 = \frac{0,845 \cdot 8,44}{7,86} = 0,907; \quad b_2 = \frac{-0,159 \cdot 8,44}{-1,42} = 0,945$$

$a$  -nın qiymətini aşağıdakı münasibətdən təyin edək:

$$a = \bar{y} - b_1 \cdot \bar{x}_1 - b_2 \cdot \bar{x}_2$$

$$a = 88,8 - 0,907 \cdot 52,9 - 0,945 \cdot 35,5 = 7,2722$$

$$y_{x_1x_2} = 7,2722 + 0,907 \cdot x_1 + 0,945 \cdot x_2$$

$x_1$  və  $x_2$  -nin  $y$ -ə nisbi təsirinin xarakteristikası üçün orta elastiklik əmsallarını hesablayaq:

$$\bar{Y}_{yx_j} = b_j \frac{\bar{x}_j}{\bar{y}};$$

$$\bar{Y}_{yx_1} = \frac{0,907 \cdot 52,9}{88,8} = 0,5403 \%$$

$$\bar{Y}_{yx_2} = \frac{0,945 \cdot 35,5}{88,8} = 0,3771 \%$$

**Nəticə 1.** Orta əmək haqqının,  $x_1$ -in, 1% artması (onun orta səviyyəsindən) adambaşına düşən orta gəlirin,  $y$ -in, öz orta səviyyəsindən 0,54 qədər artmasını göstərir; işsizliyin orta yaşını,  $x_2$ -ni, 1% artırmaqla adambaşına düşən gəlir  $y$  – öz orta səviyyəsindən 0,38% aşağı düşür. Aydındır ki, orta əməkhaqqının adambaşına düşən orta gəlirə,  $y$  -ə təsiri daha çoxdur, nəinki, orta işsizlik yaşına-  $x_2$  -ə.  $\beta_1$  və  $\beta_2$  modullarını müqaisə etməklə əlaqələrin gücü haqqında analoji nəticələrə gəlmək olar:

$$|\beta_1| = |0,845| \quad |\beta_2| = |-0,159|$$

$\bar{Y}_{yx_j}$  və  $\beta_j$  -nin müqaisəsi zamanı alınmış, faktorun nəticəyə təsir gücündəki, fərqlər onunla izah olunur ki, elastiklik əmsalı aşağıdakı orta münasibətlərdən alınır :

$$\bar{Y}_{yx_j} = b_j \frac{\bar{x_j}}{\bar{y}},$$

$\beta$  -əmsalı orta kvadratik meyl münasibətlərindən alınır:  $\beta_1 = b_1 \frac{\sigma_{x_1}}{\sigma_y}$ .

2. Xüsusi xətti korrelyasiya əmsalları aşağıdakı rekkurent düstur üzrə hesablanır:

$$r_{yx_1} x_2 = \frac{r_{yx_1} - r_{yx_2} \cdot r_{x_1 x_2}}{\sqrt{(1 - r_{yx_2}^2)(1 - r_{x_1 x_2}^2)}}$$

$$r_{yx_1} x_2 = \frac{0,8605 - (-0,2401) \cdot (-0,096)}{\sqrt{(1 - 0,2401^2)(1 - 0,096^2)}} = \frac{0,8375}{\sqrt{0,9337}} = 0,8667,$$

$$r_{yx_2} x_1 = \frac{r_{yx_2} - r_{yx_1} \cdot r_{x_1 x_2}}{\sqrt{(1 - r_{yx_1}^2)(1 - r_{x_1 x_2}^2)}} = \frac{-0,2401 - 0,8605 \cdot (-0,096)}{\sqrt{(1 - 0,8605^2)(1 - 0,096^2)}} = \frac{-0,1571}{\sqrt{0,2576}} = \frac{-0,1571}{0,5075} = -0,3096,$$

$$r_{x_1 x_2} y = \frac{r_{x_1 x_2} - r_{yx_1} \cdot r_{yx_2}}{\sqrt{(1 - r_{yx_1}^2)(1 - r_{yx_2}^2)}}$$

$$r_{x_1 x_2} y = \frac{-0,096 - 0,8605 \cdot (-0,2401)}{\sqrt{(1 - 0,8605^2)(1 - (-0,2401)^2)}} = \frac{-0,096 - (-0,2066)}{\sqrt{(1 - 0,7405)(1 - 0,0576)}}$$

$$r_{x_1 x_2} y = \frac{0,1106}{\sqrt{0,2446}} = \frac{0,1106}{0,4945} = 0,2237.$$

Əgər cüt və xüsusi korrelyasiya əmsallarının qiymətini müqaisə etsək, onda belə bir nəticəyə gələrik ki, faktorlar arasındakı zəif əlaqə üzündən ( $r_{x_1 x_2} = -0,096$ ) cüt və xüsusi korrelyasiya əmsalları biri-birindən əhəmiyyətli dərəcədə fərqlənir: cüt və xüsusi korrelyasiya əmsalları əsasında sıxlıq və əlaqənin istiqaməti haqqında nəticələr üst-üstə düşür:

$$\begin{aligned} r_{yx_1} &= 0,8605; & r_{yx_2} &= -0,2401; \\ r_{x_1 x_2} &= -0,096; & r_{yx_1} x_2 &= 0,8667; \\ r_{yx_2} x_1 &= -0,3096; & r_{x_1 x_2} y &= 0,2237. \end{aligned}$$

Cəm xətti korrelyasiya əmsallarının hesablanması  $r_{yx_j}$  və  $\beta_j$  əmsallarından istifadə etməklə yerinə yetirilir:

$$\begin{aligned} R_{yx_1 x_2} &= \sqrt{r_{yx_1} \cdot \beta_1 + r_{yx_2} \cdot \beta_2} = \sqrt{0,8605 \cdot 0,845 + (-0,2401) \cdot (-0,159)} = \\ &= \sqrt{0,727 + 0,038} = \sqrt{0,765} = 0,874. \end{aligned}$$

**Nəticə 2.** y-in  $x_1$  və  $x_2$  -dən asılılığı sıxlıq kimi xarakterizə olunur, beləki, adambaşına düşən orta gəlirin 76% variyasiyası modeldə qeydə alınmış faktorların –orta əmək haqqı və orta işsizlik yaşının



variasiyası ilə müəyyən edilir. Modelə daxil olmayan digər faktorlar ümumi  $y$  variasiyasından uyğun olaraq 24% variasiya ilə fərqlənir.

3. Ümumi  $F$  - kriteriyası reqressiya tənliyinin statistik əhəmiyyətliyi haqqında hipotezi və əlaqə sıxlığının göstəricisini ( $R^2 = 0$ ) yoxlayır:

$$F_{\text{üm}} = \frac{R^2_{yx_1x_2}}{1 - R^2_{yx_1x_2}} \div \frac{m}{n - m - 1} = \frac{R^2_{yx_1x_2}}{1 - R^2_{yx_1x_2}} \cdot \frac{n - m - 1}{m}$$

$$F_{\text{üm}} = \frac{0,7638}{0,2346} \cdot \frac{27}{2} = 3,2558 \cdot 13,5 = 43,9533,$$

$$F_{xüs} = 3,35, \alpha = 0,05.$$

$F_{\text{üm}}$  və  $F_{xüs}$  müqaisə etməklə,  $H_0$  hipotezinin rədd edilməsinin zəruriliyi haqqında nəticəyə gəlib çıxırıq, beləki,

$$F_{xüs} = 3,35 < F_{\text{üm}} = 43,9533.$$

$1 - \alpha = 0,95$  ehtimalı ilə  $x_1$  və  $x_2$  faktorlarının təsadüfi olmayan təsirlərindən formalaşan  $R_{yx_1x_2}$  əlaqə sıxlığının göstəricisi və tənliyin statistik əhəmiyyətliyi haqqında nəticə çıxarıq. Xüsusi  $F$  - kriteriyası -  $F_{x_1}$  və  $F_{x_2}$  - cəm reqressiya tənliyində  $x_1$  və  $x_2$  faktorlarının iştirakının statistik əhəmiyyətliyini qiymətləndirir, həmçinin, tənliyə bir faktordan sonra digər faktorun daxil olmasının məqsədəuyğunluğunu qiymətləndirir, yəni,  $F_{x_1}$  tənliyə  $x_2$  faktoru daxil olan kimi  $x_1$  faktorunun daxil olmasının məqsədəuyğunluğunu qiymətləndirir. Uyğun olaraq  $F_{x_2}$   $x_1$  faktorundan sonra modelə  $x_2$  faktorunun daxil olmasının məqsədəuyğunluğunu göstərir:

$$F_{x_1\text{üm}} = \frac{R^2_{yx_1x_2} - r^2_{yx_2}}{1 - R^2_{yx_1x_2}} \div \frac{1}{n - m - 1} = \frac{R^2_{yx_1x_2} - r^2_{yx_2}}{1 - R^2_{yx_1x_2}} \cdot \frac{n - m - 1}{m}$$

$$F_{x_1\text{üm}} = \frac{0,874^2 - 0,0576}{1 - 0,7655} \cdot \frac{27}{1} = \frac{0,7062}{0,2345} \cdot 27 = 3,0115 \cdot 27 = 81,3105.$$

$$F_{xüs} = 4,21; \alpha = 0,05.$$

$F_{\text{üm}}$  və  $F_{xüs}$  -i müqaisə edərək modelə  $x_2$  faktorundan sonra  $x_1$  faktorunun daxil edilməsinin məqsədəuyğunluğu haqqında nəticəyə gəlirik, beləki,  $F_{x_1\text{üm}} = 85,3105 > F_{xüs}$ .  $X_2$  faktorundan sonra  $x_1$  faktorunun daxil edilməsi hesabına  $R_y^2$  artımının əhəmiyyətsizliyi haqda  $H_0$  hipotezini alırıq [4].

$x_1$  faktorundan sonra modelə  $x_2$  faktorunun daxil edilməsinin məqsədəuyğunluğunu  $F_{x_1\text{üm}}$  yoxlayır:

$$F_{x_2\text{üm}} = \frac{R^2_{yx_1x_2} - r^2_{yx_1}}{1 - R^2_{yx_1x_2}} \div \frac{1}{n - m - 1} = \frac{R^2_{yx_1x_2} - r^2_{yx_1}}{1 - R^2_{yx_1x_2}} \cdot \frac{n - m - 1}{1}$$

$$F_{x_2\text{üm}} = \frac{0,874^2 - 0,8605^2}{1 - 0,8774^2} \cdot \frac{27}{1} = \frac{0,7638 - 0,7405}{1 - 0,7638} = \frac{0,0233}{0,2363} = 0,0986.$$

**Nəticə 3.**  $F_{x_2üm}$  aşağı qiyməti  $r_{yx1}^2$  artımının statistik əhəmiyyətsizliyini göstərir. Uyğun olaraq,  $x_2$  faktorunun (işsizliyin orta yaşı) modelə daxil olmasının məqsədəuyğun olmaması haqda sıfır  $H_0$  hipotezi təsdiqlənir. Bu onu göstərir ki, orta gəlirin orta əmək haqqından asılılığının cəm reqressiya modeli kifayət qədər statistik əhəmiyyətlidir, etibarlıdır və  $x_2$  faktorunu (işsizliyin orta yaşı) daxil etməklə onu yaxşılaşdırmağa ehtiyac yoxdur .

## ƏDƏBİYYAT

1. Антохонова, И. В. Методы прогнозирования социально-экономических процессов : учеб. пособие для вузов / И. В. Антохонова. — 2-е изд., испр. и доп. — М. : Издательство Юрайт, 2018. — 213 с.
2. Бабайцев, В. А. Математические методы финансового анализа : учеб. пособие для вузов / В. А. Бабайцев, В. Б. Гисин. — 2-е изд., испр. и доп. — М. : Издательство Юрайт, 2019. — 215 с.
3. Гармаш, А. Н. Экономико-математические методы и прикладные модели : учебник для бакалавриата и магистратуры / А. Н. Гармаш, И. В. Орлова, В. В. Федосеев ; под ред. В. В. Федосеева. — 4-е изд., перераб. и доп. — М. : Издательство Юрайт, 2017. — 328 с.
4. Ковалев, Е. А. Теория вероятностей и математическая статистика для экономистов : учебник и практикум для бакалавриата, специалитета и магистратуры / Е. А. Ковалев, Г. А. Медведев ; под общ. ред. Г. А. Медведева. — 2-е изд., испр. и доп. — М. : Издательство Юрайт, 2019. — 284 с.

## CONSTRUCTION OF ECONOMETRIC MODEL BASED ON ECONOMIC INDICATORS AND FORECAST WITH THE BEST MODEL

**GULARA RAHIMOVA**

*Baku State University, Associate professor*

*ORCID NO: 0000-0003-3084-9091*

**NARMIN GULIYEVA**

*Baku State University, Master*

*ORCID NO: 0000-0002-3181-5523*

### Introduction

Econometric models are successfully applied at the micro and macro levels of the economy. Through these models, the theoretical problems of economics are tested on the basis of factual or empirical materials by the methods of mathematical statistics. The first task facing mathematical statistics is to group and collect data when there is a lot of it. The second task of mathematical statistics is to determine the methods of analysis of statistical data, depending on the purpose of the study. Mathematical statistical methods are widely used in solving a number of problems posed by science and technology. For example: in the correct organization of technological processes, more optimal planning of the economy, etc. It is no coincidence that the most modern of the scientific and methodological methods is the method of statistical and econometric analysis. Econometric analysis provides a quantitative analysis of the relationship between economic indicators using mathematical and statistical methods. Therefore, in the article, we conducted a micro-level analysis of the economy by the econometric method and forecasted the best model.

In general, econometrics differs from mathematical economics in that it can actually apply probability theory and statistical methods directly to economic processes. Therefore, the purpose of econometrics is to obtain empirical results from economic laws.

Issues of econometrics include the construction of economic models and the assessment of their parameters, the testing of hypotheses about the characteristics of economic indicators and the form of relationships between them. Econometric analysis is the basis of economic analysis and forecasting for the adoption of basic economic solutions.

Note that an arbitrary economic variable reflects the characteristics of any economic object and has a statistical nature. It is necessary to apply special methods for their analysis and processing.

Once the econometric model is established, it should be checked that the model coincides with the real economic indicators. There are two levels of analysis: theoretical and empirical.

At the theoretical level, we assume that all possible realizations of economic indicators are known, and on the basis of these realizations it is possible to theoretically determine the parameters of the model. At the empirical level, the meaning of the parameters of the model can be estimated based on the selected values of economic indicators.

The purpose of the assessment is to more accurately calculate the values of unknown parameters of economic indicators.

One of the key issues in econometric research is to analyse the relationships between variables. The functional dependence is given in the form of a precise formula, in which each value of a variable corresponds to a single fixed value, in which case the effect of random factors is not taken into account.

The relationship between variables in which the effects of random factors are taken into account is called statistical dependence. Therefore, the regression equation is the equation of statistical relations between the variables. The formula for the statistical relationship between two variables is called double regression, and the statistical relationship between several variables is called total regression. To build regression models in econometrics, it is necessary to know the basic concepts of regression analysis, estimation by the least squares method, the basic rules for

estimating the significance of regression coefficients in the obtained equation and finding a reliable interval. The application of regression analysis imposes certain requirements on the initial data:

- Statistical sample of objects should be functionally and structurally homogeneous;
- Factor variables must be measured fairly accurately and at the same time, these variables must be either independent or minimally dependent on each other.

Econometric models are characterized by 3 main features: identification, verification and specification. The specification is generally carried out with an empirical approach and consists of two stages: the construction of the points of the regression field and the graphical (visual) interpretation of the possible approximate curve.

During the preparation of the article, we have used the subject of analysis, identified the area of regression, given a graphical interpretation of the results of econometric analysis, and identified the type of best model for forecasting.

**Keywords :** Econometric models, Econometric Forecast, model accuracy level, Sampling theory.

## **İQTİSADI GÖSTƏRİCİLƏRƏ ƏSASƏN EKONOMETRİK MODELİN QURULMASI VƏ ƏN YAXŞI MODELLE PROQNOZ**

### **Giriş.**

Ekonometrik modellər iqtisadiyyatın mikro və makro səviyyəsində uğurla tətbiq edilir. Bu modellər vasitəsilə iqtisadiyyatın nəzəri məsələləri riyazi statistikanın üsulları ilə faktiki və ya empirik materiallar əsasında yoxlanılır. Riyazi statistikanın qarşısında duran birinci məsələ məlumatların çox olduğu halda, onların qruplaşdırılması və toplanmasından ibarətdir. Riyazi statistikanın ikinci məsələsi isə statistik məlumatların, tədqiqatın məqsədindən asılı olaraq analiz üsullarını müəyyənləşdirməkdən ibarətdir. Elmin və texnikanın irəli sürdüyü bir sıra məsələlərin həllində riyazi statistika üsullarından geniş istifadə olunur. Məsələn: texnoloji proseslərin düzgün təşkilində, iqtisadiyyatın daha optimal planlaşdırılmasında və s.. Təsədüfi deyil ki, elmi-metodoloji üsullar içərisində ən müasiri də məhz statistik və ekonometrik təhlil üsulu hesab olunur. Ekonometrik təhlil riyazi-statistik üsullardan istifadə etməklə iqtisadi göstəricilər arasında qarşılıqlı əlaqələrin kəmiyyət təhlilini verir. Buna görə də biz məqalədə iqtisadiyyatın mikrosəviyyədə təhlilini ekonometrik metodla apardıq və ən yaxşı modelle proqnozu verdik.

Ümumiyyətlə, Ekonometrika real olaraq, iqtisadi proseslərə ehtimal nəzəriyyəsi və statistik üsulları birbaşa tətbiq edə bilməsi ilə, riyazi iqtisadiyyatdan fərqlənir. Buna görə də, ekonometrikanın məqsədi, məhz iqtisadi qanunlardan empirik nəticələrin alınması ilə səciyyələnir.

*Ekonometrikanın məsələləri* – iqtisadi modellərin qurulması və onların parametrlərinin qiymətləndirilməsi, iqtisadi göstəricilərin xüsusiyyətləri və onlar arasındakı əlaqələrin forması haqqında hipotezlərin yoxlanmasını əhatə edir. Ekonometrik analiz, əsas iqtisadi həllin qəbul edilməsi üçün iqtisadi analiz və proqnozlaşdırmanın əsası sayılır.

Qeyd edək ki, ixtiyari iqtisadi dəyişən hər hansı iqtisadi obyektin xarakteristikalarını özündə əks etdirir və statistik təbiətə malik olur. Onların analizi və emalı üçün xüsusi metodların tətbiqi zəruridir.

Ekonometrik model qurulduqdan sonra modelin real iqtisadi göstəricilərlə üst-üstə düşməsi yoxlanmalıdır. Bu zaman analizin iki səviyyəsini fərqləndirirlər: nəzəri və empirik.

Nəzəri səviyyədə fərz edirik ki, iqtisadi göstəricilərin bütün mümkün realizasiyaları məlumdur, və bu realizasiyalar əsasında modelin parametrlərini nəzəri olaraq təyin etmək mümkündür. Empirik səviyyədə isə, iqtisadi göstəricilərin seçilmiş qiymətləri əsasında modelin parametrlərinin mənasını qiymətləndirmək olar.

Qiymətləndirmənin məqsədi – iqtisadi göstəricilərin naməlum parametrlərinin qiymətlərini daha dəqiq hesablamaqdan ibarətdir.

Ekonometrik tədqiqatlarda əsas məsələlərdən biri dəyişənlər arasındakı asılılıqların analiz edilməsidir. Funksionl asılılıq dəqiq düstur şəklində verilir, hansı ki, bir dəyişənin hər bir qiymətinə ciddi təyin olunmuş yeganə qiymət uyğun gəlir və bu halda təsadüfi amillərin təsiri nəzərə alınmır.

Təsadüfi faktorların təsirinin nəzərə alındığı dəyişənlər arasındakı əlaqə statistik asılılıq adlanır. Buna görə də Reqressiya tənliyi dəyişənlər arasındakı statistik əlaqələrin tənliyidir. İki dəyişən arasındakı statistik əlaqələr düsturu cüt reqressiya, bir neçə dəyişən arasındakı statistik asılılıq isə cəm reqressiya adlanır. Ekonometrikada reqressiya modellərini qurmaq üçün reqressiya analizinin əsas konsepsiyalarını, ən kiçik kvadratlar üsulu vasitəsilə qiymətləndirmənin aparılmasını, alınmış tənlikdə reqressiya əmsallarının əhəmiyyətinin qiymətləndirilməsi və inamlı intervalın tapılması üçün əsas qaydaları bilmək lazımdır. Reqressiya analizinin tətbiqi ilkin verilənlər üzərinə müəyyən tələblər qoyur:

- obyektlərin statistik nümunəsi funksional və struktur cəhətdən homogen olmalıdır;
- faktor dəyişənləri kifayət qədər dəqiq ölçülməli və eyni zamanda, bu dəyişənlər ya müstəqil olmalı və ya minimal dərəcədə bir-birindən asılı olmalıdırlar.

Ekonometrik modellər 3 əsas xüsusiyyətlərlə xarakterizə olunur: identifikasiya, verifikasiya və spesifikasiya ilə. Spesifikasiya, ümumiyyətlə empirik yanaşma ilə həyata keçirilir və iki mərhələdən ibarətdir: regresiya sahəsinin nöqtələrinin qurulması və mümkün təxmini əyrinin qrafiki (vizual) interpretasiyası.

Model qurulduqdan sonra modelin real iqtisadi göstəricilərlə üst-üstə düşməsi yoxlanmalıdır. Analizin iki səviyyəsini fərqləndirirlər: nəzəri və empirik.

Nəzəri səviyyədə fərz edirik ki, iqtisadi göstəricilərin bütün mümkün realizasiyaları məlumdur, və bu realizasiyalar əsasında modelin parametrlərini nəzəri olaraq təyin etmək mümkündür.

Empirik səviyyədə, iqtisadi göstəricilərin seçilmiş qiymətləri əsasında modelin parametrlərinin mənasını qiymətləndirmək olar [2].

**Praktik hissə.** Statistik göstəricilərə əsasən regionda yüngül sənaye sahəsi üzrə, məhsul buraxılışı həcmnin (Y milyon manat) kapital qoyuluşu həcmindən asılılığını (X milyon manat) ifadə edən informasiya belə olmuşdur :

Y	64	56	52	48	50	46	38
X	64	68	82	76	84	96	100

Tələb olunur :

1. X -dən asılı Y-in xarakteristikaları üçün aşağıdakı modelləri qurmalı:
  - Xətti (qeyri-xətti ilə müqayisə üçün); Qüvvət; Üstlü; Hiperbolik.
2. Aşağıdakıları təyin etməklə, hər bir modeli qiymətləndirməli:
  - korrelyasiya indeksi; Orta nisbi xəta; Determinasiya əmsalı; Fişerin F-kriteriyası.
3. Ən yaxşı modeli seçməklə yekun hesablama cədvəlini qurmalı, hesablanmış xarakteristikaların interpretasiyasını verməli.
4. Kapitalqoyuluşunun 89,573 milyon manat təşkil etdiyi halda ən yaxşı modelin nəticə əlamətlərinə görə proqnoz qiymətlərini hesablamaq.
5. Hesablamaların nəticələrini qrafikdə əks etdirməli.

*Həlli*

1. Reqressiya modelinin qurulması
  2. Xətti cüt Reqressiya modelinin qurulması
- Cədvəl 1-dəki verilənlərdən istifadə edərək, aşağıdakı düsturla ifadə olunan xətti cüt korrelyasiya əmsalını hesablayaq:

$$r_{xy} = \frac{\sum (y - \bar{y}) \times (x - \bar{x})}{\sqrt{\sum (y - \bar{y})^2 \times \sum (x - \bar{x})^2}} = \frac{-593,714}{\sqrt{397,71 \times 1077,71}} = -0,907.$$



Demək olar ki,  $X$  kapitalqoyuluşunun həcmi ilə  $Y$ - məhsulun istehsal həcmi arasında əks əlaqə mövcuddur, yəni asılılıq kifayət qədər güclüdür.

Xətti reqressiyanın tənliyi belədir [3]:

$$\hat{y} = a + bx$$

Cədvəl 1-dəki verilənlərdən istifadə edərək xətti modelin  $a$  və  $b$  parametrlərinin qiymətlərini təyin edək.

$$b = \frac{\overline{yx} - \bar{y}\bar{x}}{\overline{x^2} - (\bar{x})^2} = \frac{4033,14 - 50,57 \times 81,43}{6784,57 - 81,43^2} = -0,55,$$

$$a = \bar{y} - b\bar{x} = 50,57 + 0,55 \times 81,43 = 95,36.$$

Reqressiya tənliyi belə alınacaq;

$$\hat{y} = 95,36 - 0,55x$$

Hesablamanın nəticəsi göstərir ki, kapitalqoyuluşu həcmnin 1 milyon manat dəyərində artırılması məhsul istehsalı həcmi 550 min manat azaldır. Bu isə onu sübut edir ki, müəssisənin işi qeyri effektivdir, və bunun səbəblərinin araşdırılması, çatışmazlıqların aradan qaldırılması üçün təcili tədbirlər görülməlidir. Cədvəl 1.

Cədvəl 1.

T	Y	X	yx	$x^2$	$y_i - \bar{y}$	$(y_i - \bar{y})^2$	$x_i - \bar{x}$	$(x_i - \bar{x})^2$	$\hat{y}$	$e_i = y_i - \hat{y}_i$	$\left  \frac{e_i}{y_i} \right  \times 100\%$
1	64	64	4096	4096	13,43	180,36	-17,4	303,8	60,2	3,84	6,000
2	56	68	3808	4642	5,43	29,485	-13,4	180,36	58,0	-1,96	-3,500
3	52	82	4264	6724	1,43	2,0449	0,57	0,3249	50,3	1,74	3,346
4	48	76	3648	5776	-2,57	6,6049	-5,43	29,485	53,6	-5,56	-11,583
5	50	84	4200	7056	-0,57	0,3249	2,57	6,6049	49,2	0,84	1,680
6	46	96	4416	9216	-4,57	20,885	14,57	212,28	42,6	3,44	7,478
7	38	100	3800	10000	-12,6	158,0	18,57	344,84	40,4	-2,36	-6,211
Yekun	354,00	570,00	28232	47492	0,01	397,71		1077,7		-0,02	39,798
Orta qiymət	50,57	81,43	4033,14	6784,57							5,685

Determinasiya əmsalını hesablayırıq:

$$R^2 = r_{y-x}^2 = 0,822.$$

$Y$  (məhsul buraxılışı həcmi)-in nəticə variasiyası 82,2%  $X$  (kapitalqoyuluşunun həcmi) faktorunun variasiyası ilə izah olunur.

Reqressiya tənliyinin əhəmiyyətliyi qisməndirilməsini Fişerin  $F$ -kriteriyasının köməyi ilə aparırıq:

$$F = \frac{r_{YX}^2}{1 - r_{YX}^2} \times (n - 2) = \frac{0,822}{1 - 0,822} \times (7 - 2) = 23,09$$

$$F > F_{\text{cad}} = 6,61, \alpha = 0,05 \text{ üçün}; k_1 = m = 1, k_2 = n - m - 1 = 5.$$

Reqressiya tənliyi 0,95 ehtimalla statistik əhəmiyyətlidir, başqa sözlə,  $F > F_{\text{cad}}$ .

Orta xətanı müəyyənəndirək:

$$\bar{E} = \frac{1}{n} \sum \frac{|E_i|}{y} \times 100\% = \frac{1}{n} \times \sum \left| \frac{y - \hat{y}}{y} \right| \times 100\% = \frac{39,798}{7} = 5,685\%$$

Xətti model üçün hesablanmış  $\hat{y}$  orta qiymətləri faktiki qiymətlərdən 5,685% fərqlənir.

Üstlü tənliklə ifadə olunan cüt regressiya modelinin qurulması

Üstlü modelin tənliyi :  $\hat{y} = a \times x^b$  formasında verilir [4].

Belə modelin qurulması üçün dəyişənlərin xəttişədirilməsini həyata keçirmək lazımdır. Bu məqsədlə tənliyin hər iki tərəfini loqarifimləyirik:

$$\lg \hat{y} = \lg a + b \lg x.$$

Veilənlər cədvəl 2-də göstərilib.

Cədvəl 2.

	Fakt. Y(t)	lg(y)	Dəyişən X(t)	lg(x)
1	64,0	1,806	64	1,806
2	56,0	1,748	68	1,833
3	52,0	1,716	82	1,914
4	48,0	1,681	76	1,881
5	50,0	1,699	84	1,924
6	46,0	1,633	96	1,982
7	38,0	1,580	100	2,000
$\Sigma 28$	354,0	11,893	570	13,340
Orta qiymət	50,5714	1,699	81,429	1,906

Aşağıdakı şəkildə işarələmələr aparaq:

$$Y = \lg \hat{y}, X = \lg x, A = \lg a.$$

Onda tənlik :  $Y=A+bX$  şəklinə düşəcək, və bu da – xətti regressiya tənliyidir. Cədvəl 3 –dən istifadə etməklə onun parametrlərini hesablayaq.

Cədvəl 3.

	Y	Y	X	X	YX	X <sup>2</sup>	$\hat{y}$	E <sub>i</sub>	$\left  \frac{E_i}{y} \right  \times 100\%$	E <sub>i</sub> <sup>2</sup>
1	64	1,8062	64	1,8062	3,2623	3,2623	61,294	2,706	4,23	7,322
2	56	1,7482	68	1,8325	3,2036	3,3581	58,066	-2,066	3,69	4,270
3	52	1,7160	82	1,9138	3,2841	3,6627	49,133	2,867	5,51	8,220
4	48	1,6812	76	1,8808	3,1621	3,5375	52,580	-4,580	9,54	20,976
5	50	1,6990	84	1,9243	3,2693	3,7029	48,088	1,912	3,82	3,657
6	46	1,6628	96	1,9823	3,2960	3,9294	42,686	3,314	7,20	10,982
7	38	1,5798	100	2,000	3,1596	4,0000	41,159	-3,159	8,31	9,980
Yekun	354	11,8931		13,3399	22,6370	25,4528		0,51	42,32	65,407

$$b = \frac{\overline{YX} - \overline{Y} \overline{X}}{\overline{X^2} - \overline{X}^2} = \frac{3,2339 - 1,699 \cdot 1,9057}{3,6361 - 1,9057 \cdot 1,9057} = -0,8921,$$

$$A = \overline{Y} - b \overline{X} = 1,699 + 0,8921 \cdot 1,9057 = 3,3991.$$

Regressiya tənliyi:

$$Y = 3,3991 - 0,8921X \text{ şəklinə düşür.}$$

İlkin x və y dəyişənlərinə qayıdaraq bu tənliyin potensiallanmasını həyata keçirək.

$$\hat{y} = 10^{3,399} \times x^{-0,892}.$$

Üstlü regressiya modelinin tənliyini belə alırıq:

$$\hat{y} = 2506,915 \times x^{-0,892}.$$

Korelyasiya indeksini təyin edirik:

$$\rho_{YX} = \sqrt{1 - \frac{\sum (y - \hat{y})^2}{\sum (y - \bar{y})^2}} = 0,914 .$$

Nəticə göstərir ki,  $y$  göstəricisi və  $x$  faktoru arasındakı əlaqə kifayət qədər güclüdür.  
Determinasiya əmsalı 0,836-a bərabərdir:

$$R^2 = \rho_{YX}^2 = 0,914^2 = 0,836 .$$

*Bu modelə əsasən Y (məhsul buraxılışı həcmi) -in nəticə variasiyası 83,6% X (kapitalqoyuluşunun həcmi) faktorunun variasiyası ilə izah olunur.*

Regressiya tənliyinin əhəmiyyətliyi qisməndirilməsini Fişerin F-kriteriyasının köməyi ilə aparırıq:

Fişerin F-kriteriyasını hesablayaq:

$$F = \frac{R^2}{1 - R^2} \times (n - 2) = \frac{0,836}{1 - 0,836} \times 5 = 25,5 .$$

$$\alpha = 0,05 \text{ üçün } F > F_{cad} = 6,61 \text{ olur ; } k_1 = m = 1, k_2 = n - m - 1 = 5 .$$

Regressiya tənliyi 0,95 ehtimalla bütünlüklə statistik əhəmiyyətlidir, başqa.sözlə,  $F > F_{cad}$ .

Orta nisbi xəta:

$$\bar{E}_{\text{nisbi}} = \frac{1}{n} \sum \frac{|E_i|}{y} \cdot 100\% = \frac{1}{n} \sum \left| \frac{y - \hat{y}}{y} \right| \cdot 100\% = \frac{42,32}{7} = 6,04\% .$$

Üstlü model üçün  $\hat{y}$  hesablanmış qiymətləri faktiki qiymətlərdən 6,04% fərqlənirlər.

*Üstlü funksiyanın qurulması*

Üstlü funksiya ayrısının tənliyi:

$$\hat{y} = ab^x$$

şəklində tədqiq olunur [5].

Bu modelin qurulması üçün dəyişənlərin xəttiləşdirilməsini həyata keçirmək lazımdır. Bunun üçün tənliyin hər iki tərəfini loqarifmləyək:

$$\lg \hat{y} = \lg a + x \lg b .$$

İşarələmələr belədir:

$$Y = \lg \hat{y}, \quad B = \lg b, \quad A = \lg a .$$

Xətti regressiya tənliyini bu cür alacağıq:

$$Y = A + Bx .$$

Cədvəl 4-dən istifadə edərək onun parametrlərini hesablayaq.

Cədvəl 4.

T	Y	$\bar{Y}$	X	Y <sub>x</sub>	x <sup>2</sup>	$Y - \bar{Y}$	$(Y - \bar{Y})^2$	$X - \bar{X}$	$(X - \bar{X})^2$	$\hat{y}$	$(y - \hat{y})^2$	E <sub>i</sub>	$\left  \frac{E_i}{y} \right  \times 100\%$
1	64	1,8062	64	115,60	4096	0,1072	0,0115	-17,43	303,76	60,6	11,464	3,3859	
2	56	1,7482	68	118,88	4624	0,0492	0,0024	-13,43	180,33	58	3,9632	-1,991	
3	52	1,7160	82	140,71	6724	0,0170	0,0003	0,57	0,33	49,7	5,4221	2,3285	
4	48	1,6812	76	127,77	5776	-0,017	0,0003	-5,43	29,47	53,1	25,804	-5,08	
5	50	1,6990	84	142,71	7056	0,0000	0,0000	2,57	6,61	48,6	2,0031	1,4153	
6	46	1,6628	96	159,62	9216	-0,036	0,0013	14,57	212,33	42,5	11,933	3,4544	
7	38	1,5798	100	157,98	10000	-0,119	0,0142	18,57	344,90	40,7	7,3132	-2,704	
Yekun	354	11,8931	550	963,28	47495		0,0300		1077,7		67,903	0,8093	
Orta qiymət	50,57	1,6990	81,4	137,61	6785								

$$B = \frac{\overline{yx} - \overline{y} \overline{x}}{\overline{x^2} - \overline{x}^2} = \frac{137,61 - 1,699 \times 81,43}{6785 - 81,43^2} = -0,0048;$$

$$A = \overline{y} - B\overline{x} = 1,699 + 0,0048 \times 81,43 = 2,09.$$

Verilmiş tənliyi potensiallamaqla ilkin  $x$  və  $y$  dəyişənlərinə keçək:

$$\hat{y} = 10^{2,09} \times (10^{-0,0048})^x = 123,03 \times 0,989^x.$$

Korelyasiya indeksini təyin edək:

$$\rho_{yx} = \sqrt{1 - \frac{\sum (y - \hat{y})^2}{\sum (y - \overline{y})^2}} = \sqrt{1 - \frac{67,9}{397,71}} = 0,91.$$

Alınmış kəmiyyət göstərir ki,  $y$  göstəricisi və  $x$  faktoru arasındakı əlaqə kifayət qədər güclüdür.

Determinasiya indeksi:

$$R^2 = \rho_{xy}^2 = 0,91^2 = 0,828.$$

$Y$  (məhsul buraxılışı həcmi) -in nəticə variasiyası 82,8%  $X$  (kapitalqoyuluşunun həcmi) faktorunun variasiyası ilə izah olunur.

Fişerin  $F$ -kriteriyasını hesablayırıq:

$$F = \frac{R^2}{1 - R^2} \times (n - 2) = 24,06.$$

$$\alpha = 0,05 \text{ üçün } F > F_{\text{cə}} = 6,61; k_1 = m = 1, k_2 = n - m - 1 = 5.$$

Regressiya tənliyi 0,95 ehtimalla, bütünlüklə statistik əhəmiyyətlidir, başqa sözlə,  $F > F_{\text{cə}}$ .

Orta nisbi xəta:

$$\overline{E}_{\text{nisbi}} = \frac{41,363}{7} = 5,909\%$$

Üstlü funksiya üçün  $\hat{y}$  hesablanmış qiymətləri faktiki qiymətlərdən orta hesabla 5,909% fərqlənirlər.

*Hiperbolik funksiyanın qurulması.*

Hiperbolik funksiyanın tənliyi [1]:

$$\hat{y} = a + \frac{b}{x}.$$

$\frac{1}{X} = x$  əvəzləməsi aparmaqla modelin xəttləşdirilməsini həyata keçirək.  
Nəticədə

$$\hat{y} = a + bX$$

xətti tənliyini alacağıq.

Onun parametrlərini cədvəl 5-ə əsasən hesablayaq.

$$b = \frac{\overline{yX} - \overline{y} \overline{X}}{\overline{X^2} - \overline{X}^2} = \frac{0,6491 - 50,57 \times 0,0126}{0,0001618 - 0,0126^2} = 3571,95;$$

$$a = \overline{y} - b \overline{X} = 50,57 - 3571,9 \times 0,0126 = 5,7$$

Hiperbolik modelin növbəti tənliyini alırıq:

$$\hat{y} = 5,7 + \frac{3571,9}{x}.$$

Determinasiya əmsalını hesablayırıq:

$$R^2 = \rho_{YX}^2 = 0,914^2 = 0,835$$

Cədvəl 5.

T	Y	X	X	yX	X <sup>2</sup>	Y - $\bar{Y}$	(Y - $\bar{Y}$ ) <sup>2</sup>	$\hat{y}$	(y - $\hat{y}$ ) <sup>2</sup>	E <sub>i</sub>	$\left  \frac{E_i}{y} \right  \times 100\%$
1	64	64	0,0156	1,0000	0,0002441	13,43	180,33	61,5	6,1954	2,489	3,889
2	56	68	0,0147	0,8235	0,0002163	5,43	29,47	58,2	4,9637	2,228	3,978
3	52	82	0,0122	0,6341	0,0001487	1,43	2,04	49,3	7,5089	2,740	5,270
4	48	76	0,0132	0,6316	0,0001731	-2,57	6,61	52,7	22,078	4,699	9,789
5	50	84	0,0119	0,5952	0,0001417	-0,57	0,32563	48,2	3,1591	1,777	3,555
6	46	96	0,0104	0,4792	0,0001085	4,57	20,90	42,9	9,5648	3,093	6,723
7	38	100	0,0100	0,3800	0,0001000	-12,57	158,04	41,4	11,69	3,419	8,997
yekun	354		0,0880	4,5437	0,0011325		397,71	354,2	65,159	0,246	42,202
Orta qiym.	50,57		0,0126	0,6491	0,0001618						6,029

Y (məhsul buraxılışı həcmi) -in nəticə variyasiyası 83,6% X (kapitalqoyuluşunun həcmi) faktorunun variyasiyası ilə izah olunur.

Fişerin F-kriteriyası:

$$F = \frac{R^2}{1 - R^2} \times (n - 2) = \frac{0,835}{1 - 0,835} \times 5 = 25,3.$$

$\alpha = 0,05$  üçün

$$F > F_{\text{cədv}} = 6,61 ; k_1 = m = 1, k_2 = n - m - 1 = 5.$$

Regressiya tənliyi 0,95 ehtimalla, bütünlüklə statistik əhəmiyyətlidir, başqa sözlə,  $F > F_{\text{cədv}}$ .

Orta nisbi xəta:

$$\bar{E}_{\text{nisbi}} = \frac{1}{n} \sum \frac{|E_i|}{y} \times 100\% = \frac{42,202}{7} = 6,029\%$$

Hiperbolik model üçün  $\hat{y}$  hesablanmış qiymətləri faktiki qiymətlərdən orta hesabla 6,029 % fərqlənirlər.

Ən yaxşı modelin seçilməsi

Ən yaxşı modelin seçilməsi üçün nəticələrin yekun cədvəlini quraq.

Cədvəl 6.

Parametrlər Model	Determinasiya əmsalı $R^2$	Fişerin F-kriteriyası	Korelyasiya indeksi $\rho_{yx}$ ( $r_{yx}$ )	Orta nisbi xəta $E_{\text{nisbi}}$
Xətti	0,822	23,09	0,907	5,685
Qüvvət	0,828	24,06	0,910	6,054
Üstlü	0,828	24,06	0,910	5,909
Hiperbolik	0,835	25,30	0,914	6,029

Bütün modellər təqribən eyni xarakteristikalara malikdir, lakin Fişerin F-kriteriyasının və  $R^2$  determinasiya əmsalının ən böyük qiyməti hiperbolik modeldə alınmışdır. Ona görə də bu modeli proqnozun verilməsi üçün ən yaxşı model hesab etmək olar.

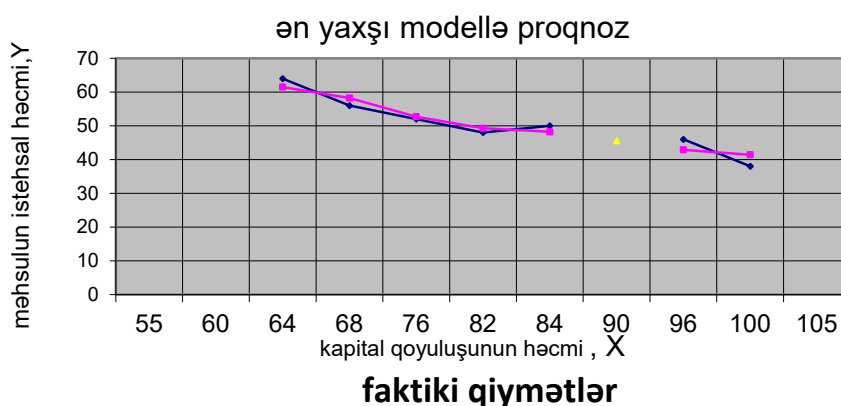
**Nəticə göstəricilərinin (səmərali göstəricilər) proqnoz qiymətlərinin hesablanması**

Nəticə əlamətinin proqnoz qiymətləri (məhsul buraxılışının həcmi) hiper-bolik modelin tənliyi ilə müəyyən olunur, kapitalqoyuluşu həcmnin planlaşdırılan kəmiyyətlərini (şərtə görə verilən) onda yerinə qoymaqla hesablamaları aparaq:

$$\hat{y}_{\text{proq}} = 5,7 + \frac{3571,9}{X_{\text{npoz}}} = 5,7 + \frac{3571,9}{89,573} = 45,542 \quad (\text{milyon man.}).$$

Ən yaxşı modelin faktiki, hesablanmış və proqnoz qiymətləri aşağıdakı qrafikdə əks olunmuşdur.





Tədqiqat zamanı MS Excel verilənlərin analizi paketindən istifadə edilmişdir («Korrelyasiya» və «Regressiya» proqramı).

**Nəticə.** Tədqiqatın nəticəsi göstərir ki, Mikroiqtsadiyyatın təhlilində statistik məlumatların keyfiyyətinin yüksəldilməsi üçün mikroməlumatların ekonometrik təhlilinə ehtiyac vardır. Mikroməlumatların təhlilindən əvvəl onların redaktəsi, şərti hesablanması, göstəricilərin statistik xarakteristikaları təhlil olunmalıdır. Sonra qurulmuş modellər içərisindən ən yaxşı nəticələri əks etdirən model seçilir, bu model vasitəsilə proqnoz verilir, və proqnoz əyrisi qurulur.

## ƏDƏBİYYAT

1. Рудык, Б. М. Математический анализ для экономистов : учебник и практикум для академического бакалавриата / Б. М. Рудык, О. В. Татарников. — М. : Издательство Юрайт, 2019. — 356 с.
2. Смагин, Б. И. Экономико-математические методы : учебник для академического бакалавриата / Б. И. Смагин. — 2-е изд., испр. и доп. — М. : Издательство Юрайт, 2019. — 272 с.
3. Тимофеев, В. С. Эконометрика : учебник для академического бакалавриата / В. С. Тимофеев, А. В. Фаддеев, В. Ю. Щеколдин. — 2-е изд., перераб. и доп. — М. : Издательство Юрайт, 2018. — 328 с.
4. Елисеева, И.И. Практикум по эконометрике: Учеб.пособие / И.И.Елисеева, С.В, Курышева, Н.М. Гордиенко [и др.] / под ред. И.И. Елисеевой – М.: Финансы и статистика, 2017. – 192 с.
5. Орлова, И.В. Экономико-математические методы и модели. Выполнение расчетов в среде EXCEL. Практикум: Учеб.пособие для вузов / И.В.Орлова – М.: Финстатинформ, 2018. – 136 с.

## THE CONCEPT OF SOCIAL CONTRACT IN JOHN LOCKE'S POLITICAL PHILOSOPHY

Svetlana Slusarenco<sup>1</sup>, Veronica Pozneacova<sup>2</sup>

<sup>1</sup> *Moldova State University, Faculty of Law, Department of Public Law, Chisinau, Republic of Moldova*

<sup>2</sup> *Moldova State University, Faculty of Law, Chisinau, Republic of Moldova,*

### Abstract

John Locke was the great thinker that finished the formation of the social contract theory. On the one hand, the philosopher's ideas represent the continuation of Thomas Hobbes theory. On the other hand, the originality of John Locke's doctrine manifests in the finality of his theory and in the analysis performed. John Locke is the founder of the liberal ideology of liberalism as a political regime. According to John Locke, the state appears as a result of the drafting of social contract by people. So, state is the creation of people's will. Based on these considerations, philosopher claimed that state should guarantee to people their fundamental rights, which were presented before the state's foundation. The importance of John Locke theory is manifested in the completion of the conceptual development of democratic ideology, which is the main philosophical base of the Great French Revolution, American Revolution, the revolutionary legislation of France, theories that followed these revolutions and modern constitutionalism. This article is a study dedicated to determining the specific aspects of the social contract theory in the background of the idea's history. In this context, we have outlined the following objectives: to identify the essence of the social contract theory, to analyze the concept of humans rights in the thinker's point of view, to determine the importance of the philosopher's ideas in the modern constitutionalism. As a result of this research, we aimed to determine the role of the theory of social contract in the constitutional law, in general, and John Locke's philosophy, in particular.

**Keywords:** state, humans rights, social contract, constitution, philosophy, revolution, democracy

### INTRODUCTION

John Locke is one of the brilliant thinkers of humanity which contributed to the development of political philosophy, in general, and liberalism, in particular. The philosopher argued the importance of the human's rights and the state's obligation to ensure respect for fundamental rights. John Locke and Jean-Jacques Rousseau developed the idea of the social contract created by Thomas Hobbes and fought with the absolute monarchy described by Niccolò Machiavelli. The specificity of the theories of John Locke and Jean-Jacques Rousseau is manifested in the positioning of man in the center of the political and social life of the state, in the foundation of national and popular sovereignty. In the philosophical thought of the Enlightenment, man represents the pinnacle of divine creation, which determines the revaluation of human potential and the role of man within society. This determines the development of the volitional conception of the appearance of the state and the positioning of the entire human society, in general, and the life of each man, in particular, as the holders of supreme power in the state. We observe the transition from absolute monarchy to liberalism and democracy, from the sovereignty of the monarch to popular and national sovereignty, from the superiority of the interests of the state to the superiority of the individual interests. The thinker's philosophy corresponds to the general directions of the philosophy of the XVII century. So, we should analyze the historical context and the premises that influenced the

formation of the John Locke's doctrine. This philosopher lived in the Enlightenment epoch. For this intensive period of humanity's thinking is characteristic the appeal to reason as the major criterion of understanding the world and society, popularization of knowledge, which should bring benefit to the entire society. In addition, we could note the tendency presented in the Enlightenment to systematize the knowledge accumulated during the humanity's development. In this period, France becomes the cultural center of the world. Thinkers as Voltaire, Charles Louis Montesquieu, Jean-Jacques Rousseau, Denis Diderot wanted to find the principles of man's natural life, searching for the natural religion and law. We should mention the criticism and denial of positive law, formed during the historical development of humanity, in favor of natural law. French philosophers such as Voltaire, Charles Louis Montesquieu, Jean-Jacques Rousseau, Denis Diderot argued the ideas of rationalism, the development of political-social ideas and religious tolerance. Their primary goal was the progressive development of humanity and the creation of rational society. Indeed, these considerations highlight a link between the ideas that dominated the political thought of the Enlightenment and those promoted by the great thinkers, who founded the concept of natural and inalienable human rights, perfectly blend into the context of the French Enlightenment society of the XVIII century.

## **MATERIALS AND METHODS**

This research paper is based on the analysis of the philosophy writings of John Locke in which the great thinker founded the theory of the social contract. In this research, we used the logical method with its operations such as analysis, synthesis, deduction, induction, generalization, abstraction for the consistent study all aspects of the thesis topic. We analyzed critically the essence of the most important concepts of the thinker's philosophy relevant for our topic. The application of the synthetic method gave us the possibility to identify the philosophical concepts developed by the great thinkers that helped us to support the proposed thesis. The analysis of the theme from the general point of view gave us the possibility to determine the importance of the social contract theory in the actual constitutional order. Analyzing the subject from the historical point of view, we could determine the dominant tendencies of the Enlightenment's philosophy that have the significant impact on the actual constitutional order.

Thus, we started by analyzing the historical context of the development of the social contract theory. An important part of this study was dedicated to the research of the origins of the state according to the political philosophy of John Locke. We analyzed critically the substantiation of the concept of human rights in the thinker's philosophy, which represents the ideological base of the democracy as a political regime. This research paper focuses on the philosophical argumentation of the humans inalienable rights from John Locke's point of view and the practical applicability of this theory in the actual constitutionalism.

## **RESULTS**

Certainly, John Locke is one of the most important thinkers of Enlightenment whose doctrine represents the base of the actual democratic regime. In his writings, John Locke expressed the social and political aspirations of the English bourgeoisie of his time. The "Two Treatises of Government" written by the great thinker is considered as the basic texts of modern democratic doctrine (of constitutionalism, parliamentarianism, the supremacy of law) and the main foreshadowing of modern liberalism. The capital significance of John Locke's work for modern political thought and will is connected with the ideal of eliminating arbitrariness and establishing a rule-based civilization. (Popa N., Dogaru I., 2002, p. 162)

The great thinker started from the consideration that freedom and equality are part of human nature in developing of the theory of "political liberalism". Human nature comprises freedom.

However, in the pre-state period, relations between people are based on force, because there was no positive right. The concept of law implies the regulation of relations between two free being that realizes in equality. As a result, social relations between people are naturally formed before any convention leading to the formation of civil society. There was a natural society before any civil society. Locke goes in continuation of the Aristotelian idea that man is a social being. If man did not have in himself the call to association with other people, as a natural gift, civil society would not have been made up. Based on these ideas, the great philosopher asserted that there was a natural right before civil law.

We should begin with the analyzing of the essence of the social contract theory that represents the base of the whole Locke's political philosophy. The concept of social contract theory is that in the beginning man lived in the state of nature. They had no government and there was no law to regulate them. There were hardships and oppression on the sections of the society. To overcome from these hardships they entered into two agreements which are: 1. Pactum Unionis; and 2. Pactum Subjectionis. By the first pact of unionis, people sought protection of their lives and property. As, a result of it a society was formed where people undertook to respect each other and live in peace and harmony. By the second pact of subjectionis, people united together and pledged to obey an authority and surrendered the whole or part of their freedom and rights to an authority. The authority guaranteed everyone protection of life, property and to a certain extent liberty. Thus, they must agree to establish society by collectively and reciprocally renouncing the rights they had against one another in the State of Nature and they must imbue some one person or assembly of persons with the authority and power to enforce the initial contract. In other words, to ensure their escape from the State of Nature, they must both agree to live together under common laws, and create an enforcement mechanism for the social contract and the laws that constitute it. Thus, the authority or the government or the sovereign or the state came into being because of the two agreements. (Laskar M., 2013, p.10-17)

So, arguing the theory of social contract John Locke used to say, partly repeating Hobbes's arguments about the natural state of people (Arseni A., 2019, p.174), that the transition from the natural state to civil society was possible because the natural state has some characteristics that bring it closer to civil society and make this transition possible. Thus, it substantiates the concept of the natural state, which represents a rational, natural and prelegal state. In this state, dominate freedom and equality. It is natural because people possess some rights according to the natural law. (Popa N., Dogaru I., 2002, p.166) According to John Locke's point of view, it was reasonably good and enjoyable, but the property was not secure. He considered State of Nature as a *Golden Age*. It was a state of peace, goodwill, mutual assistance, and preservation. In that state of nature, men had all the rights which nature could give them. Locke justifies this by saying that in the State of Nature, the natural condition of mankind was a state of perfect and complete liberty to conduct one's life as one best sees fit. It was free from the interference of others. In that state of nature, all were equal and independent. This does not mean, however, that it was a state of license. It was one not free to do anything at all one pleases, or even anything that one judges to be in one's interest. The State of Nature, although a state wherein there was no civil authority or government to punish people for transgressions against laws, was not a state without morality. The State of Nature was pre-political, but it was not premoral. Persons are assumed to be equal to one another in such a state, and therefore equally capable of discovering and being bound by the Law of Nature. So, the State of Nature was a state of liberty, where persons are free to pursue their own interests and plans, free from interference and, because of the Law of Nature and the restrictions that it imposes upon persons, it is relatively peaceful. (Laskar M., 2013, p.10-17)

Locke's Natural Right, then, is that all men are equal, that is, they are all human beings created by God. No man has any jurisdiction over any other and each has an equal right to his

Life, Liberty, and Property. (Macpherson C.B. ,1964 p. 199) Concerning life and liberty, Locke wrote that men are in "a State of perfect Freedom to order their Actions, and dispose of their Possessions, and Persons as they think fit, within the bounds of the Law of Nature, without asking leave, or depending upon the Will of any other Man". Men are able to live their lives free from the demands of anyone else. In addition to perfect freedom, men are also equals since they are all "Creatures" of the same species, "born to all the same advantages of Nature." What Locke means by equality is not equality of abilities nor wealth, because these obviously vary from one person to another; he means that men are equal in their right of not being subjected to the will of another with respect to their perfect freedom. Locke also says that men are equal with regard to their property. (Steele, D. A., 1993 p.3-4)

So, there is no social order regulated by laws other than natural laws, which preceded the emergence of positive law. Private Justice prevails in this state and brings its validity to the right of each individual to his defense and the reciprocity of behaviors. (Brimo A., 1978, p.117) The concept of positive natural law at this period is incipient, exercised spontaneously, being more moral, unlike civil law that is implemented by those who govern. The basic characteristic of the natural state is the state of Social Peace, (Popa N., Dogaru I., 2002, p. 167) which manifests in the reign of natural laws based on the freedom and equality, order and well-being of all people. (Râbca E., 2016, p. 97) Locke claims that the Law of Nature is discovered through the use of reason. Locke says, "There is a great deal of difference between an innate law and the law of nature; between something imprinted on our minds in their very original and something that we, being ignorant of, may attain to the knowledge of, by the use of and due application of our natural faculties" . In his *Essays on the Laws of Nature*, Locke confirms his idea that the Law of Nature is not an innate idea. The Law of Nature, according to Locke, is not acquired by a priori knowledge, nor is it traditional knowledge, which is second hand knowledge acquired by instruction or as information. Rather, it is acquired through sense-experience and reason, referred to as the Light of Nature.(Steele, D. A., 1993 p.3-4)

Definitely, the basis for the doctrinal affirmation of a natural state is: a) the tendency of each man to establish peace and security between people; b) the actions of people find foundations in rationality; c) wishing to achieve safety and peace in relations with other people, each man is necessarily "condemned" to confuse his own interests with the interests of others people. (Râbca E., 2016, p. 97)

According to Locke's doctrine, the emergence of the state finds its basis in the theory of social contract. (Râbca E., 2016, p. 97) Locke said that one is not likely to find records of the State of Nature because, generally, the keeping of records begins with civil societies, that is, political bodies. However, Locke tried to show his view of what most likely was the origin of civil society. Locke derived his idea of the State of Nature, in part, from his own social conditions and problems which existed at the time. He then combined his observations with traditional Christian views on natural law and God to arrive at a possible origin of the civil state.(Steele, D. A., 1993 p.3-4)

So, the author also imposes the conceptualization of political power as the right to legislate and the right to exercise the applicative-legal activity. (Râbca E., 2016, p. 97) The state represents a product of the social contract, which results from the expression of the will of the people. (Râbca E., 2016, p.98) From Locke's point of view, "social contract" is not an act of alienation, but the compromise, which makes the people true depositary of the general interest. (Locke J., 1999, p. 54)

As a result, the transition to civil society took place, following a consensus by which people wanted maximum security and freedom. The essence of his theory Locke expressed thus: "man in the natural state is a reasonable and free being, eager to live well. For this, he voluntarily renounces, by contract, of some of his claims and prerogatives in favor of the



state, which owes him respect and protection.” (Locke J., 1999, p. 54) Philosopher observes that people gave up their natural state and made up civil society in order to get maximum protection. It transitioned from the natural state to the civil State based on a contract. People could denounce the contract underlying this agreement if those who hold the power do not fulfill the obligation assumed. As a result, people making up the state keep the freedom to end the contract if the state leadership does not respect their rights and cannot grant them the security, violating the obligations assumed by concluding this contract. Definitely, the principle of any association can only be common consent. As a result, the state relies on the free consent of each, being concluded in the absence of any constraint. (Georgescu Ş., 2001, p. 58) People consent to go out of the natural state in order to find in the state legal security, prosperity and welfare. People agree with others to unite in society in order to enjoy each one, in safety and peace, of what belongs to them—life health, freedom, wealth—in order to be more safe from harm and insult.

We should highlight Locke’s insistence on the ideas of “consent” of each one, of “trust” that each place in those to whom he confers power, that expresses the individualistic and liberalist orientation, peculiar to his political and legal philosophy. In contrast to the passive submission promoted by Hobbes, Locke opposes free-will acceptance of the social contract. Man enters society to live freely; a law is not made to constrain, but to make an intelligent and free agent to act according to his own interests. At the same time, law should prescribe the behavior that would help to attend to the general happiness of the entire society. The purpose of the law is not to abolish or limit freedom, but to preserve and enhance it. (Georgescu Ş., 2001, p. 58-59)

So, we can conclude that the object of the contract is the guarantee of natural rights, not their suppression in favor of the sovereign, as Hobbes thought. The only right that associations make available to civil society is to punish and make justice. (Popa N., Dogaru I., 2002, p. 167) The primary purpose of the emergence of the state is to ensure the security and freedom of people by establishing the judicial power. This power represents the politically organized coercive apparatus, the existence of which is a distinct feature of political power that manifests through legislative and executive activity (Râbca E., 2016, p. 97), which guarantees compliance with the positive laws established by the state.

The concept of the social contract is summarized in the state's creation, that’s major functions is the judicial one. The role of judicial power is to make up for the freedom and prosperity of everyone, to guarantee people’s natural freedom, equality and independence. As a result, political power should not be absolute, it should have limits. The purpose of any political power should be the preservation of life, freedom, property. The government will come into conflict with civil society, if this goal is not respected. People could return to the natural state. As in any contract, if one party violates it, the contract cannot longer bind the other. (Popa N., Dogaru I., 2002, p. 167) We note that civil society plays the crucial role in the eventual termination of the social contract. It should control over the governors who actually exercise state power. In particular, civil society should identify possible violations of the government’s obligations and put pressure on the government, so that it does not deviate from the purpose of establishing the state—the safety and respect of citizens’ rights and freedoms - and does not shirk from the obligations assumed. State sovereignty belongs to people and they do not give up their share of sovereignty by establishing legislative and executive power. If these powers limit people’s rights, citizens can resort to force (the right to revolution) to replace governance. By this conception, the great thinker legitimizes the revolution, (Popa N., Dogaru I., 2002, p. 168) which represents that method by which civil society can end the social contract.

According to Locke, the natural human rights represent another limit of political power. (Popa N., Dogaru I., 2002, p. 168) In contrast to Thomas Hobbes opinion, John Locke shows that

the natural state is not a state of war, but the pre-state epoch is the state of natural society in which man has imprescriptible rights, that should be defended by society. In the category of natural rights enter: 1. Ownership; 2. The right of personal freedom, 3. The right to self-defense, which is linked with the right to punish. People cede the right to punishment by entering the society substituting revenge for justice. (Georgescu Ș., 2001, p. 58)

Property plays an essential role in Locke's argument for civil government and the contract that establishes it. According to Locke, private property is created when a person mixes his labour with the raw materials of nature. Given the implications of the Law of Nature, there are limits as to how much property one can own: one is not allowed to take so much from nature than oneself can use, thereby leaving others without enough for themselves, because nature is given to all of mankind for its common subsistence. One cannot take more than his own fair share. Property is the linchpin of Locke's argument for the social contract and civil government because it is the protection of their property, including their property in their own bodies that men seek when they decide to abandon the State of Nature. John Locke considered property in the State of Nature as insecure because of three conditions; they are: 1. absence of established law; 2. absence of impartial Judge; and 3. absence of natural power to execute natural laws. Thus, man in the State of Nature felt need to protect their property and for the purpose of protection of their property, men entered into the Social Contract. (Laskar M., 2013, p.10-17)

We should highlight that Locke considered the liberty one of the most important characteristics of the pre-state era. Freedom represents the first fundamental natural right. (Capcelea V., 2004, p. 108) Based on this natural right, people "built" the remaining part of the "pyramid" of natural rights. At the same time, freedom requires compliance with laws, thus excluding the possibility of freedom as a practice of free will and chaos. (Râbca E., 2016, p. 97-98) So, the person keeps certain freedom in relation to the state. This freedom represents the result of the precise determination of the state's power. The governance could not extend the state's activity beyond the limits imposed by legislation. Social relations, which go beyond the powers of the state, constitute the sphere of manifestation of citizens' freedoms. (Râbca E., 2016, p. 98)

The possibility of people to preserve freedom is based on several principles: a) the state must should respect humans' rights; b) the principle of separation of powers in the state in legislative power, executive power and Federative power, which refers to the work of the state in international relations, should be defined, c) the principle of legality. (Râbca E., 2016, p. 98) The thinker is the founder of the concept known as rule of law. Locke positioned laws above state power, which can act within the law's limits.

In conclusion, Locke's idea of democracy is based on the fact that people's will is defining in the state's construction and the benefit of citizens' should be the governance's aim. The state exists until the people desire it. If the state leadership derogates from the will of most citizens, they may end the contract, invoking the right to revolution. So, the state's benefit could not be positioned as more important than people's well-being. The most important of Locke's ideas summarize in the consideration that people have gained security and justice by forming the state and have not lost autonomy and natural and inalienable rights presented in the pre-state epoch. In this way, state does not become the Leviathan omnipotent that should be catered by people, on the contrary, the entire state construction is created to satisfy the people's needs.

## DISCUSSIONS

The importance of Locke's philosophy, in general, and of this study, in particular, represents the attempt to solve the fundamental dilemma related to the emergence of the state - the problem of human freedom and the necessity of submission to state power. In contrast to Thomas Hobbes ideas, according to which state represents the almighty body that govern

according to its own interests John Locke's state does not submit human's freedom. On the contrary, the people's liberty represents the base of state, its foundation. People are no longer forced to choose between freedom and the minimum guarantees provided by a totalitarian state. The most important contribution of this thinker is the foundation of the concept of human rights, popular sovereignty and the social contract as the foundation of state, which must be strictly respected. So, the philosophical and juridical vision of John Locke is rightfully included in the group of theories that substantiate democracy as a political regime and that represent the foundation of modern constitutionalism.

The actuality of the theory of the social contract, in general, and John Locke's ideas, in particular, has been expressed by the great Romanian constitutionalist Constantin Stere. According to him, "The Great French Revolution formulated these principles, these rights, which man reserved, entering the state, in the great Declaration of the Rights of Man and of the Citizen. This declaration of human and civil rights in various forms represent the component part of a majority of written constitutions of our time ... Thus, we can say that modern positive law is permeated with this concept of the foundations of the state and rights, born from the individualistic concept, the concept of individual rights." (Stere C., 2016, p. 26) Correspondingly, the most important contribution of John Locke's for the modern doctrine of law is manifested in the justifying, substantiating the concept of the rights of man, founded on the belief that every human being is sacred and inviolable by its existence, because men are born and remain free and equal in rights. The great thinker attempted to protect us from absolutist power, from the totalitarian regime, from the situation in which the existence of a state becomes more important than the good of citizens, from the times when people sacrifice their lives to ensure the existence of the great, almighty, but cruel and ruthless Leviathan. The exhortation of John Locke was legally embodied in The Constitution of the Commonwealth of Massachusetts, which had preceded the Constitution of the United States of America by seven years, being the first written Constitution in the world. According to the Article I of The Constitution of the Commonwealth of Massachusetts: "All men are born free and equal and have certain natural, essential, and unalienable rights; among which may be reckoned the right of enjoying and defending their lives and liberties; that of acquiring, possessing, and protecting property; in fine, that of seeking and obtaining their safety and happiness." (Massachusetts Constitution 1780) The same idea triumphed on July 4, 1776, being enshrined in The United States Declaration of Independence, representing one of the most important pylons of American democracy: "We hold these Truths to be self-evident, that all Men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the Pursuit of Happiness". (Declaration of Independence, 1776) Later this idea was enshrined in The Universal Declaration of Human Rights of December 10, 1948 proclaimed by the General Assembly of the UN which in art. 1 proclaim: "All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood." (Universal Declaration of Human Rights, 1948) This article represents an echo of the French Revolution which proclaimed as national motto "Liberté, Egalité, Fraternité", that was included in art. 1 of The Declaration of the Rights of Man and of the Citizen (August 26, 1789): "Men are born and remain free and equal in rights. Social distinctions can be founded only on the common good." (Declaration of the Rights of Man and of the Citizen 1789) So, the ideas of John Locke that were developed by great French philosopher Jean-Jacques Rousseau triumphed the political and legal thinking of humanity, being proclaimed, respected and guaranteed at local and worldwide level, giving people rights, protection and equality, representing at the same time a Triumph against absolutism and contempt for human dignity.

## CONCLUSION

In conclusion we would like to highlight one of the most important principles of Locke's philosophy that refers to the state power. According to philosopher's point of view, the purpose of the Government and law is to uphold and protect the natural rights of men. So long as the Government fulfils this purpose, the laws given by it are valid and binding but, when it ceases to fulfil it, then the laws would have no validity and the Government can be thrown out of power. In Locke's view, unlimited sovereignty is contrary to natural law. (Laskar M., 2013, p.10-17) So, this principle together with respect for the fundamental human rights argued and legitimized by John Locke represents the foundation of the actual democracy.

## REFERENCES

- Arseni A., (2019). *Drept constituțional și instituții politice: Tratat*, Edition Second, Chisinau: CEP USM, vol.1
- Brimo A., (1978). *Les grands courants de la philosophie du droit et de l'Etat*, Pedone, Paris
- Capcelea V., (2004) *Filosofia dreptului: Manual pentru instituții de învățământ superior*, Chisinau, Arc Publishing House
- Declaration of Independence: A Transcription, In Congress, July 4, 1776, Online: [Declaration of Independence: A Transcription | National Archives](#)
- Declaration of the Rights of Man and of the Citizen 1789, Online: [Declaration of the Rights of Man and of the Citizen 1789 \(emersonkent.com\)](#)
- Georgescu Ș.(2001) *Filosofia dreptului. O istorie a ideilor din ultimii 2500 de ani*. Bucharest, ALL BECK
- Laskar, M. (2013). Summary of social contract theory by Hobbes, Locke and Rousseau. *Locke and Rousseau (April 4, 2013)*.
- Locke J. (1999). *Al doilea tratat despre cărmuire. Scrisoare despre toleranță*. Bucharest Nemira
- Macpherson C.B. (1964). *The Political Theory of Possessive Individualism*, Oxford: Oxford University Press
- Massachusetts Constitution 1780 Online: [Massachusetts Constitution \(malegislature.gov\)](#)
- Popa N., Dogaru I., Dănișor G., Claudiu Dănișor D., (2002). *Filosofia dreptului. Marile curente*, Bucharest, ALL BECK
- Râbca E., Zaharia V., Mărgineanu V., Ciobanu R., (2016). *Filosofia dreptului*, Chisinau, Artpoligraf Publishing House
- Steele, D. A. (1993). *A comparison of Hobbes and Locke on natural law and social contract*. AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH.
- Stere C., *Curs de drept constituțional*, Chișinău, Ed. Cartier, 2016
- Universal Declaration of Human Rights 1948 Online: [Universal Declaration of Human Rights | United Nations](#)

## THE POSITION OF PUBLIC EXPENDITURES IN THE PROCESS OF ECONOMIC GROWTH: AN EVALUATION OF TURKEY

**Prof. Dr. Ahmet Niyazi ÖZKER<sup>1</sup>, Burcu CANPULAT<sup>2</sup>**

<sup>1</sup>*Bandirma Onyedi Eylul University, Faculty of Economics and Administrative Sciences, Public Finance Department 10200-TURKEY*  
ORCID ID: 0000-0001-5313-246X

<sup>2</sup>*Master Student, Bandirma Onyedi Eylul University, Faculty of Economics and Administrative Sciences, Public Finance Department 10200-TURKEY*  
ORCID ID: 0000-0001-5446-6453

### Abstract

This study aims to reveal the structural position of the macro effects of the public expenditures phenomenon with the impact of accelerating and multiplier in the economic growth processes and the significant impact on the target economic growth. It appears that the increased effect of public expenditures is generally higher than expected, especially in emerging economies, and it is observed that R&D expenditures have an important place in the process. In this context, it is seen that there is a positive correlation between the increase in public expenditures and the achievement of economic growth targets, and this effect stands out with the higher increase in social spending in underdeveloped and developing countries. This row is more significant in developed countries with higher factor incomes and R&D studies. Increases in public expenditures for Turkey, especially after the 2000s, entered a high-level increasing trend and occupied an important place as a proportion of GDP. On the other hand, these expenditure rates were tried to be financed with public finance balances corresponding to the proportional values of GDP. However, this process has also created the inevitable position of possible budget deficits due to increased public expenditures after the increased public expenditures. It is a globally accepted phenomenon that the motivating force of growth is the phenomenon of public expenditure as a whole. When this phenomenon is considered in comparison with OECD countries, it is understood that both the real values of public expenditures continue at an increasing level, and even in developed OECD countries, public expenditures do not return to their previous levels of continuing. In this respect, it is important for us to compare the rate of increase in public expenditures in Turkey with the economic growth targets and to interpret it at the global level at the level of OECD countries.

**Key Words:** Emerging Economies; GDP; OECD; Public Expenditures; Socio-Economics Policies.

**JEL Codes:** H11; H51; H52.

### INTRODUCTION

In the process of economic growth, public expenditures, especially investment expenditures and the accelerating effect of consumer goods, have an important meaning on economic growth. In this context, the important effects of the change in public expenditures directly affect the macroeconomic values and constitute an important infrastructure of the policies to be formed, especially in achieving the economic growth targets. This approach also makes it necessary to understand the impact levels within the classifications of public expenditures within the scope of these classifications. Undoubtedly, the most effective usage areas of public expenditures are the public expenditures made within the scope of the researches that we call R&D researches (Gür, 2017: 4). Especially the growth and efficiency of the economy with a predominance of the public sector, and the transition of the private sector to an upper



production margin that can be directly affected by the technical and technological infrastructure depends on these public expenditure effects concerned. In addition to all these, it is important to evaluate the effect values of public expenditures in the process after the financial and economic crises, within the level of the financial impact criteria that can create a financial stabilizer effect at the same time (OECD, 2009: 21). In other words, the existence of the control of public expenditures in a structure, especially in overcoming the global financial crises, is meaningful for the establishment of the said national economic values and national economic balances. In this context, it is seen that public expenditures take place in the process as an important balancing element in terms of balancing current expenditures, investment expenditures, and possible future foreign exchange deposit accounts.

In addition to all these, it is necessary to evaluate the impact of public expenditures on economic growth as the scope of expenditure within a broader and holistic structure, rather than addressing it unilaterally. In particular, public expenditures have an important place in increasing human capital, and their economic effects directly affect economic development as a current investment measure in providing quality human capital (Canton et al, 2018: 17-18). The existence of public expenditures at each stage has an important place for economic development goals, especially in achieving all kinds of economic targets and financial balances. The evaluation of public expenditures within the scope of efficiency and effectiveness with less cost has also been one of the factors that emerged after the 1970s and accepted alternative policies, especially in overcoming serious socio-economic crises. Therefore, it is seen that public expenditures have a place in the process as an important intervention tool in ensuring economic growth. This understanding also reveals that public expenditures, as a financial instrument, are an element of a process in which public interventions are used as an important balancing element in the process and in search of a structural model with the preference models in the public decision-making process (OECD, 2002: 23). This efficiency level of public expenditures is an important reason why it is perceived as investment and medium-term current expenditures or commercial investment expenditures for investments, along with current expenditures. Today, this comprehensive public expenditure approach has come to the fore with a modern fiscal policy approach, and with its holistic effect level in the targeted economic growth rates, it has taken an important place in the global process as a financial policy determining factor beyond all other financial instruments (European Parliament: 2017: 41).

# **1. THE PLACE AND STRUCTURAL RELATIONSHIP OF PUBLIC EXPENDITURES WITHIN THE SCOPE OF ECONOMIC GROWTH THEORY**

It is seen that economic growth targets and public expenditures also reveal the processes in which they create an opposite effect level from time to time, despite the mutual multiplier effect. In other words, the inevitability of an increase in public expenditures in this law, which can be expressed according to Wagner's law, is actually an expression of an infrastructure dynamic of economic growth. Contrary to the Keynesian economic approach, which argues that the economy tends to grow due to the increase in public expenditures during the economic development process, it is seen that the values that can actually contribute to the economy today aim to reveal a structure that aims to increase productivity. On the other hand, this situation reveals a different structural global approach from the 19th and 20th century structural approaches, which are accepted as necessary to ensure economic growth in public expenditures. At this stage, Wagner's law and Keynesian view emerged with differences in several different phenomena regarding the effectiveness of public expenditures (Ertekin and Bulut, 2021: 189-190 and 192). Wagner's law is more prominent today with the view that effective and predominantly demographic characteristics can be meaningful with public expenditures based on productivity. In the Keynesian approach, it is essential to target the

increase in demand with the multiplier value of all kinds of factorial inputs that can be invested in ensuring the efficiency of economic growth in making investments; however, the Wagner Approach now reveals an economic growth that its mutual external effects can explain (Ulucak and Ulucak, 2014: 91-92).

However, when the theoretical effects of public expenditures on the economic growth process are analyzed analytically, it is understood that the positive impact of public spending on economic growth is inevitable. In addition to this, it appears that the external effects of the economic growth process on the global level also reveal a structure in which the economic growth processes and public expenditures are affected by the current account deficit level. At this point, it is understood that apart from the conflict of fair distribution regarding efficiency and factorial resource distribution in the economy, social welfare equality also includes a structure based on public expenditures in the process (Campodónico et al, 2014: 6). In this context, it is impossible to consider effective public expenditure policies regarding economic growth separately from public expenditures on social public expenditures and income distribution. In other words, in contrast to the developed countries where social expenditures increase more, overcoming the growing problems in the countries representing the underdeveloped and developing emerging economies emerges with investments rather than social expenditures, and the current investment processes taking place with expenditures (OECD, 2015: 10). This structural position has brought the role of the public economy of today's states to the present day, especially in developing economies, with a different structural basis for developed economies. Therefore, the acceptance of services such as defense, justice, and education as a public expenditure necessitates a public expenditure approach based on establishing this infrastructure for the economic growth process (OECD, 2001: 321).

However, in a structure where the globalization process imposes the standards of economic development, it is seen that the theoretical approaches that come to the fore in public interventions by using public expenditures take place in the process. In other words, it is a fact that public expenditure policies are predominantly used to overcome the frequently experienced global financial crises and to revive the market or to reach the targeted macro values for the economy. This interventionist structure of the state appears as one of the important Keynesian elements, which still finds its place in a Keynesian approach today (Skidelsky, 2011: 12). Besides, it should be emphasized it appears that the up-to-date economic formations that depend on public expenditures change the theoretical approach to public expenditures. The up-to-date structural public finance alterations reveal a structure in which productive expenditures and sectoral incentives are predominant, apart from the classical classification as more significant to ensure the adequate level. This approach means the social expenditures have declined. In contrast, R&D and the global public expenditures have increased in recent years, which has brought on the agenda, which needs to balance as the phenomenon inevitably between economic decisions and social welfare choices (United Nations, 2020: 37). This phenomenon has taken place in the concerned process through the last global imposition interventional, which significantly affects the less developed country economies as related to the changed of public expenditures policies. An economy that grows more sectoral than a minimal public economy approach in achieving the target economic growth trends often brings up the increasing demand-oriented public expenditures approach. Still, the value of public economic efficiency is very high in the global process, and emerging economies, supported by increasing public expenditures, are also the subject of a cost-benefit efficiency-based public expenditure policy in which the private sector is not much involved but is supported (World Bank, 2019: 1). As an expenditure policy, when the efficiency in the provision of infrastructure services by the state encourages private investments, public expenditures find a place today with a theoretical approach in which standards for reducing

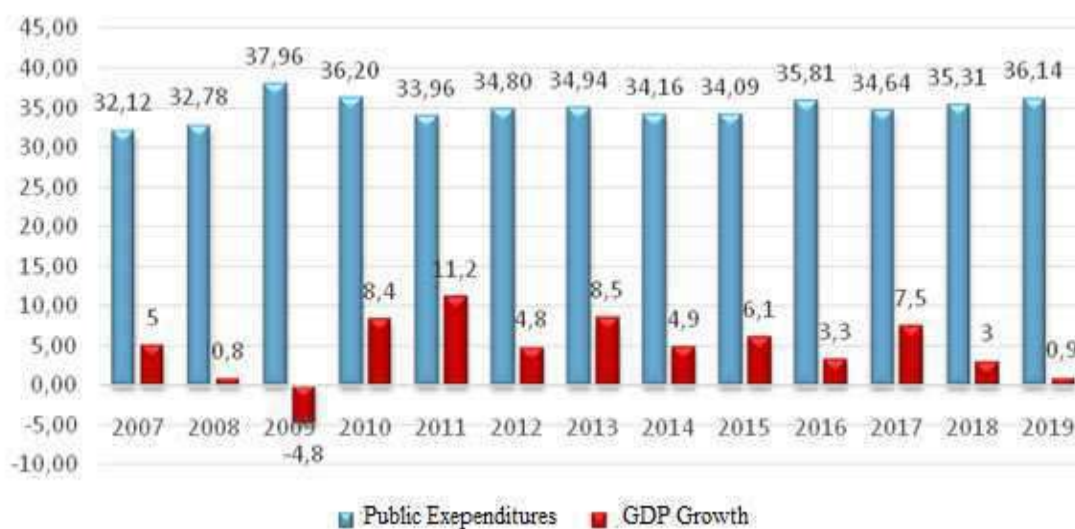
costs are established and form the basis of international financial-fiscal adjustment policies such as the Maastricht criteria based on public expenditures to GDP

## 2. RECENT CHANGE VALUES IN PUBLIC EXPENDITURES, AND ECONOMIC GROWTH EFFICIENCY

The real rate of change in public expenditures in our country shows significant fluctuations, especially its proportional structure to GDP. When it is associated with economic growth, it is seen that increasing public expenditures have a meaningful place in economic growth trends. It is possible to evaluate this phenomenon together with the shrinking effect of economic growth in trends in which public expenditures increase, especially in public expenditures (Zouhar et al, 2021: 14).

### 2.1. Periodic Changes in Public Expenditures and the Course of Real Economic Growth

The important reason for the deviation in GDP against increasing public expenditures also reveals that expenditures show a change in consumption expenditures rather than productive expenditures. In 2018 and 2019, where the effect of this change was around 30 percent, especially after 2005, it is seen that these increases in public expenditures were around 35% and below 30% as a ratio of GDP. This numerical value appears as a real value as a ratio of GDP, as a real value for economic growth, and as a real structural position of public expenditures. In Chart 1 below, it is possible to monitor public expenditures and GDP growth rates:



Source: Strateji ve Bütçe Başkanlığı (2020), *İstatistikler: Genel Devlet Harcamaları*, Ankara: Strateji ve Bütçe Başkanlığı, 2020.

**Graphic 1. Recent Real Position of Public Expenditures and Economic Growth**

As shown in chart 1 above, the ratio of public expenditures to GDP has not changed much with minimal changes. This rate in Turkey is around 36 percent of GDP. The relationship of increasing public expenditures in Turkey with public fiscal policies has also created an effective process. Despite this, a different and quite fluctuating change in GDP change rates as economic growth is remarkable. It is observed that it is challenging for the GDP to reach a stable economic growth trend, especially after the global financial crisis of 2009, after a recessive shrinkage trend of around -4.8 percent. However, we can say that the value position of public expenditures has reached the highest point proportionally, especially in 2018 and 2019.

This approach reveals that this increase in public expenditures, which was around 36% in 2019, is also in question with the effect of reforms regarding public finance policies. An important reason for the small economic growth values in 2018 and 2019 at every stage is due to the negative multiplier effect of current expenditures on value public growth, apart from public expenditures. Since increasing public expenditures also mean the increase in the share of the public sector in the economy, it should be emphasized that the factorial resource use in the public sector related to public expenditures emerges within the scope of transfer expenditures and social expenditures rather than efficiency expenditures. In addition, in recent years, when the expenditures on interest payments were also high, it is seen that the increase in public expenditures did not have a significant positive effect on the economic growth trends.

In addition, as an important GDP value, public expenditures reveal a situation in which the increased values of each public expenditure are controlled according to the Maastricht criteria in real terms. Ensuring the continuation of the increase in public expenditures in a controlled manner also means limiting the intervention effect of the public sector on the markets. However, another noteworthy point here is that it should be emphasized when increases in public expenditures appear as increases in R&D studies and public financial transfers that can support the private sector increase. Therefore, it has a significant share in the increase in public expenditures, especially after 2017, in supporting the private sector with financial incentives. The structural relationship between economic growth and public expenditures reveals a significant regressive structure. It is essential to consider this increasing trend in public expenditures based on the classification of public expenditures as investment expenditures, current expenditures, and transfer expenditures.

Comparing these values with the actual growth value of GDP creates a necessary significant process in this regard. In this context, we can see more clearly that the values in the ratio of the increase in public expenditures to GDP in total occur within the scope of transfer expenditures. Within the range of transfer expenditures, the weighted increase in interest expenditures and social expenditures caused significant deviations in the productivity values of total public expenditures related to economic growth, and this deviation created a negative effect on economic growth, leading to an increase in sectoral resource distribution in terms of economic growth. set the agenda.

In Table 1 below, it is possible to monitor the ratios of public expenditures to GDP and their position with real economic growth rates.:

**Table 1. Distribution of Public Expenditures Composition in terms of GDP and Real Economic Growth**

Years	Current Expenditures	Investment Expenditures	Transfer Expenditures	Real GDP Growth	Public Expenditures to GDP
2007	14,23	3,01	14,87	0,5	32,12
2008	14,86	3,22	14,69	0,8	32,78
2009	16,77	3,12	18,06	-4,8	37,96
2010	16,09	3,22	16,90	8,4	36,20
2011	15,37	3,08	15,50	11,2	33,96
2012	15,67	3,15	15,99	4,8	34,80
2013	15,44	3,61	15,88	8,5	34,94
2014	15,31	3,26	15,59	4,9	34,16
2015	15,21	3,45	15,43	6,1	34,09

2016	16,24	3,48	16,09	3,3	35,81
2017	15,32	3,67	15,65	7,5	34,64
2018	15,82	3,77	15,73	3,0	35,31
2019	16,50	2,67	16,98	0,9	36,14

**Source:** IMF (2020), *World Economic Outlook 2020*, Washington D.C.: IMF- International Monetary Fund Publications, 2020.

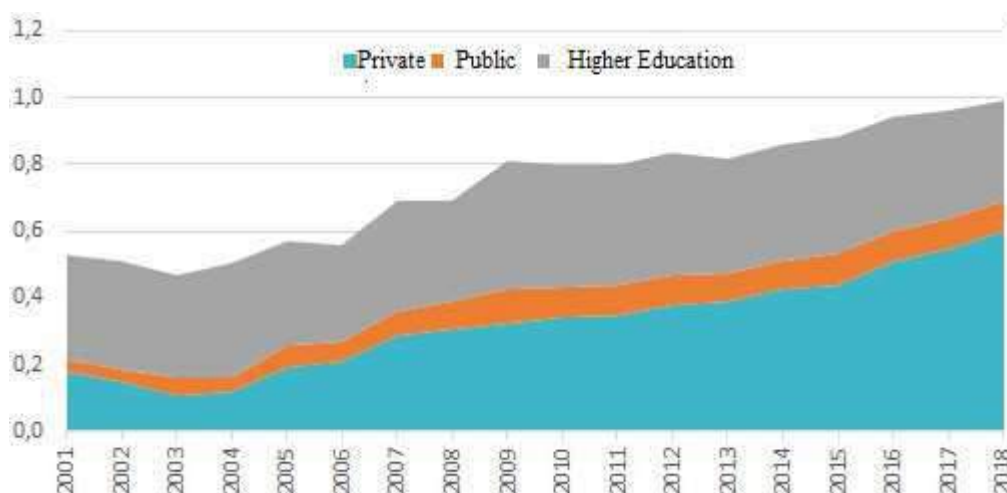
As seen in Table 1 above, the direct effect of increases in current expenditures and transfer expenditures on economic growth is considerably higher than the increases in investment expenditures. The fact that investment expenditures are so low in interpreting the effects of public expenditures on economic growth and the most contributing value results from a negative effect of transfer expenditures and current expenditures expressed as unproductive expenditures. The fiscal fact put forth means that the current social transfer expenditures are quite high as out of production process, but non-effect on economic growth. In other words, creating a significant increase trend in the general classification of public expenditures, especially in health expenditures for 2019 and 2020, and other current expenditures in the process resulted in a further reduction in investment expenditures, especially in the last few years.

These unproductive public expenditures have been a greater negative impact on the economic growth trend, and in brief, this phenomenon has resulted in a negative process impact for a few years as related to economic growth rates. Indeed, as seen in Table 1, the economic growth trend, which was around seven and a half percent in 2017, entered a very striking downward trend in real terms in 2018 and 2019 and caused an economic recession. The proportional increase value of current expenditures and transfer expenditures is relatively close to GDP. The present value of investment expenditures, which was around 3 percent of the Gross Domestic Product in 2007, has decreased to around 2.5 percent. The trend of inefficient public expenditures has taken more place in the process. Within the scope of the transfer expenditures, which caused a negative impact in the process, a spending trend with a high financial impact but low economic efficiency has emerged.

## 2.2. Impact Levels of Types of Public Expenditures Affecting Economic Growth and The Other Dynamics on Economic Growth

Apart from this classification of public expenditures as productive expenditures, it is important to consider R&D expenditures as an expenditure item that directly affects economic growth an expenditure trend. Namely, it should be emphasized that an important impact trend of public expenditures on economic growth has emerged with public R&D researches and that expenditures for these studies have a direct significant impact on economic growth. This effect, especially after the 2009 financial crisis, has revealed a significant contribution value with both the support of the private sector and the research and R&D developments in the public economy as public expenditures (OECD, 2018: 12). This phenomenon, in which the support of higher education within the scope of public expenditures is also evaluated within the scope of public expenditures as R&D, has created a significant margin of influence on economic growth; As an added value created by R&D studies under the name of R&D development, it has created an important mechanism of influence on economic growth. In Graphic 2 below, it is possible to see the distribution of these expenditures and the support effect of public expenditures on R&D studies:





Source: H. Bader Arslan (2019), "AR-GE Nereden Nereye", *Dünya*, 29Kasım2019, <https://www.dunya.com/kose-yazisi/ar-ge-nereden-nereye/457698> (Accessed July, 11.2021).

### Graphic 2. Real Position and Ratio of R&D Expenditures in Turkey to GDP

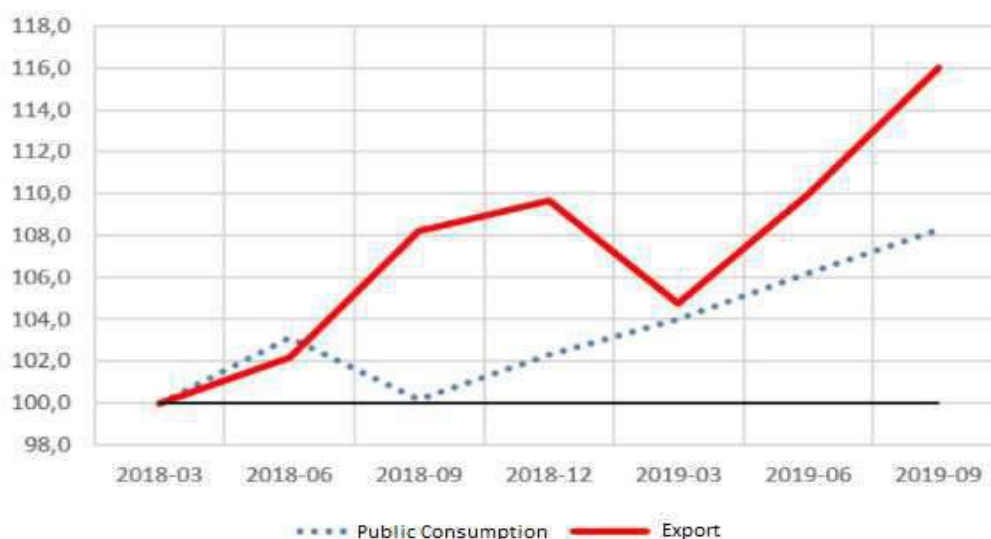
As shown in graphic 2 above, expenditures for R&D research, which has a significant expenditure effect on economic growth, entered a significant upward trend after 2007 and again took place in the process, in a situation where public financial resources and research and development supports. The financial expenditures that support higher education are also fed as public financial resources and contribute to economic growth in terms of public spending (Karhan, 2018: 36). When public expenditures, which have an impact on economic growth, are compared with research and development expenditures in the private sector, it is observed that private sector R&D expenditures are at a very low level. However, it is also understood that public supports and research and development expenditures are supported by a remarkable structure in order to create a possible R&D expenditure trend of the private sector with public supports (Coccia, 2011: 126). In other words, it reveals the fact that this effect of supporting the private sector in public expenditures, although it seems like private sector expenditures, actually emerges with publicly supported policies.

In this context, it is understood that while the supportive expenditures of public expenditures for research and development took place in the process as central budget expenditures, it also created a significant level of public expenditure impact in expenditure areas based on Higher Education and other than the supportive central government budget. However, it is seen that R&D expenditures constitute an increasing economic efficiency dimension within public expenditures. Although the structural position of these expenditures, especially in the public sector, shows a minimal increase as a ratio of GDP, it is not possible to say that they are sufficient. Changes in the structure of R&D expenditures as public expenditures will reveal a significant impact with more financial resources allocated by the central government budget. It can be said that this is an important reason why the importance of public expenditures on economic growth is an issue of financial reform (Florin and Petrișor, 2011: 420).

On the other hand, public consumption expenditures are at the forefront of public spending that directly affects economic growth and creates a correlation effect. As we have seen in our previous classifications, the accelerator and multiplier effect on the increase in public consumption expenditures other than investment and current spending creates a positive effect coefficient on economic growth and positively affects economic growth. In this respect, it is essential to investigate the effect of public consumption expenditures in Turkey on financial values, which has an important economic growth effect such as exports. It appears that the increasing public expenditure values for investigating the relationship between public consumption expenditures and exports have affected export increases in a very positive way.

Still, despite the rise in public expenditures, especially in 2018 and 2019, it was insufficient to prevent a shrinking effect on export values.

Besides, in response to the increasing public spending in 2018 and 2019, one of the reasons for the significant decrease in exports is the considerable decrease in the exchange rate values at the country level, which is expressed as the value of current account deficits. The fact that the Dollar-based pricing of energy imports turned into a significant consumption expenditure against the increasing dollar against the national currency has created a significant contraction in our country's export volume, which means an economic recession (Demirhan and Ercan, 2018: 14). In other words, the trend of public expenditures to positively impact exports, which could positively affect exports, put it into a negative process in 2018 and 2019. In Graphic 3 below, by comparing the change levels of public consumption expenditures and periodic exports it is possible to interpret the effects on economic growth:



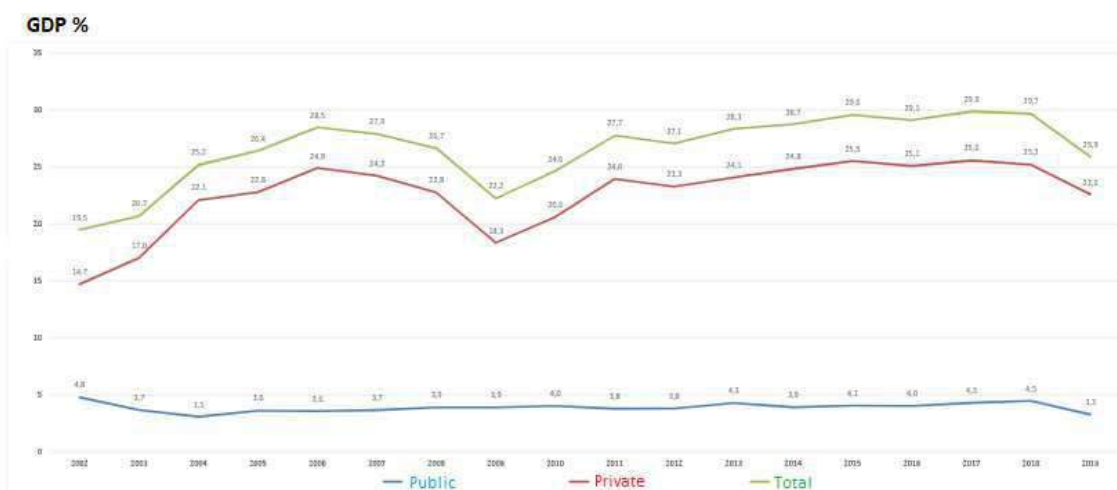
**Source:** Fatih Özatay (2019), “2020’de Türkiye Ekonomisi”, *Dünya Gazetesi*, 19.12.2019; Fatih Özatay (2020), *2020’de Türkiye Ekonomisi*, <https://www.tepav.org.tr/tr/blog/s/6554>, (Accessed July, 12.2021).

### Graphic 3. Public Consumption Expenditures and the Position of Periodical Exports

As seen in chart 3 above, export values entered a severe upward trend after the second half of 2019, after the changes in 2018 and 2019. Public expenditures were positively affected by the accelerator and multiplier effect in line with the upward trend. Therefore, it is clearly seen that public consumption expenditures positively affected the added value and created a significant positive value effect on economic growth. In this context, public consumption expenditures supported other sectors and incentives apart from their investments. They created a significant effect on economic growth by creating a significant increase in export-oriented sectors that support public consumption expenditures as public financial resource transfer. In the other years after 2019, the increase in the same exports, the others are at a significant record level. This situation regarding economic growth can be interpreted in two ways: Based on public expenditures, the first of these interpretations is that directly increased public expenditures created a significant positive effect that can encourage exports through export promotion methods creating an important economic growth trend (Temiz and Gökmen, 2010: 126). The second is the indirect encouragement of sectors to create a public consumption expenditure effect through the erasure or forgiveness of some sectoral debts that may have an expenditure effect in public expenditures and the budget. The aim is to reach the economic growth trend, with the consumption expenditures that will support the infrastructure of the export sectors

being included in the process at a more meaningful level and the increased effect of the export sectors being positively affected. Both of these approaches created a significant level of impact on economic growth by positively affecting export data due to the increase in public consumption expenditures after the second half of 2019, with their positive added value contributions. While shrinkage is expected in the sectors that are in the economic growth trend at the global level, especially in the last period and during the 2010 Covid-19 process, the realization of the growth in the economic growth trends in Turkey can also be explained by these concerning reasons (Central Bank of Turkey Republic, 2021: 27).

Undoubtedly, understanding the position of public investments, apart from the effects of public expenditures on economic growth as a consumption expenditure, makes it inevitable to reveal the relationship between the said percentage changes in public investment expenditures based on GDP, especially the changes in investment limits and economic growth. The real comparison of public investment expenditures with the other total private sector investment expenditures at the country level in Turkey in the last period is important in understanding the effectiveness of investment expenditures as a public expenditure at the public level. In Graph 4 below, it is possible to monitor the changes in the periodic value of public investment expenditures and the economic growth relationship:



**Source:** Strateji ve Bütçe Başkanlığı (2021), Yatırımların GSYH ve MYG İçindeki Payı, <https://www.sbb.gov.tr/yatirimlar/yatirimlarin-gsyh-ve-myg-icin-deki-payi/> (Accessed July, 13. 2021).

**Graphic 4. Share of Public Investments in GDP and Distribution of Total Investments in Turkey**

As can be seen in Graph 4 above, the ratio of public investment expenditures to GDP continues to be in a balanced course. Still, it remains proportionally lower than the real rates and value of private sector investment expenditures. The process in which public investment expenditures were mostly located based on Public Economic Enterprises (SEE) created more meaningful private sector investment limits with public incentives and public consumption expenditures to support the private sector. This situation undoubtedly revealed a significant increase in the ratio of investment values in the private sector to national income. That means the economic contribution value regarding the low-level value added to public investment expenditures should not be interpreted as being low. Public raw material and intermediate sectors support the private sector as current investments as factorial inputs, although public investment expenditures appear to be low at all periodic levels (World Bank Group, 2020: 14).

In this context, interpreting the investment support effect of public expenditures as low value-added, especially based on investment expenditures, may mean ignoring other indirect sectoral effects of public expenditures. However, this structure of public expenditures, especially based on SOEs, means that a significant increase in value for the private sector to make more investments is supported at the economic level to create added value. Indeed, it is understood that public investment expenditures and the real value of public investments hover around 5% as a share of GDP, and core investment expenditure limits for investments in public investment expenditures are maintained at a fairly stable level. However, an attempt to increase these stable public investment levels may mean that the public sector has a greater sectoral say in the economy. This position, which can also create a significant crowding-out effect on the private sector, is an important cause of market failures in economic growth. Establishing this balance based on the public sector is based on the fact that, as shown in Chart 4, this situation that depends on the public investment trends remains stable in real terms of economic growth via public investment expenditures. In brief, public sector investments expenditures mean an investment expenditure trend and effect that can indirectly positively affect economic growth by supporting private sector investments in spite of being the lower expenditure levels (World Bank, 2021).

### 3. CONCLUSION AND SUGGESTIONS

The empirical studies have put forth that the literature shows that the expenditures made in the field of education and health to increase human capital have a positive effect on economic growth in the long run. In a healthy society, it is expected that healthy individuals will improve themselves through education and contribute to both their own income and the country's economy, thereby positively affecting economic growth throughout the public expenditures. On the other hand, the positive effect of education expenditures, as public current investment expenditures, on economic growth for Turkey has put forth significant results for the future. Empirical findings on social transfer expenditures have contradictory results in terms of economic growth. Social benefits or expenditures, which will negatively affect the individual's desire to work, also have a negative effect on economic growth in the long run.

When the theories and empirical studies are examined, the positive effect of public expenditures and social expenditures on the economy appears. For this reason, developed countries and developing countries increase their social-public expenditures as their economies grow. Considering the recent evaluation of public expenditures in Turkey, it is seen that public expenditures have an absolute effect on economic growth. However, there is no change in real values as a ratio of GDP. This effect emerges in the classification of public expenditures, especially with the level of influence it creates as current investment expenditures and public consumption expenditures, in addition to investment expenditures. It is understood that the private sector's ability to survive and that it frequently needs public financing support in Turkey. On the other hand, raw materials and semi-finished goods produced by the public, energy supports, and infrastructure supports significantly impact economic growth. This fact means that their private sector supports the structure by public expenditures related to the aimed economic growth. The variability in public expenditures has been indirectly affected by the global financial crisis processes. The contraction in economic growth trends reveals the impact of the financial crisis with a negative effect level. In particular, the shrinkage of "- 9.5" in 2009 could not reveal positive stability in the economic growth trends, despite the increases in public expenditures. This fact does not mean a decrease in the increase in public expenditures during the financial crisis periods; however, it appears that this situation causes the added value effect of public expenditures on the economy to affect real terms negatively. Besides, even if each increase in public expenditures

does not create a real growth effect in the public sector, it is understood that this stable expenditure trend creates an absolute accelerator and multiplier effect on economic growth. In addition to public institutions supported by public expenditures, it is seen that the indirect effect of public expenditures on economic growth, which is supported by significant public financing support in expenditures on research (R&D) in the private sector, also reveals a significant level of impact. On the other hand, the support of export-oriented sectors to increase exports and the increase in public expenditures in the consumption margin, and the fact that the public supports the value of all kinds of financial support based on export-oriented sectors, is also an important contribution to economic growth.

## REFERENCES

- Arslan, H. B. (2019), “AR-GE Nereden Nereye”, *Dünya Gazetesi*, 29Kasım2019, <https://www.dunya.com/kose-yazisi/ar-ge-nereden-nereye/457698> (Accessed July, 11.2021).
- Canton, E. Thum-Thysen, A. and Voigt, P. (2018), *Economists’ Musings on Human Capital Investment: How Efficient is Public Spending on Education in EU Member States?*, Discussion Paper 081-June 2018, Brussels: European Commission Directorate-General for Economic and Financial Affairs, 2018.
- Campodónico, J. F. B., Cassinelli, J. R. P. and Mesones, J. A. (2014), *The Impact of Public Expenditures in Education, Health, and Infrastructure on Economic Growth and Income Distribution in Peru*, Washington D.C.: Inter-American Development Bank, 2014.
- Central Bank of Turkey Republic (2021), *Macroeconomic Outlook and Monetary Policy in Turkey*, Ankara: Central Bank of Turkey Republic, 2021.
- Coccia, M. (2011), “The Interaction Between Public and Private R&D Expenditure and National Productivity”, *Prometheus* 29(2), pp. 121–130.
- Demirhan, A. A. and Ercan, H. (2018), *Export Behavior of Turkish Manufacturing Firms Under Crises*, Central Bank of the Republic of Turkey Working Paper No: 18/02, January 2018, Ankara: Central Bank of the Republic of Turkey 2018.
- Ertekin, Ş. and Bulut Ş. (2021), “The Relation of Public Expenditures with Economic Growth in OECD Countries”, *Yönetim ve Ekonomi*, 28(1), pp. 187-203.
- European Parliament (2017), *Financial Instruments: Defining The Rationale for Triggering Their Use*, IP/D/ALL/FWC/2015-001/LOT4/C6/SC2 26/10/2017 PE 603.787, Brussels: Policy Department for Budgetary Affairs Directorate-General for Internal Policies of the Union, 2017.
- Florin, O. and Petrişor, M. B. (2011), *Public Expenditure Policy in The Context of Economic Crisis - Challenges and Implications*, [https://www.researchgate.net/publication/227462776\\_PUBLIC\\_EXPENDITURE\\_POLICY\\_IN\\_THE\\_CONTEXT\\_OF\\_ECONOMIC\\_CRISIS\\_-\\_CHALLENGES\\_AND\\_IMPLICATIONS](https://www.researchgate.net/publication/227462776_PUBLIC_EXPENDITURE_POLICY_IN_THE_CONTEXT_OF_ECONOMIC_CRISIS_-_CHALLENGES_AND_IMPLICATIONS), (Accessed July, 14. 2021).
- Gür, B. (2017), “The Impact of R&D Expenditures on Development: A Case of Turkey”, *International Journal of Humanities and Social Science Invention*, 6(4), pp. 1-9.
- IMF (2020), *World Economic Outlook 2020*, Washington D.C.: IMF-International Monetary Fund Publications, 2020.
- Karhan, G. (2018), “The Relationship Between Public Expenditures and Economic Growth: A Panel Var Approach”, *C.Ü. İktisadi ve İdari Bilimler Dergisi*, 19(2), pp. 35-43.
- OECD (2001), *Managing Public Expenditure: A Reference Book for Transition Countries*, Paris: OECD Publication Services, 2001.
- OECD (2002), *Models of Public Budgeting and Accounting Reform*, OECD Journal on Budgeting Volume 2, Supplement 1, Paris: OECD Publications, 2002.
- OECD (2009), *Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth-June 2009*, Paris: OECD Publications, 2009.



- OECD (2015), *Infrastructure Versus Other Investments in The Global Economy and Stagnation Hypotheses: What Do Company Data Tell Us?*, OECD Journal: Financial Market Trends, Volume 2014/2, Paris: OECD Publications, 2015.
- OECD (2018), *OECD Economic Surveys: Turkey- July 2018*, Paris: OECD Publications, 2018.
- Özatay, F. (2019), “2020’de Türkiye Ekonomisi”, *Dünya Gazetesi*, 19.12.2019.
- Özatay, F. (2020), *2020’de Türkiye Ekonomisi*, <https://www.tepav.org.tr/tr/blog/s/6554>, (Accessed July, 12.2021).
- Skidelsky, R. (2011), “The Relevance of Keynes”, *Cambridge Journal of Economics*, 35(1), pp. 1-13.
- Strateji ve Bütçe Başkanlığı (2020), *İstatistikler: Genel Devlet Harcamaları*, Ankara: Strateji ve Bütçe Başkanlığı, 2020.
- Strateji ve Bütçe Başkanlığı (2021), Yatırımların GSYH ve MYG İçindeki Payı, <https://www.sbb.gov.tr/yatirimlar/yatirimlarin-gsyh-ve-myb-icin-deki-payi/> (Accessed July, 13. 2021).
- Temiz, D. and Gökmen, A. (2010), “An Analysis of The Export And Economic Growth in Turkey over The Period of 1950-2009”, *International Journal of Economic and Administrative Studies*, 3(5), pp. 123-142.
- Ulucak, R. and Ulucak Z. (2014), “Kamu Harcamaları ve Ekonomik Büyüme Arasındaki Nedensellik: Türkiye Örneği”, *Uluslararası Yönetim İktisat ve İşletme Dergisi*, Sayı: 23, pp. 81-97.
- United Nations (2020), *World Social Report 2020 Inequality in A Rapidly Changing World*, New York: United Nations Department of Economic and Social Affairs, 2020.
- World Bank (2019), The Worldwide Governance Indicators (WGI) Project (Rule of Law) *The Worldwide Governance Indicators (WGI) Project*, [https://www.police.gov.hk/info/doc/WGI\\_Rule\\_of\\_Law-E.pdf](https://www.police.gov.hk/info/doc/WGI_Rule_of_Law-E.pdf) (Accessed July, 08. 2021).
- World Bank Group (2020), *Turkish Cypriot Economy: Looking Ahead to Steer The Economy Toward A Higher Growth Path: A Macroeconomic Monitoring Note Special Issue: Reducing The Turkish Cypriot Economy’s Vulnerability to Shocks*, Washington D.C.: International Bank for Reconstruction and Development / The World Bank, 2020.
- World Bank (2021), *World Bank in Turkey: Turkey Country Partnership Strategy 2018 - 2021*, <https://www.worldbank.org/en/country/turkey/overview>, (Accessed July, 14. 2021)
- Zouhar, Y., Jellema, J., Lustig, N. and Trabelsi, M. (2021), *Public Expenditure and Inclusive Growth – A Survey*, IMF Working Paper WP/21/83, Washington D.C: International Monetary Fund (IMF), 2021.

## ITIL TABANLI HİZMET MASASI SİSTEMLERİNDE, VERİMLİLİĞİ ARTIRICI YAKLAŞIMLAR ve ÖNCELİK BELİRLEME SİSTEMİ UYGULAMASI

### EFFICIENCY INCREASING APPROACHES AND PRIORITY IDENTIFICATION SYSTEM IMPLEMENTATION IN ITIL-BASED SERVICE DESK SYSTEMS

**Mehmet Salih Sancaroglu<sup>1,\*</sup>, Murat Yücel<sup>2</sup>**

<sup>1</sup>*Gazi Üniversitesi, Bilişim Enstitüsü, Bilişim Sistemleri, Ankara, Türkiye*

<sup>2</sup>*Gazi Üniversitesi, Teknoloji Fakültesi, Elektrik-Elektronik Mühendisliği Bölümü, Ankara, Türkiye.*

#### Özet

Günümüzde Bilgi Teknolojileri (BT) neredeyse her endüstrinin vazgeçilmez bir parçası durumundadır. Bilgi Teknolojileri sistemlerinde oluşan herhangi bir aksamada, birçok işletmenin operasyonları ciddi bir şekilde etkilenmektedir. Ancak günümüzde sürekli artan yazılım ve donanım çeşitliliği ve bu sistemlerin işletmelerde niceliksel anlamda artması, bütün sistemleri kontrol altında tutma noktasında BT departmanları için ciddi zorluklar yaratmaktadır. Bu nedenle sunulan BT hizmetlerinin, sistematik bir yaklaşım içerisinde yönetilmesi ihtiyacı oluşmuştur.

Hizmet Masası (*Service Desk*), BT hizmeti alan son kullanıcıların, BT ile ilgili herhangi bir sorun ya da istekte başvurdukları tek iletişim noktasıdır. Bazı firmalar Hizmet Masası rolünü şirket içinde barındırırken bazı firmalar ise bu iş üzerinde uzmanlığı olan firmalardan destek almaktadır. Bu çalışmada, firmaların hizmet masası departmanlarının işleyişi, karşılaştıkları zorluklarla birlikte verimliliği artırıcı yaklaşımlar tartışılarak, hizmet masasının gelecek beklentileri üzerinde durulacaktır. Hizmet masalarının önemli sorunlarından biri olan, olay kayıtlarında öncelik belirleme için geliştirilmiş, Öncelik Belirleme Sistemi (*ÖBS*) yazılımı tanıtılacaktır.

**Anahtar Kelimeler-** BT hizmet yönetimi, ITIL, Hizmet Masası, Bilet Önceliklendirme

#### Abstract

Information Technology (IT) is now an indispensable part of almost every industry. In any disruption in Information Technology systems, the operations of many businesses are seriously affected. However, today, the increasing variety of software and hardware and the quantitative increase of these systems in enterprises create serious difficulties for IT departments in keeping all systems under control. For this reason, there has been a need to manage the provided IT services in a systematic approach.

The Service Desk is the single point of contact for end users receiving IT service for any IT-related problem or request. While some companies have the Service Desk role within the company, some companies receive support from companies that have expertise in this business. In this study, the functioning of the service desk departments of the companies, together with the difficulties they face, and the approaches to increase productivity will be discussed, and the future expectations of the service desk will be emphasized. The Priority Identification System (PIS) software, which is one of the important problems of service desks and created for prioritization in event records, will be introduced.

**Keywords-** IT service management, ITIL, Service Desk, Incident Prioritization

## 1. GİRİŞ

ITIL (Information Technologies infrastructure Library – Bilgi teknolojileri Altyapı Kütüphanesi ) Bilgi Teknolojileri(BT) ile ilgili sunulan hizmetlerin ve kaynaklarının yönetilmesi konusunda alanında uzman kişi ve kuruluşların tecrübeleri ile en iyi uygulamalardan(best practices) oluşturulmuştur. İsminden de anlaşılacağı gibi BT Hizmet Yönetimi konusunda yararlanılacak bir kütüphane gibi düşünülebilir. Bu çalışma hizmet masası verimliliğinin artırılması için hizmet önceliklendirmelerinin otomatize edilmesi için tasarlanmıştır. Hizmet masası direk ya da dolaylı olarak tüm ITIL Operasyon süreçleri(processes) ile ilgilendiği için, bu çalışmada diğer süreçlerden bahsedilse de, daha çok ITIL Operasyon (Operation) kapsamında değerlendirilmelidir. İstenildiğinde ITIL ile ilgili tüm detaylar, çalışmanın sonunda belirtilen kaynaklardan edinilebilir. [1-6]

Hizmet masası, gerek son kullanıcılar için gerekse diğer BT personeli ve tüm paydaşlar için tek iletişim noktasıdır. Olay biletleri ve hizmet taleplerinin tek noktadan yönetilmesinden ve bu talep ve sorunların, başlangıcından sonlandırılmasına kadar olan süre içerisinde izlenmesinden sorumludur. Hizmet masası ayrıca açılan biletlerin doğru sınıflandırılıp önceliklendirilmesinden de sorumludur. Yanlış sınıflandırma ve önceliklendirme, gereksiz zaman kaybı ve hizmet seviye anlaşmalarının ihlaline sebep olabilir. Bu nedenle, hatasız sınıflandırma ve önceliklendirme BT hizmeti sağlayan işletmeler ve departmanlar için çok önemlidir.

Bu çalışmada, işletmelerin hizmet masası bölümlerinin işleyişi, karşılaştıkları zorluklar, bu zorlukları aşmak ve bu bölümlerin verimliliği artırıcı yaklaşımlar incelenmiştir. Ayrıca, hizmet masalarının olay kayıtlarında öncelik belirleme sorununun çözümü için Öncelik Belirleme Sistemi yazılımı geliştirilmiş ve sonuçlar yorumlanmıştır.

## 2. BİLGİ TEKNOLOJİLERİ HİZMET YÖNETİMİ (ITSM – IT Service Management)

ITIL hizmeti “ *belirli maliyetler ve riskler olmadan müşterilerin ulaşmak istediği sonuçları kolaylaştırarak müşterilere değer sunmanın bir yolu*” olarak tanımlar. BT hizmet yönetimi, BT ile ilgili tüm işleri belli bir düzene oturtmak amacıyla düşünülmüştür. BT hizmet yönetimi, BT departmanlarına yardımcı olmakla kalmaz aynı zamanda işletmenin kaynaklarının verimli bir şekilde kullanılarak yine oluşabilecek aksaklıklarda etkilenebilecek işletme itibarına pozitif anlamda katkı sağlar. BT hizmet yönetimi, BT ile ilgili hizmet veren personelin, hizmet verilen kullanıcılar ile etkileşim içerisinde bulunması için bir çerçeve sağlar. BT hizmet yönetimini sağlamak için farklı çerçeveler ve standartlar geliştirilmiştir. [1]

### 2.1.ITIL (Information Technologies infrastructure Library–Bilgi teknolojileri Altyapı Kütüphanesi )

BT hizmet yönetimi için bugün en çok bilinen ve uygulanan çerçevedir. 1980’li yıllardan itibaren sektör uzmanlarından alınan geri beslemelerle sürekli gelişerek bir “en iyi uygulamalar (best practices)” bütünü olarak, süreç tabanlı bir yaklaşımla, yüksek kalitede BT hizmetleri sunulmasını sağlar. ITIL V3 toplam 5 yayından oluşur ve bunlardan biri operasyon yayınıdır. [1]

ITIL Hizmet stratejisi (Service Strategy), ITIL Hizmet Tasarımı (Service Design ), ITIL Hizmet Geçiş (Service Transition), ITIL Hizmet Operasyonu (Service Operation), ITIL Sürekli Hizmet İyileştirme (Continual Service Improvement). ITIL bir standart değildir, bir çerçevedir. Ne yapmanız gerektiğini söylemez, nasıl yapıldığında en yüksek faydanın sağlanacağını söyler. İşletmeler kendi gereksinimlerine uygun olarak, ITIL’ı temel alarak sistemlerini oluşturup, dökümanite ederler. ITIL, BT maliyetlerini azaltır, verimliliği artırır, müşteri memnuniyeti artır.

## 2.2.ITIL Hizmet Operasyonu

Rehberlik sağladığı konular; kullanıcılara, hizmet seviyesi anlaşmalarında belirtilmiş seviyelerdeki hizmetleri sunarak, faaliyetleri yürütmek, tüm paydaşlar (BT hizmet sağlayıcısı, müşteri ve kullanıcı) için değer yaratmaktır. Hizmet Operasyonu altında tanımlanmış olan süreçler şunlardır: Olay Yönetimi, Durum Yönetimi, Erişim Yönetimi, İstek İfası ve Sorun Yönetimidir. Hizmet Operasyonu altında ayrıca dört fonksiyon tanımlanmıştır. Bunlar; BT Operasyonları yönetimi, Teknik yönetim, Uygulama yönetimi, Hizmet Masasıdır.

**Olay Yönetimi:** ITIL olayı “bir BT hizmeti üzerindeki kesinti ya da hizmetin kalitesindeki azalma” olarak tanımlar. Olay yönetimini ise “bir hizmeti anlaşılan süreler içerisinde, eğer bu sağlanamazsa mümkün olan en kısa zamanda çalışır duruma getirmek” olarak tanımlar. Hizmeti sağlayan taraf ile müşteri/son kullanıcı arasında imzalanan ve her iki tarafın haklarını güvenceye alıp sorumluluklarını belirten yazılı anlaşmaya Hizmet Seviyesi Anlaşması (*Service Level Agreement - SLA*) denir. Tüm bu kesintiler ve hizmet kalitesi üzerindeki azalmaların ne kadar zaman içerisinde müdahale edilip ne kadar zaman içerisinde çözüleceği bu anlaşmada tanımlanır.[5]

Aciliyet	Operasyonu tamamen etkiliyor	Operasyonu büyük ölçüde etkiliyor	Operasyonu kısmen etkiliyor	Operasyonu etkilenmiyor
Etkilenen Kul. Sayısı/Etki				
Çoklu lokasyon/yaygın	Öncelik1	Öncelik1	Öncelik2	Öncelik3
Tek lokasyon/Bütün Kullanıcı	Öncelik1	Öncelik2	Öncelik3	Öncelik4
Tek lokasyon/Birden fazla Kullanıcı	Öncelik1	Öncelik2	Öncelik3	Öncelik4
Tek lokasyon/Tek Kullanıcı	Öncelik1	Öncelik2	Öncelik3	Öncelik4
Kritik	Önemli	Orta derece Önem	Düşük Önem	

Şekil 1 - Hizmete alma öncelikleri

Olay kaydının açılıp destek grubuna atanmasından itibaren hedeflenen cevap verme süresi	Öncelik 1 = 30dk	Öncelik 2 = 1 Saat	Öncelik 3 = 8 Saat yada 1 iş günü	Öncelik 4 = 16 iş saati yada 2 iş günü
Olay kaydının açılıp sorunun giderilmesi için hedeflenen süre	1 Saat	4 Saat	16 Saat yada 2 iş günü	24 Saat yada 3 iş günü

Şekil 2 – Sorun giderme süreleri

### Operasyonel Destek Seviyeleri:

**Seviye 0 (Level 0) :** Bu seviye müşterinin kendisini ya da web tabanlı çalışan kendi kendine hizmet olarak ifade edilen hizmetleri içerir. **Seviye 1 (Level 1) :** Bu seviye, kullanıcılar ile direk temas kuran ilk seviye teknik destek hattıdır. Kullanıcıyla iletişim halinde olan Hizmet Masası tarafından sunulur. **Seviye 2 (Level 2) :** Bu seviye, olay inceleme ve teşhisine teknik destek sağlamak için uzmanlık becerilerini uygular. **Seviye 3 (Level 3) :** Bu Seviye, özel hizmetler ve sistemler için uzman servis ve kaynak desteği sağlar. (Bunların dışında, bazen üretici firma desteğini tanımlamak için **Seviye 4** kullanılır).

***Durum Yönetimi:***

ITIL durum yönetimini, BT aracılığıyla gerçekleşen tüm olayları izleyen süreç olarak tanımlar. Çalışmanın devamına izin verilir ve istisnai durumlar algılanır. Örneğin, kritik bir sunucunun işlemcisinin %80 yükle çalıştığını sunucuları izleyen araç rapor edebilir. Bu durumlar için genellikle eşik değerler tanımlanır.

***Erişim Yönetimi:***

Kullanıcıların görevlerini yerine getirebilmesi için kullanmak zorunda oldukları hizmetler üzerinde gerekli olan hakların verilmesidir. Örneğin, bir kullanıcının departmanının diğer üyeleri ile bilgi paylaşımında bulunduğu bir portala erişim yetkisi verilmesi.

***İstek ifası:***

Genellikle küçük olmayan, düşük riskli değişiklikler olan hizmet isteklerini, olay yönetimine benzer bir süreç kullanarak hizmet masası aracılığıyla işlenen bir süreçtir. Kullanıcıların, önceden tanımlanmış ve onaylanmış hizmetleri almalarını sağlar. Örnek; eğer önceden onaylanmış ise, kullanıcı bir elektronik posta dağıtım grubuna üye olmak isteyebilir ve istek hizmet masası tarafından gerçekleştirilir.

***Problem Yönetimi:***

Genellikle Olay Yönetimi ile karıştırılır. Olay yönetimi, herhangi bir sebepten, kesinti ya da kalitedeki düşüş nedeniyle etkilenen hizmeti mümkün olduğunca çabuk tekrar normal konumuna almaya çalışır. Problem yönetimi sorunun kalıcı ya da geçici çözümü bulunduktan sonra altında yatan asıl nedenin bulunmasına yoğunlaşır. Problemlerin tüm yaşam döngüsünden sorumludur; ilk teşhisinden araştırılmasına ve nihayetinde ana sorunun bulunup, hizmet üzerinde gerekli iyileştirmelerin yapıp dökümanite edilmesine kadar. Böylece aynı sorunların tekrarlanması önlenir.

**2.3.Hizmet Masası**

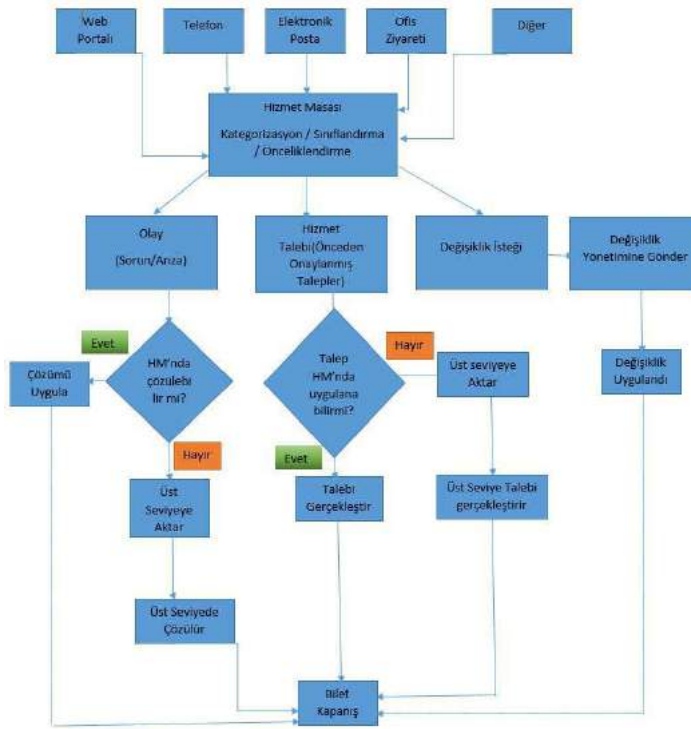
BT desteği veren bir kuruluş için çok önemli bir fonksiyondur. Müşteriler ya da son kullanıcılar için temel BT kaynaklı sorun ve istekler için tek iletişim noktası olmalıdır. BT Departmanı'nın, müşterilerine ya da son kullanıcılara karşı görünen yüzüdür. Burada verilen hizmet kalitesi müşterinin algısını olumlu veya olumsuz direk etkileyecektir. Tüm sorunlar ve yeni isteklerin yürütülmesinden sorumludur. Aynı zamanda, yürütülen bu hizmetlerle ilgili anlamlı raporlar hazırlayıp üst yönetime rapor eder.

İletilen tüm sorunları kayıt altına alır, kategorize edip önceliklerini belirler, birinci seviye (Level 1) destek ve eğer mümkünse çözüm sağlar, eğer bu seviyede çözüm bulunamazsa biletleri üst seviye destek gruplarına yönlendirir, kullanıcıları planlı kesintiler ve biletleri hakkında bilgilendirir ve müşteri memnuniyeti anketlerini gerçekleştirir.[5,11]

**2.3.1. Bilet Dağıtıcısı (Dispatcher)**

Hizmet masası içerisinde bir rol olarak tanımlıdır. Görevi, kullanıcıların bir portal üzerinden yarattıkları ve diğer seviyelerden veya gruplardan gelen/geri dönen biletleri uygun gruplara atamaktır. Ayrıca, kullanıcıların portal üzerinden yarattıkları biletlerin kalitesinden, hizmet sınıflandırılmasından ve doğru önceliklerin atanmasından sorumludur. Hizmet Seviyesi Anlaşmalarında (SLA) tanımlı sorumlulukların yerine getirilmesi noktasında çok önemlidir. Çünkü genelde SLA'lerde yerine getirilemeyen (belirtilen zaman aralığında çözilemeyen) hizmetler için maddi yaptırımlarda tanımlanır.





Şekil 3 - Örnek Hizmet Masası Bilet İşleme Akış Şeması (Service Desk Ticket Handling Flow chart)

### 2.3.2. Hizmet Masası Sistemlerinde Verimliliği Artırıcı Yaklaşımlar

**Şablon (Template):** Hem kullanıcıları hem de hizmet masası teknisyenlerini, sorunun çözümü ya da isteğin yerine getirilmesi için gereken minimum bilgileri sağlamaya zorlamak ve eğer mümkünse o aşamada sorunların çözümü için kısa bir rehberlik sağlamasıdır.

**Otomasyon:** Genel olarak BT hizmetlerinde otomasyon, bir işletmede bazı görevleri insan elinden alarak, arka planda çalışmaya programlanmış yazılımlarla yerine getiren süreçlerdir. Mümkün olan herhangi bir iş için otomasyona geçilmesi, o iş üzerinde hâlihazırda çalışan personeli serbest bırakarak çok daha değerli işlerle ilgilenmesini sağlar. Böylece kaynaklar daha verimli kullanılıp, maliyetler azaltılmış olur. Sıklıkla uygulanabileceği alanlar, tekrar eden istek ya da sorunlar olabilir. Şifre sıfırlama, klasör erişim izni, kullanıcı hesabı yönetimi v.b.

Doğru yapılandırılmış ve BT hizmet aracı ile bütünleştirilmiş, çok kullanıcıli bir lokasyonda, varlık yönetim sistemi kullanıldığında, bir sorun için arayan kullanıcının doğru ekipmanı kullanıp kullanmadığı ve hatta o ekipmanın normalde kullanıcı lokasyonunda olup olmaması gerektiği bile ilk aramada tespit edilebilir. Son kullanıcının bilgisayarını açtığı bir çağrıda, bilgisayardaki bütün yazılımların ve işletim sisteminin son güncellemeleri alıp almadığı ve eğer almadı ise temel yapılandırmadan saptığı rapor edilerek, henüz bir üst seviye teknisyene aktartılmadan hemen çözülebilir.

### 2.3.3. Hizmet Masası Operasyonlarındaki Zorluklar

Bilet dağıtıcısı rolünü üstlenen kişi ya da kişilerin, hizmet sunulan tüm alanlarla ilgili bilgi sahibi olmamaları, yöneticilerin gerek bilet dağıtıcıları gerekse diğer hizmet masası rolleri ile ilgili yüksek farkındalık sahibi olmamaları, teknisyenler üzerindeki zaman kısıtlamaları ve kalite üzerindeki olumsuz etkisi karşılaşılan ana zorluklardır. Şablonların gereksiz uzunluğu, bu sebeple teknisyenin asıl soruna odaklanması yerine, ona verilen sürede sadece bileti kaydetmeye çalışması, destek seviyeleri sınırlarının net bir şekilde çizilememesi (L1, L2) diğer sorunlardır. Bazen üst seviyeler, hizmet masasında kullanılacak şablonları öyle bir düzenlerler ki, ikinci ya da üçüncü seviye teknisyenlerinin ilgilenmesi gereken sorunlar, birinci seviye

teknisyenlerinden beklenir ve bu, hizmet masası teknisyenleri üzerinde baskı yaratır. Çok karmaşık süreç tasarımları iş yükünü azaltmak yerine artırabilir. Hizmet masası teknisyenliği doğası gereği çok yıpratıcı bir iştir. Yöneticilerin bu konuda teknisyenlere destek olmaması ve teknisyenlerin aidiyetlerini korumaları noktasındaki zorluklar, işletmede, BT hizmet yönetimi ile ilgili yeterli çalışma yapılmadan ve eğitim alınmadan uygulamaya çalışmak, yeni bir teknoloji ya da sisteme yönelik direnç, test ve ölçüm mekanizmalarının (*metrik*) bazen başarımı göstermemesi ve hizmet masası fonksiyonu için çok önemli bir gösterge olan ilk çağrıda sorunların çözülmesinden (*First Call Resolution - FCR*) ödün verilmesi operasyondaki zorluklardır [10,13].

#### 2.3.4. Hizmet Masası Operasyonlarındaki zorluklara karşı çözüm önerileri

İşletmelerin BT hizmet yönetiminde öncelikle kendi içlerinde hangi soruna ya da sorunlara çözüm aradıklarını net olarak bilmeleri gerekir. Bilet dağıtıcısı rolünün, BT hizmetleri ile ilgili geniş tecrübesi olan kişiler tarafından yürütülmesi gerekir. Şablonlarda sadece 1. seviye teknisyenlerinin kullanıcıdan alması gereken bilgiler ve çok basit çözüm önerileri olmalıdır. İkinci ve üçüncü seviye grupların tarafından yapılması gereken araştırma adımlarını içermemelidir. Hizmet kataloğunda sunulan hizmetler yelpazesinin çok geniş olması ve aynı zamanda hizmet verilen kullanıcı sayısının çok fazla olması durumunda, daha kaliteli hizmet verilebilmesi için, birinci seviye teknisyenlerinin belli kıstaslara göre bölünmesini gerektirebilir (Yazıcı, Masa üstü sistemleri, ağ desteği gibi). Bu yapılsa çağrıların ayrıştırılması gerekir. Sesli mesaj sisteminin olması, yukarıda belirtilen sebeple birlikte başka nedenlerle de gereklidir. Örneğin tek bir organizasyon içerisinde kullanılacaksa, devam etmekte olan ve üzerinde çalışılan sorunlar için ses kaydı oluşturularak hizmet masasının gereksiz yere meşgul edilmesi önlenecektir. Bilgisizlik kaygısı doğurur. Kaygıda bilinmeyene karşı direnci ortaya çıkarır. Bu sebeple, BT hizmet yönetiminin ve uygulanacak çerçevenin işletmeye sağlayacağı faydaların tüm paydaşlar tarafından bilinmesi ve desteklenmesi gerekir [10,11].

BT sektöründe, sürekli değişen ihtiyaçlar ve bu ihtiyaçları giderirken karşılaşılan yeni zorluklar, muhtemelen hizmet masası teknisyenliğini tamamen ortadan kaldırmayacaktır. Ancak, kuşku duyulmayacak diğer bir gerçek ise, giderek artan oranda hayatımıza giren farklı yapay zekâ uygulamalarının, BT Hizmet yönetimi ve Hizmet Masası uygulamalarında da kendisine daha fazla yer edineceğidir. İnsan çalışanların, büyük veri yığınları arasından ihtiyaç duyulan bilgiyi elde etmeleri, tutarlı davranış sergilemeleri, kesintisiz çalışma ve diğer birçok alanda, robot sistemlere kıyasla sahip olduğu dezavantajları, hizmet masası operasyonlarında yapay zekâ robotlarının daha fazla kullanımına yol açacaktır.

### 3. ÖNCELİK BELİRLEMeye YÖNELİK GELİŞTİRİLEN UZMAN SİSTEM YAZILIMI

Şu anda, sektörde kullanılan ve geniş kapsamlı olarak ifade edilen hazır ITIL tabanlı yazılımlarda varsayılan önceliklendirme parametreleri manuel olarak (elle) teknisyenler tarafından atanacak şekilde tasarlanmıştır. Aynı şekilde web tabanlı bilet oluşturma portallarında da son kullanıcıya bu imkân verildiğinde bile son kullanıcılar yaşadıkları IT sorunlarının en kısa sürede çözülmesini arzu ettikleri için, operasyonel gereksinimler ve IT departmanı iş gücünü düşünmeden en yüksek önceliği seçmeye meyillidirler. Yazılımlarda bunun otomatize edilmemesinin arkasındaki en önemli neden sürekli farklı hizmetler için değişen hizmet seviye anlaşmaları ya da anlaşmaya yapılan ilaveler ve değişikliklerdir. Bunun sonucu olarak, gerektiğinde değiştirilmeyen öncelikler olursa hizmet sağlayıcı cezai müeyyideye tabi tutulur.

Mevcut yazılımlarda genellikle teknisyenler aciliyet ve etki parametrelerini girerler ve öncelik (*priority*) bu parametrelere göre şekillenir. Ancak bu tür bir yaklaşım SLA'de tanımlanan servis önceliklerinin sürekli kontrol edilmesi ya da bilinmesi durumunda geçerlidir. Hatta bunun ötesinde genellikle bazı organizasyonlar için gerekli olan parametreler değerlendirmeye

alınmaz (Örnek, VIP (very important person – çok önemli kişi) kullanıcı). Bunu sistem üzerinde örneklersek; Şekil 1'e göre sistem operasyonel anlamda çalışıyor ve tüm personel bu hizmeti kullanıyor olabilir. VIP kişinin bilgisayarındaki bir sorun direk bu hizmetle ilgili değildir ancak bu kişinin bu hizmeti sürekli izlemesi hayati öneme sahip olabilir. Dolayısıyla bu sorun kaydında hizmet olarak donanım seçilebilir ancak önceliğin değiştirilmesi gerekir.

Uzman sistemler (US), işinde uzman bir kişinin yaptığı işi hatasız ve tutarlı bir şekilde yapabilen sistemlerdir. İş tanımı içerisinde çok farklı roller olan kişilerin yaptığı işleri yapması beklenmemelidir. Çünkü doğası gereği bir alan üzerinde, alan ilgili verilerin kayıt edildiği bir veri tabanı (sabit ya da sürekli değişebilir) ve bu veri tabanından alınan verileri önceden belirlenmiş kural setleri ile yorumlayacak çıkarım mekanizması sayesinde sadece o alan için işini kusursuz yapmalıdır. Temel yaklaşım; eğer durum bu ise şunu gerçekleştirdir.

Bu çalışmada veri tabanından gelen bilgiler kural tabanındaki koşullara göre şekillenerek servis masası teknisyenine firma, servis, aciliyet ve etki alanı parametreleri girilerek olması gereken önceliklendirmeyi sunmaktadır. Varsayılan değer olarak **Şekil 1**' de geçerli olan öncelikler uygulanır. Eğer kural tabanında farklı kural verilmiş ise, kural tabanındaki öncelik baskın olarak uygulanır. Böylelikle, herhangi bir firma ve servis için yapılacak bir değişiklik ve ilave, kural tabanına eklenerek güncel duruma uygunluk sağlanır. Belirlenen bu öncelik, hizmetin anlaşmada belirtilen şekilde ne kadar zaman içerisinde tekrar çalışır duruma getirilmesi gerektiğini, bilet üzerinde çalışacak tüm teknik destek personelinin farkında olmasını sağlar.

Firma	Departman	Hizmet	Etki	Aciliyet	VIP (evet/Hayır)	Öncelik	(Yanına tablodaki açıklama gelecek)	xxx sürede Çözülmeli
ABC AŞ	Pazarlama	Donanım Arızası	Tek Lokasyon / Tek kullanıcı	Operasyon Etkilenmiyor	Evet	4	16 Saat içinde çözülmelidir	(VIP evet ise 30 Dakika)
DEF Ltd	Satış	Kullanıcı erişim	Tek Lokasyon / Birden çok kullanıcı	Operasyon Kısmen etkileniyor	Hayır	3	8 Saat içinde çözülmelidir	(VIP evet ise 30 Dakika)
GHI AŞ	İnsan Kaynakları	Email	Tek Lokasyon / Bütün kullanıcı	Operasyonu büyük ölçüde etkiliyor		2	1 Saat içinde çözülmelidir	(VIP evet ise 30 Dakika)
IKL Ltd	Muhasebe	Ticari Yazılım	Çoklu Lokasyon / Yaygın	Operasyonu tamamen etkiliyor		1	30 Dakika içinde çözülmelidir	

Şekil 4 – Öncelikler Tablosu

File Edit Format View Help

1- Company5 AS;;;;;Evet;1

2- Company6 Ltd Şti;Satın Alma;Email;Tek Lokasyon / Bütün Kullanıcı;Operasyonu Kısmen Etkileniyor;Hayır;4

Şekil 5 – Yeni öncelik ekleme

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Company Id	Company Name														
2	1	Company1 AŞ														
3	2	Company2 AŞ														
4	3	Company3 Ltd Şti														
5	4	Company4 AŞ														
6	5	Company5 AŞ														
7	6	Company6 Ltd Şti														
8	7	Company7 Ltd Şti														
9	8	Company1 AŞ														
10																
11																

Şekil 6 – Veri tabanı

Şekil 7 – Yazılım ekran görüntüsü

#### 4. SONUÇ VE ÖNERİLER

Günümüzde, çok karmaşık hale gelmiş olan BT hizmetlerini yönetmekle ilgili, sistemli bir yaklaşıma duyulan ihtiyaç çok açık bir şekilde ortadadır. Bu sistemli yaklaşımı karşılayabilecek birçok standart ve çerçeve bulunmaktadır. Bu çerçevelerin arasında, yıllardır binlerce firma tarafından uygulama alanı bulan ve kendisini BT Hizmet yönetimi konusunda kanıtlamış olan ITIL öne çıkmaktadır. Elbette sunulan çok çeşitli ve karmaşık hizmetlerin, belli bir sistematik içerisinde bugünden yarına bir düzüne ve oturtulması ve kontrol altına alınması mümkün değildir. Ancak ITIL uygulayan birçok firma, ilk yıllarından sonra, sundukları hizmetlerde çok ciddi bir kalite artışı ve tasarruf elde ettiklerini söylemektedir.

Hizmet Masası BT hizmet yönetimi altında en kritik fonksiyonlardan biridir. İyi işleyen bir hizmet masası, bir işletmenin müşteriye dönük yüzü olması nedeniyle çok önemlidir. Gerek maliyetlerde tasarruf gerekse müşteriye memnuniyeti konularında anahtar rol üstlenmişlerdir.

BT hizmeti sunan işletmelerin ya da firma içi BT hizmeti sunan departmanların, hizmet yönetimi ve hizmet masası konularında gerekli eğitimleri almaları ve farkındalık sahibi olmaları, verdikleri hizmetlerin kalitesini artırarak, hizmet seviyesi sözleşmelerinde geçen kriterleri karşılayıp ve tüm BT hizmetlerini kontrol altında tutmaları açısından çok önemlidir.

Bu çalışmada, kurumların hizmet masası bölümlerinde çalışanlar için bu bölümlerin işleyişi, karşılaşılan zorluklar, bu zorlukları aşmak ve hizmet masası bölümlerinin verimliliği artırıcı yaklaşımlar sunulmuştur. Daha sonra hizmet masalarının karşılaştıkları problemlerden birisi olan, olay kayıtlarında öncelik belirleme sorununun çözümü için “Öncelik Belirleme Sistemi” yazılımı geliştirilmiştir. Bu yazılım sayesinde hizmet masası kullanıcısı mevcut kural tabanını kullanarak istediği takdirde kendi yeni kurallarını ekleyebilir. Bu kurallara göre gerekli seçimlerini de yaparak önceliklendirme sonucunu ve önceliklendirmenin önemini görüntüleyebilir. Bu sayede hizmet masası kullanıcıları esnek ve ergonomik bir yazılım sayesinde önceliklendirme sorununu rahatlıkla çözüme kavuşturabilir.

**KAYNAKÇA**

- [1] IT E.Brewster, R.Griffiths, A.Lawes, J.Sansbury, SERVICE MANAGEMENT, A Guide for ITIL® Foundation, Exam Candidates, Second Edition, 2012
  - [2] ITIL Service Strategy – ITIL Official Publication 2011
  - [3] ITIL Service Design – ITIL Official Publication 2011
  - [4] ITIL Service Transition – ITIL Official Publication 2011
  - [5] ITIL Service Operation – ITIL Official Publication 2011
  - [6] ITIL Continual Service Improvement – ITIL Official Publication
  - [7] N.Ahmad, Z.M.Shamsudin, Systematic Approach to Successful Implementation of ITIL, 2011,
  - [8] X.Tang, Y.TODO, A Study of Service Desk Setup in Implementing IT Service Management in Enterprises June 13, 2013
  - [9] M.Gërvalla, N.Preniqi, P.Kopacek, IT Infrastructure Library (ITIL) framework approach to IT Governance, 2018,
  - [10] Paramesh S.P, Shreedhara K.S, Building Intelligent Service Desk Systems using AI, 2019
  - [11] Paramesh S.P, Ramya C, Dr. Shreedhara K.S, Classifying the Unstructured IT Service Desk Tickets Using Ensemble of Classifiers, 2018
  - [12] Service Desk Institute, Service Desk Essential Handbook, 2019
  - [13] C.Fletcher,K.Lord, Apply Machine Learning and Big Data at the IT Service Desk to Support the Digital Workplace, 2016
- ITIL®, AXELOS Limited'in (tescilli) bir Ticari Markasıdır. Her hakkı saklıdır



## THE IMPACT OF GLOBALIZATION ON THE MANAGEMENT OF BANKING CAPITAL IN THE COUNTRIES OF THE WORLD

**Garmidarova Evgeniya Igorevna**

*post-graduate student of the Department of Economics of the State Economic University of Azerbaijan, 69 Nizami St, ISR plaza. (12th floor), Azerbaijan*

**Babayev Nusret Salman**

*dissertation candidate of the Department of Finance and Financial Institutions of the State Economic University of Azerbaijan, 69 Nizami St, ISR plaza. (12th floor), Azerbaijan*

### **Suggested Citation:**

*Garmidarova, E.I., A.E., Babaev N.S. 2021. The impact of globalization on the management of banking capital in the countries of the world. Journal of Applied Economic Sciences, Volume XII, Spring, 1 (23): 105 - 113.*

### **Annotation**

The article examines the impact of globalization on changes in the legislative bases of the USA, Germany, Russia and Azerbaijan. The analysis made it possible to conclude that in the countries of the world the requirement to increase bank capital is increasing, and there is a decrease in lending growth among the most vulnerable banks (undercapitalized banks). The Republic of Azerbaijan was able to achieve significant results in increasing its capital due to a timely increase in its level, as well as resorting to the process of merging those banks that could not increase their capital.

**Key words:** globalization; bank capital; capital management, capital adequacy, banking risks.

**JEL: E22**

### **Introduction**

Today, globalization has affected almost all countries, but it is most rapidly occurring in developing countries. In the context of the development of globalization, the banking sector has chosen a capital management strategy with more liquidity and reduced risks. There has been an increase in control over bank capital from both investors, regulators and other stakeholders. The novelty of the research lies in identifying the general trend of bank capital management in the context of globalization in countries and the application of this experience in the Republic of Azerbaijan. The aim of the work is to assess the impact of globalization on the management of bank capital in various countries. The objectives of the study are: 1) to determine the degree of influence of globalization on the management of banking capital; 2) definition of the concept of "management of bank capital"; 3) analysis of bank capital management in countries in accordance with international requirements; 4) formation of conclusions on the issues of banking capital management in the Republic of Azerbaijan, based on the conducted analysis. The subject of the research is banking capital. The object of the research is the ways and methods of bank capital management in the context of globalization.

### **Literary review**

The analysis showed that today there are practically no scientific works aimed at studying the impact of globalization on the management of bank capital. Most modern works provide an overview of the main international economic trends over the past few decades, which shows

that the world financial markets have undergone revolutionary changes caused by globalization (Yong et al., 2017; Kou, 2019).

Olivier De Jonghe examines the dynamic behavior of bank capital in a global sample of 64 countries over the period 1994-2010. Banks seek to reduce the share of borrowed funds mainly through capital growth (and not liquidation of assets). On the contrary, they achieve borrowed funds by reducing profit retention and significantly expanding assets. The speed of capital structure adjustment varies from country to country. Banks are adjusting their capital structures faster in countries with stricter capital requirements, better supervisory controls, more developed capital markets and high inflation. During crises, banks adjust their capital structure much faster (Jonghe, 2017).

Kern Alexander's article examines the implementation of Basel II methods of measuring banking risks for calculating regulatory capital in order to increase the competitiveness and efficiency of banks, while ensuring their stability. The study also discusses Basel III's attempts to rethink the way bank capital supports financial stability by comparing its definition and measurement with microprudential risks of a bank's balance sheet and the social consequences of accepting banking risks for the economy and society as a whole. In addition, the author examines the relationship between banking capital and corporate governance of the bank, as well as its impact on financial stability and economic sustainability. Finally, it highlights the relationship between the concept of bank capital and the broader concept of "social" capital (Kern, 2015).

In 2018, Don Dean and Robin Sickles conducted a Stochastic Frontier Analysis (SFA) that was used to construct a frontier to measure the cost effectiveness of banks and the effectiveness of bank capital management (Dong et al., 2018). The sample was divided into different classes of size and ownership, as well as the most and least efficient banks. Empirical evidence suggests that more efficient banks increase capital stocks and take on more credit risk while reducing risk-weighted assets. In addition, an increase in the capital buffer appears to affect banks' risk taking based on their level of cost efficiency, which is a placeholder for how productively their brokerage services are performed. An additional conclusion is that in the context of globalization, the direction of the relationship between risks and capital buffers differs, depending on which risk measure is used.

Jamie Dimon, in his *Understanding Bank Capital: A Case Study* (Dimon, 2018), reveals the nature of bank capital, highlighting its role as a form of self-insurance, providing both a buffer against unexpected losses and an incentive for risk management, describes some of the challenges in measuring capital and briefly discuss a number of approaches to setting capital requirements. Hans Devaster et al. analyze how time-varying bank capital requirements affect bank lending to the non-financial corporate sector as well as bank balance sheet adjustments (Jonghe et al., 2020). The paper notes that, despite the many research efforts currently underway by academics to help shape macroprudential policy (Galati and Mousner, 2013), no empirical study has yet led to a comprehensive assessment of the combined impact of globalization as changing in the time of banks, and the actual ratios of capital on the supply of bank loans to firms.

Jean Ambrocio, in his work, cites a study of 149 leading scientific studies on the regulation of bank capital (Ambrocio, 2021). Research has shown that North Americans prefer a significantly higher equity-to-asset ratio than Europeans. There was also significant support for new forms of regulation introduced in Basel III, such as liquidity requirements. The author concludes in the article that the best predictor of capital requirement preferences is how strongly the expert believes that higher capital requirements will increase the cost of bank lending. Experts note that banks use the proceeds from loan transfers to influence both reported earnings and regulatory capital for banks after considering other economic motives (Anand and Cotter, 2020).

Other studies argue that the impact of globalization and increased requirements on bank capital depends on the industry sector (Bridges et al., 2014), bank dependence (Gropp et al., 2018), the rating approach of banks (Behn et al., 2016), or bank type (Jonghe et al., 2020). Jimenez, Ongena, Peidro and Saurina (Jimenez, 2017) investigate dynamic collateralization of capital requirements and believe it helps to smooth the credit cycle.

Thus, we can conclude that many scientific works have been devoted to the study of the impact of globalization on banking capital, but there are still gaps in scientific knowledge that require further research. The literature review confirms the existence of a scientific problem: the impact of globalization on banking capital.

### **Analysis methods**

Comparative analysis was chosen as the main research method. To conduct a comparative analysis, countries were selected that have sufficient experience in managing bank capital in the context of globalization. These countries include the United States, Germany, Russia and Azerbaijan. The following were selected as the main parameters for comparing countries: 1) basic regulatory requirements in relation to bank capital; 2) the state of the banking sector, depending on the requirements for bank capital; 3) assessing the impact of an increase in requirements for bank capital on the supply of loans.

### **Research results**

Based on the comparison of the situation in different countries, the following conclusions were drawn. The USA is one of the largest banking countries in the world (Nepshina et al., 2020). The banks in this country are the largest in terms of first-tier capital (Risfandy et al., 2020).

In July 2013, US federal banking regulators adopted bank capital regulations, implementing the Basel III capital system established by the Basel Committee on Banking Supervision. The new capital rules came into effect on January 1, 2015 and were fully implemented on January 1, 2019. US banks are required by regulation to maintain sufficient capital to meet both the risk-based asset ratio and the leverage ratio (Haiyan. 2019).

The risk-based ratio is determined by allocating assets and certain types of off-balance sheet liabilities into risk-weighted categories, with a higher weight assigned to the higher risk categories. The risk-based ratio is total capital divided by total risk-weighted assets. The Leverage Ratio is Tier 1 capital, which includes common equity, certain types of perpetual preferred and other instruments, divided by the total assets to be adjusted, but not weighted by risk (Kou, 2019).

In this regard, at the legislative level in the United States, there is a requirement that capital among large US banks should be 3% of their assets (Abhinav, 2019). The required ratio above 5% is set for individual US banks, which are considered the most important for the overall financial system of the country (Yin, 2019). Critically undercapitalized banks are those in which the ratio of material capital to total assets is less than 2%. In the event that an organization becomes undercapitalized (due to non-compliance with capital ratios or in accordance with a decision of regulatory authorities), a huge number of significant restrictions and rules are imposed on it (Belaid et al., 2017).

All undercapitalized banks must submit a capital recovery plan to government regulators in order to become a capitalized organization again. The bank submits the following documents to the regulatory government body (Bhatia, 2019):

- the steps the entity will take to obtain adequate capitalization;
- the levels of capital that will be received during each year of the plan;
- how the bank will comply with the restrictions applicable to the institution;

- types and levels of activities that the bank will be engaged in.

Along with the US, Germany also influences part of the banking sector. The largest player in the country today is Deutsche Bank, with net income of \$ 27.5 billion in 2018 (Bhatia, 2019). Banks in Germany are divided into three distinct tiers: private banks, state-owned savings banks (Landesbanks) and member-owned credit unions. The German banking system consists of nearly 1,800 banks, which include 200 private banks, 400 state-owned banks, and 1,100 members owned by credit unions (Acharya et al., 2020).

The legal framework for the regulation of bank capital in Germany, as a member state of the European Union (EU), is based on EU directives and regulations. The most important among the documents is the Directive 2013/36 / EU on capital requirements (Directive on capital requirements IV, CRD IV) and Regulation (EU) 575/2013 on prudential requirements for credit institutions and investment firms (Requirements for capital regulation, CRR ). The main German banking regulation is the Banking Act (Kreditwesengesetz, KWG). The law covers, inter alia, licensing requirements and banking supervision. The Law provides a definition of bank capital, which includes fixed capital, as well as additional capital and third-tier funds (Naceur et al., 2018).

Today in Germany, there is an increase in requirements for bank capital, which is associated with a reduction in total domestic and cross-border bank lending (Mirgashemli, 2019). More capitalized banks are increasing lending growth in response to changes in monetary policy, while for other banks, higher bank capital requirements suggest a slower growth in their corporate lending (Katircioglu, 2019).

Thus, in the United States, in contrast to Germany, not only standards for the adequacy of bank capital have been developed, but also the criteria by which an organization is included in the list of undercapitalized banks are characterized, and control is exercised by state regulatory bodies in relation to subsequent activities to achieve the status of a capitalized bank (Belaid, 2019).

In the Russian Federation, banking capital is regulated in accordance with the requirements of the Central Bank of the Russian Federation (Bank of Russia) and the regulations of the Russian Federation / 1-9 / taking into account the recommendations of the Basel Committee on Banking Supervision and the European Union (Maudos, 2017).

In accordance with the regulation of the Central Bank 215-P, the bank capital consists of the sum of the main and additional capital minus certain indicators (Mustafazade T., 2016). The fixed capital includes the authorized capital or its part, share premium, reserve and other funds of the credit institution, audited profit of the current year and previous years. A part of the bank's property assets, own shares or shares acquired from members of a credit institution, the current year's loss and uncovered losses of previous years, the bank's investments in shares / shares of subsidiaries and affiliates or the authorized capital of resident credit institutions are deducted from this (Behn et al., 2016).

Additional capital includes unaudited earnings, subordinated debt, revaluation surplus and preferred shares. Indicators that reduce the amount of own funds - identified underdeveloped reserves, overdue debt over 30 days minus the reserves formed for it, subordinated loans provided to other resident banks. In addition, the sum of the sources of fixed and additional capital is reduced by the amount of the excess of the bank's investments in individual property assets (Laeven et al., 2016).

The Central Bank makes a number of requirements to the capital of credit institutions. In particular, the bank must comply with the condition of the sufficiency of its own funds, the additional capital must not exceed the main one. The Central Bank also sets the minimum amount of its own funds: from January 1, 2010 - 90 million rubles, from January 1, 2012 - 180 million. General licenses are issued to banks only with a capital of at least 900 million rubles (Haiyan, 2019).

The financial sector of Azerbaijan is dominated by banks, which account for about 95% of the total assets of the financial sector. In the Republic of Azerbaijan, in accordance with the new regulations that came into force on January 1, 2014, the requirements for the minimum total capital of existing banks, as well as the authorized capital of newly created banks, were increased 5 times and amounted to 50 million manats. This decision was made not only under the influence of globalization, but also due to the fact that a larger number of banks at that time already had these capital indicators close to the declared 50 million manats.

It should be noted that both Russia and Azerbaijan took the path of the need to merge or reorganize those banks that could not independently increase their capital. While the US has enabled banks to take appropriate steps to increase capital and develop a plan to achieve these goals (Tröger, 2018).

A general analysis of banks showed that by December 2020, banks increased their share capital for a total of 116.7 million manats. The liquid assets of the banking sector today amount to 9 million manats, and the urgent liquidity ratio in the banking system is 59%, which is almost twice the standard of 30% (Kamilov, 2018). Small banks, unable to independently increase capitalization to the required level, or not ready to merge, were forced to lower their status to the level of non-bank credit institutions. Capital adequacy requirements of at least AZN 0.3 million will be applied to such organizations (Mirgashemli, 2019).

In connection with the coronavirus pandemic in Azerbaijan, the rules for the temporary regulation of the activities of credit institutions in relation to capital adequacy came into force. These rules, designed to reduce the possible negative impact of the coronavirus (COVID-19) pandemic on the banking sector of Azerbaijan and aimed at improving the efficiency of banks and credit institutions, determine the classification of loans and risk groups, the capital adequacy ratio and the procedure for calculating it, which makes it possible to calculate the bank's capital adequacy, excluding pandemic risks of consumer loans issued by banks from May 1 to January 1, 2020. According to the changes introduced, the total capital adequacy ratio for systemically important banks until January 1, 2021 cannot be less than 11 percent, for other banks - less than 9 percent. In addition, until that date, the countercyclical capital buffer is set to zero.

As of 2021, the Central Bank of Azerbaijan noted that banking capital significantly exceeds the regulatory requirements of the banking sector, and it is sufficient to cover losses from insolvent creditors.

## Discussions

The analysis made it possible to determine the huge impact of globalization on the management of banking capital. First of all, this is characterized by the attention paid to the development of banking capital around the world and its compliance with the modern conditions of the development of both globalization and digitalization.

The study identified several consistent definitions of bank capital that are used in the countries under consideration (Tyutereva, 2019). First, equity is the residual accounting that remains after deducting the bank's fixed liabilities from its assets. Secondly, this is what is due to the owners of banks (shareholders) after deducting all assets at their book value. Third, it is the buffer that separates the bank from insolvency: the point at which its liabilities exceed the value of its assets. Capital requirements are standardized rules for banks and other depository institutions that determine how much liquid capital (that is, easily tradable securities) should be held in relation to a certain level of their assets.

The study showed that the influence of bank capital in the studied countries on lending is ambiguous. The available evidence suggests that higher capital requirements for banks in countries could lead to a reduction in lending in the short term, but many questions remain



unanswered, such as what the long-term implications of the increased requirements will be (Tröger, 2014, 2018, 2020). The Basel Accords helped standardize capital regulation across countries by setting the required minimum capital-to-asset ratios for banks (Laeven, 2016). Basel I provides a simple risk-weighted equity ratio in which bank assets are classified into four groups and weighted by their risk. However, its simplicity in measuring risk has led to regulatory arbitrage among large banks. Developing countries take a more cautious approach, which seems appropriate because one set of rules may not work for all countries. Rather than taking overly complex approaches to capital requirements, regulators in developing countries should focus on simpler capital ratios and prioritize building oversight capacity.

The analysis showed that the Republic of Azerbaijan coped with the process of increasing the capital of banks through a competent strategy: merging banks that are not ready to increase capital, and providing an opportunity for banks unwilling to merge with non-bank credit institutions. At the same time, for the development of Azerbaijani banks, it will be expedient to establish correspondent relations with US banks. In addition, an increasing number of private banks are interested in attracting foreign investors to equity bank capital.

Thus, control and supervision of bank capital plays a huge role in the banking system of the countries under consideration. First, capital is protection against unforeseen losses that cause bankruptcy. Second, equity creates incentives to manage risk appropriately from the perspective of shareholders. Third, sufficient equity capital signals that the bank's creditors will not take advantage of the benefits.

Overall, financial globalization brings important benefits to economic activity. In particular, in addition to supporting international trade, greater financial openness improves the efficiency of global capital allocation, as well as opportunities for diversifying risks and generating greater returns (Molnar et al., 2018).

## Conclusion

Globalization has had a huge impact on both the banking system itself and the management of bank capital. The globalization of the banking sector is important as it has introduced new technologies that have improved banking services and infrastructure, thus reducing fraudulent activities, new risk management techniques and increasing confidence in the banking sector.

However, in the context of globalization in the compared countries, the regulatory framework has undergone a comprehensive reform, in particular with regard to banking capital. Banking capital requirements have been tightened and complemented by several macroprudential measures to provide regulators with tools that could mitigate systemic risks. However, the introduced requirements aimed at increasing bank capital lead to a decrease in the creditworthiness of banks, which affects the entire banking system as a whole.

Azerbaijan has seen a positive experience in the area of bank capital adequacy, which will be able to cover losses from insolvent creditors. However, bank transparency, disclosure and monitoring should be introduced to ensure that banks resist the temptation to circumvent banking capital adequacy regulations. It is also necessary to assess the impact of an increase in the capital adequacy ratio and, as a consequence, an increase in the interest rate on loans (Degryse et al., 2019). The study showed that in world practice, in the case of commercial banks, an increase in the capital adequacy ratio by 1% can be offset by a commensurate increase in the bank lending rate by 16% and, in general, the lending rate can increase to 94 basis points.

## List of literature

1. Molnar A.S., Dobrutskiy A.S., Pliska V.V., Sorokin E.A. Conceptual directions of transformation of banking activity under the influence of globalization. Formation of market relations in Ukraine. 2018. No. 1 (200). S. 47-52.
2. Molchanova L.A., Shanina A.N., Stepanenko I.A. Trends in the consolidation of banking capital in the context of financial globalization. Russian economic Internet magazine. 2018.No. 4.P. 76.
3. Nepshina V.N., Trofimova Yu.V. Strategic management of banks of the Republic of Kazakhstan in the global economy. Central Asian Economic Review. 2020. No. 1 (130). S. 171-187.
4. Kamilov A. Ways of attracting bank capital to finance the real sector in Azerbaijan. Silk Way. 2018.No. 2.P. 72-79.
5. Tyutereva Yu.D. Some changes in the banking sector caused by financial globalization. Colloquium-journal. 2019. No. 10-7 (34). S. 50-51.
6. Mustafazade T. Analysis of the process of integration of the banking sector of Azerbaijan into the world financial sector. Business within the law. Economic and legal journal. 2016. No. 1. S. 66-70.
7. Mirgashemli L. Capitalization of commercial banks in Azerbaijan and their role in the foreign exchange market. Bulletin of Polotsk State University. Series D. Economic and legal sciences. 2019. No. 5. S. 82-85.
8. Mamedov Z.F., Valiev E.N., Veisov E.N. Modern features of the development of the banking sector in Azerbaijan. Economic sciences. 2020. No. 188. S. 131-136.
9. Abhinav Anand, John Cotter, Integration Among US Banks, SSRN Electronic Journal, 10.2139/ssrn.3460375, (2019).
10. Acharya, V. and S. Steffen (2020). The Risk of Being a Fallen Angel and the Corporate Dash for Cash in the midst of COVID, COVID Economics (10), 44-61
11. Acharya, V., and S. Steffen (2014). Falling Short of Expectations? Stress-Testing the European Banking System.
12. Acharya, V., M. Jager, S. Steffen, and L. Steinruecke (2020). Kicking the Can Down the Road: Government Interventions in the European Banking Sector. Working Paper.
13. Admati, A., & Hellwig, M. (2014). The Bankers' New Clothes: What's Wrong with Banking and What to Do about It-Updated Edition. Princeton University Press.
14. Adrian, T., Boyarchenko, N., & Shin, H.-S. (2015). The cyclicity of leverage (Tech. Rep.). New York, NY: Staff Report, Federal Reserve Bank of New York.
15. Aiyar et al. (2016) How does credit supply respond to monetary policy and bank minimum capital requirements? Eur. Econ. Rev.
16. Aiyar, S., Calomiris, C. W. and Wieladek, T. (2016) 'How Does Credit Supply Respond to Monetary Policy and Bank Minimum Capital Requirements?', *European Economic Review*, 82, pp. 142– 165.
17. Al-Homaidi, Eissa A., Mosab I. Tabash, Najib H. S. Farhan, and Faozi A. Almaqtari. 2018. Bank-specific and macro-economic determinants of profitability of Indian commercial banks: A panel data approach. Cogent Economics & Finance 6: 1548072
18. Back Matter: Statistical Appendixes and Bibliography, Global Financial Development Report 2019/2020: Bank Regulation and Supervision a Decade after the Global Financial Crisis, 10.1596/978-1-4648-1447-1, (101-135), (2019).
19. Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquerie, Chavu Meattle, et Cooper Wetherbee. "Global Landscape of Climate Finance 2019". Climate Policy Initiative, novembre 2019. [https:// climatepolicyinitiative.org/publication/global-landscape-of-climatefinance-2019/](https://climatepolicyinitiative.org/publication/global-landscape-of-climatefinance-2019/).
20. Behn, M., Haselmann, R. and Wachtel, P. (2016) 'Procyclical Capital Regulation and Lending', *The Journal of Finance*, 71 (2), pp. 919– 956.

21. Belaid, Faïçal, Rim Boussaada, and Houda Belguith. 2017. Bank-firm relationship and credit risk: An analysis on Tunisian firms. *Research in International Business and Finance* 42: 532–43.
22. Ben Salah Mahdi, Ines, and Mouna Boujelbene Abbes. 2018. Relationship between capital, risk and liquidity: A comparative study between Islamic and conventional banks in MENA region. *Research in International Business and Finance* 45: 588–96.
23. Berezyuk V., Daribekova N., DARIBEKOVA A. Strategic Management of the Financial System in the Conditions of Economy Globalization. *Journal of Advanced Research in Law and Economics*, Vol 9 No 2 (2018): JARLE Volume IX Issue 2(32) Spring 2018, p. 774-784
24. Bhardwaj, A., Subramanian, K., & Tantri, P. L. (2015). Relationship Banking and Monetary Policy Transmission: Evidence from India (No. 2691556). Indian School of Business Working Paper.
25. Bhatia, S. (2019). Bank capital structure and monetary policy transmission: Evidence from India. 15th Annual Conference on Economic Growth and Development, Indian Statistical Institute, New Delhi.
26. Carlson, M., Shan, H. and Warusawitharana, M. (2013) ‘Capital Ratios and Bank Lending: A Matched Bank Approach’, *Journal of Financial Intermediation*, **22** (4), pp. 663– 687.
27. Cubillas, E. and Suárez, N. (2018) ‘Bank Market Power and Lending During the Global Financial Crisis’, *Journal of International Money and Finance*, **89**, pp. 1– 22.
28. Deli, Y. D. and Hasan, I. (2017) ‘Real Effects of Bank Capital Regulations: Global Evidence’, *Journal of Banking and Finance*, **82**, pp. 217– 228.
29. Dong Ding, Robin C. Sickles, 2018 Frontier efficiency, capital structure, and portfolio risk: An empirical analysis of U.S. banks. DOI: 10.1016/j.brq.2018.09.002
30. E: Policy, Law and Regulation, World Banking Abstracts, 10.1111/woba.5426, **34**, 1, (38-48), (2017).
31. Elena Cubillas, Nuria Suárez, Bank market power and lending during the global financial crisis, *Journal of International Money and Finance*, 10.1016/j.jimonfin.2018.08.003, **89**, (1-22), (2018).
32. Eleni Dalla, Erotokritos Varelas, REGULATION & OLIGOPOLY IN BANKING: The Role of Banking Cost Structure, *Journal of Economics and Business*, 10.1016/j.jeconbus.2019.02.002, (2019).
33. Enzo Dia, David VanHoose, Fixed costs and capital regulation: Impacts on the structure of banking markets and aggregate loan quality, *Journal of Financial Stability*, 10.1016/j.jfs.2018.02.007, **36**, (53-65), (2018).
34. European Parliament (2020). COVID-19: Revised rules to encourage banks to lend to companies and households (Press release). <https://www.europarl.europa.eu/news/en/pressroom/20200608IPR80708/covid-19-revised-rules-to-encourage-banks-to-lend-to-companies-andhouseholds>.
35. Gambacorta, L., & Shin, H. S. (2018). Why bank capital matters for monetary policy. *Journal of Financial Intermediation*, 35, 17–29.
36. Gornall et al. (2018) Financing as a supply chain: the capital structure of banks and borrowers *J. Financ. Econ*.
37. H. Degryse et al. (2019) Identifying credit supply shocks with bank-firm data: methods and applications *J. Financ. Intermed*
38. Haris, Muhammad, HongXing Yao, Gulzara Tariq, Ali Malik, and Hafiz Mustansar Javaid. 2019b. Intellectual Capital Performance and Profitability of Banks: Evidence from Pakistan. *Journal of Risk and Financial Management* 12: 56.
39. Haris, Muhammad, Yao HongXing, Gulzara Tariq, and Ali Malik. 2019a. An Evaluation of Performance of Public Sector Financial Institutions: Evidence from Pakistan. *International Journal of Business Performance Management* 20: 145–63.

40. Javid E, Katircioglu ST (2017) The globalization indicators-tourism development nexus: a dynamic panel-data analysis. *Asia Pac J Tourism Res* 22(11):1194–1205
41. Jiménez, G., Ongena, S., Peydró, J. L. and Saurina, J. (2012) ‘Credit Supply and Monetary Policy: Identifying the Bank Balance-sheet Channel with Loan Applications’, *American Economic Review*, **102** (5), pp. 2301– 2326.
42. Joudia, Sameh, Houssam Bouzgarrou, and Slaheddine Hellara. 2017. The effects of activity and geographic diversification on performance: Evidence from French financial institutions. *Research in International Business and Finance* 39: 920–39.
43. Katircioglu S, Zabolotnov A (2019) Role of financial development in economic globalization: evidence from global panel. *Appl Econ Lett*. <https://doi.org/10.1080/13504851.2019.1616058>
44. Kim, D. and Sohn, W. (2017) ‘The Effect of Bank Capital on Lending: Does Liquidity Matter?’, *Journal of Banking and Finance*, **77**, pp. 95– 107.
45. Kirschenmann, K., J. Korte, and S. Steffen (2020). The Zero Risk Fallacy - Banks' Sovereign Exposure and Sovereign Risk Spillovers, *Journal of Financial Stability*, forthcoming
46. Košak, M., Li, S., Lončarski, I. and Marinč, M. (2015) ‘Quality of Bank Capital and Bank Lending Behavior During the Global Financial Crisis’, *International Review of Financial Analysis*, **37**, pp. 168– 183.
47. Kou G, Chao X, Peng Y, Alsaadi FE (2019a) Machine learning methods combined with financial systemic risk. *Technological and Economic Development of Economy*. <https://doi.org/10.3846/tede.2019.8740>
48. Kou G, Ergu D, Chen Y, Lin C (2016) Pairwise comparison matrix in multiple criteria decision making. *Technol Econ Dev Econ* 22(5):738–765
49. Kou G, Yang P, Xiao F, Chen Y, Alsaadi FE (2019b) Evaluation of feature selection methods for text classification with small datasets using multiple criteria decision-making methods. *Appl Soft Comput*. <https://doi.org/10.1016/j.asoc.2019.105836>
50. Laeven, L., Ratnovski, L. and Tong, H. (2016) ‘Bank Size, Capital, and Systemic Risk: Some International Evidence’, *Journal of Banking and Finance*, **69** (Suppl. 1), pp. S25– S34.
51. Lee, John Y., Glenn Grove, Marinus DeBruine, and Inkyung Cha. 2015b. Measuring the Impact of the 2007–9 Financial Crisis on the Performance and Profitability of U.S. Regional Banks. In *Advances in Management Accounting*. Bingley: Emerald Group Publishing Limited, pp. 181–206.
52. Leroy, A. (2014) ‘Competition and the Bank Lending Channel in Eurozone’, *Journal of International Financial Markets, Institutions and Money*, **31**, pp. 296– 314.
53. Li G, Kou G, Peng Y (2016) A group decision making model for integrating heterogeneous information. *IEEE Trans Syst Man Cybern Syst*. <https://doi.org/10.1109/tsmc.2016.2627050>
54. Mariña Martínez-Malvar, Laura Baselga-Pascual, Bank Risk Determinants in Latin America, *Risks*, 10.3390/risks8030094, **8**, 3, (94), (2020).
55. Martins, António Miguel, Ana Paula Serra, and Simon Stevenson. 2019. Determinants of real estate bank profitability. *Research in International Business and Finance* 49: 282–300
56. Maudos, Joaquín. 2017. Income structure, profitability and risk in the European banking sector: The impact of the crisis. *Research in International Business and Finance* 39: 85–101.
57. Mishchenko, V. (2008). Problems of Capitalization and Consolidation of the Banking System of Ukraine. *Bulletin of the National Bank of Ukraine*, 10, 2-7
58. Mishra, P., Montiel, P., & Sengupta, R. (2016). Monetary transmission in developing countries: Evidence from India. In *Monetary Policy in India* (pp. 59–110). Springer.
59. Moau Yong Toh, Effects of bank capital on liquidity creation and business diversification: Evidence from Malaysia, *Journal of Asian Economics*, 10.1016/j.asieco.2018.12.001, (2018).
60. Naceur, S. B., Marton, K. and Roulet, C. (2018) ‘Basel III and Bank-lending: Evidence from the United States and Europe’, *Journal of Financial Stability*, **39**, pp. 1– 27.

61. Noss, J. and Toffano, P. (2016) ‘Estimating the Impact of Changes in Aggregate Bank Capital Requirements on Lending and Growth during an Upswing’, *Journal of Banking and Finance*, **62**, pp. 15–27.
62. Panayotis D. Alexakis, Ioannis G. Samantas, Foreign ownership and market power: The special case of European banks, *Journal of Banking & Finance*, 10.1016/j.jbankfin.2020.105857, **118**, (105857), (2020).
63. Salvatore Polizzi, Enzo Scannella, Nuria Suárez, The Role of Capital and Liquidity in Bank Lending: Are Banks Safer?, *Global Policy*, 10.1111/1758-5899.12750, **11**, S1, (28-38), (2020).
64. Schliephake, E. (2016) ‘Capital Regulation and Competition as a Moderator for Banking Stability’, *Journal of Money, Credit and Banking*, **48** (8), pp. 1787–1814.
65. Schularick, M. and S. Steffen (2020). A Protective Shield for Europe's Banks, *Macroeconomics Lab Bonn and Frankfurt School of Finance*, Discussion Paper.
66. Shaofang Li, The Impact of Capital Structure and Institutional Environment on Bank Competition: A Cross-Country Analysis, *Emerging Markets Finance and Trade*, 10.1080/1540496X.2020.1859366, (1-11), (2020).
67. Sinha, Pankaj, and Sakshi Sharma. 2016. Determinants of bank profits and its persistence in Indian Banks: A study in a dynamic panel data framework. *International Journal of System Assurance Engineering and Management* 7: 35–46.
68. Sun, Poi Hun, Shamsheer Mohamad, and M. Ariff. 2017. Determinants driving bank performance: A comparison of two types of banks in the OIC. *Pacific-Basin Finance Journal* 42: 193–203.
69. Tan, Yong, and John Anchor. 2017. The impacts of risk-taking behaviour and competition on technical efficiency: Evidence from the Chinese banking industry. *Research in International Business and Finance* 41: 90–104.
70. Tan, Yong, Christos Floros, and John Anchor. 2017. The profitability of Chinese banks: Impacts of risk, competition and efficiency. *Review of Accounting and Finance* 16: 86–105.
71. Tastaftiyan Risfandy, Amine Tarazi, Irwan Trinugroho, Competition in dual markets: Implications for banking system stability, *Global Finance Journal*, 10.1016/j.gfj.2020.100579, (100579), (2020).
72. Tastaftiyan Risfandy, Amine Tarazi, Irwan Trinugroho, Competition in Dual Markets: Implications for Banking System Stability, *SSRN Electronic Journal*, 10.2139/ssrn.3158510, (2018).
73. Tröger, T. (2014). The Single Supervisory Mechanism – Panacea or Quack Banking Regulation?. *European Business Organization Law Review* 15: 449-497.
74. Tröger, T. (2018). Too Complex to Work – A Critical Assessment of the Bail-In Tool Under the European Bank Recovery and Resolution Regime. *Journal of Financial Regulation* 4:35-72
75. Tutino, F., Birindelli, G. and Ferretti, P. (2011) *Basilea 3. Quali Impatti Per Le Banche*. Milano: Egea.
76. Verma, R., & Herwadkar, S. (2019). Bank recapitalisation and credit growth: The Indian case (No. 97394). Munich Personal RePEc Archive.
77. Wang, Q. (2015). Fixed-effect panel threshold model using Stata. *The Stata Journal*, 15(1), 121–134.
78. Watanabe, W. (2007). Prudential regulation and the “credit crunch”: Evidence from Japan. *Journal of Money, Credit and Banking*, 39(2-3), 639–665.
79. Yin, Haiyan. 2019. Bank globalization and financial stability: International evidence. *Research in International Business and Finance* 49: 207–24.



80. Zarrouk, Hajer, Jedidia Khoutem Ben, and Mouna Moualhi. 2016. Is Islamic bank profitability driven by same forces as conventional banks? *International Journal of Islamic and Middle Eastern Finance and Management* 9: 46–66.
81. Khalilov D.S. Banking system of Azerbaijan. In the collection: *Economics and banking system: theory and practice. Materials of the correspondence international scientific and practical conference.* FSBEI HE "Dagestan State University"; Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University"; Federal State Educational Institution of Higher Education "Financial University under the Government of the Russian Federation". 2016. Pages 383-386.
82. Kern Alexander. The role of capital in supporting banking stability. *Oxford Handbook of Financial Regulation*. Edited by Niam Moloney, Ayles Ferrand and Jennifer Payne, 2015, DOI: 10.1093 / oxfordhb / 9780199687206.013.14

## THE COUNTRY'S FOREIGN TRADE POLICY AND ITS ROLE IN INTEGRATION INTO THE INTERNATIONAL ECONOMY.

**Nusret Salman ogluy Babayev**

teacher of the Department of Finance  
and Financial Institutions of the Azerbaijan State University of Economics,

**Habil Huseyn oglu Aslanov**

Associate Professor of the Baku state University

### Summary

In modern conditions, the formation and development of the national economy is possible not only through domestic opportunities, but also through the wider and more effective use of international trade relations. The country's participation in international trade relations allows it to develop and effectively use the existing export potential in order to enhance economic development, taking advantage of the economic and strategic advantages created by the international division of labor, and opens new prospects in this direction.

In the scientific literature, the export potential is shown as an integral part of the country's economic potential that can be used for export purposes. This potential includes natural-economic, technical-economic, scientific-technical potential, foreign trade infrastructure, labor reserves, etc., which are and can be used in the production and export of goods and services for export.

**Keywords:** national economy, foreign trade, export policy, economic integration, export potential, domestic market, economic regulation

World experience shows that the development of export potential can be achieved by increasing the competitiveness of products, creating conditions that stimulate national exports, the use of advanced technology in production, increasing the output of science-intensive products, the development of export structure and other factors.

The development of export potential and the factors that determine it are widely discussed in classical and modern international trade theories. In classical theories, these factors are determined by the advantages gained by the natural and production factors that most countries have. According to them, countries should specialize in the production and export of products that make maximum use of the factors that have an advantage in production. However, the development of export potential cannot be limited to increasing the amount of factors involved in production. Special attention should also be paid to the benefits of the development of science and technology, scientific and technological progress, the development of international trade relations, and the deepening of the International Division of Labor. Economists who came after the classics took these factors into account in new, modern theories of trade. The main of them is the theory of the country's competitive advantage. As it is known from the world experience, it is not necessary to talk about the development of exports and the improvement of its structure without creating a highly competitive environment. In the theory of competitive advantage, it connects the fact that a country or a particular firm can develop its export potential with its competitive advantage. While studying the impact of intangible production conditions on the country's competitive advantages, Porter did not limit himself to traditional factors of production, but added new ones to scientific and technical information, market infrastructure, labor productivity and other factors in the production process. Another key condition for creating a competitive advantage is the level and state of development of the service and ancillary sectors. These areas play an important role in supporting the efficient operation of enterprises and export orientation.

In the current state of development of the Azerbaijani economy, the main goal of foreign economic policy is the current state of the country's economy, strengthening its place in the world economy and the implementation of a common economic development strategy. A foreign trade policy that combines different directions will be effective only if there are effective and flexible regulatory mechanisms that ensure its national interests.

The following are the priorities of the country's foreign trade policy:

- long-term orientation in the establishment of foreign trade relations;
- protection of the country's domestic market and stimulation of the development of the real sector of the economy;
- stimulating the export of domestically produced products;
- protection of the position of domestic producers in foreign markets;
- regulation of domestic markets;
- application of an efficient customs and tax system to regulate imports;
- regulation of the country's balance of payments.

At present, Azerbaijan has a strong economic potential to solve these problems, and the process of access to world markets for non-oil products in this area should be further expanded, and state support and regulation should be provided in this process. The introduction of the principles of "one window" in import – export operations is of particular importance in this process. As a result of further simplification of customs procedures, the introduction of a "single window" system for import and export operations and the improvement of the tax system, there is a rapid increase in foreign economic activity in the country, the expansion of the import-export structure. As a result, the access of the country's entrepreneurs to foreign markets has been increased, and the country's entrepreneurs have the opportunity to export to European countries with very low customs duties. All these processes bring Azerbaijan closer to taking new promising measures to export non-oil products to world markets. Of course, one of the most important points ahead is to expand economic relations with other countries, as well as to accelerate relations with international organizations that have a special reputation in the international economic space. Participation in authoritative international organizations and financial institutions should be a special goal in this process. Strengthening activities in this area, along with the expansion of foreign trade relations of our country, will have a strong impact on increasing the competitiveness of domestic producers in both domestic and foreign markets, stimulating the introduction of new equipment and technology in the production process.

The ability of the country's economy to enter into international integration relations is interrelated with foreign trade relations. This process of mutual completeness is possible only in the foreign trade relations of countries with an open and transparent economic system, which includes the spheres of reproduction. In this context, the structure of the local economy in the country requires both the export of part of the finished product and the payment of part of domestic demand through imports. Therefore, one of the important global economic issues at the present stage is the further strengthening of the integration of the world's countries into the process of international economic integration.

Today, Azerbaijan's foreign trade system combines global features and has economic relations with both Western and post-Soviet countries. After gaining independence, Azerbaijan began to gradually increase its economic and political power, joining many economic unions of the world. The main factor that allows this process is the richness of our country's natural resources. Currently, Azerbaijan ranks first in the South Caucasus in terms of natural resources. As a result of the research, it was found that currently more than 1 billion tons of oil, 800 billion cubic meters of gas, 230 million tons of metal, 240 million tons of alunite ore, 370 million tons of raw materials for cement production, 230 million tons of zeolite, 730 million tons of cubic meters of mineral water and other natural raw materials.

In foreign trade policy, special attention should be paid to the development of trade in processed agricultural products. Because, by attracting the finished products of this industry to foreign trade, it is possible to gain competitiveness in the international market for the sale of these

goods. This in itself will allow Azerbaijan to find a place for the factors of world specialization in agriculture and to enter into international cooperation.

One of the important issues is the formation of free economic zones in Azerbaijan. In accordance with the relevant state programs in this area, special talks are being held and the necessary preparations are being made. In addition, along with the improvement of the investment climate in the country, the continuation of state policy on the regulation of foreign investment in the economy, the country's economic opportunities include investment opportunities in world markets.

The country's foreign trade concept should be developed for two stages in accordance with the development periods. 1. The concept of foreign trade of the transition period - in essence, should end with the formation of the market in the republic and the formation of real market relations. 2. The concept of foreign trade of the real market period - after the process of formation of real market relations, the country will be thoroughly integrated into the world economy through radical qualitative changes in both the socio-economic nature of the economic base and the political organization of society. The country's foreign trade policy as a whole should be considered and shaped as an integral part of the concept of economic security. Because the formation and strengthening of the country's economic security system directly depends on the organization and development of foreign trade.

There are 3 development models in terms of the interdependence and close connection of the national economy with external factors: 1) Development model that provides for increasing the export orientation of the economy; 2) Development model of import-substituting industries; 3) Economic integration model. The formation of the concept of foreign trade is shaped by the choice of one of these models.

In the current situation, it is necessary to investigate which of these models is more appropriate in terms of Azerbaijan's potential. Export-oriented development is one of the key models in the current system of international economic relations and requires the development of the country's national economy in the required direction. However, in order for these models to be applied in Azerbaijan, it is important to solve some problems:

- The current situation on the world market requires a completely new basis for the export of goods and services. The use of modern equipment and technology, the growth of production of new goods and increased competition significantly limit the export potential of Azerbaijan, which produces products that do not meet world standards;
- export development requires continued competition and the creation of new advantages. Continuous investments must be made to acquire new infrastructure and technologies. However, in modern conditions, when the country's financial and foreign exchange reserves are not able to meet even the minimum needs, it is impossible to make large investments in these areas;
- in particular, even if the necessary opportunities exist, the application of an export-oriented development model will not soon yield the desired results. Because the strengthening of the export orientation of the economy in the country creates export dependence on foreign markets, which has a strong impact on the domestic socio-economic situation in the country.

In the current situation, the main direction of Azerbaijan's foreign trade concept may be free trade blocs formed within the framework of regional economic integration. The establishment of trade zones similar to the European Free Trade Association can allow the formation and implementation of the concept of foreign trade based on the optimal compatibility of domestic and foreign economic activity, both during and after the transition period. Today, Azerbaijan is the only state in the Eurasian space that simultaneously participates in five major regional groups: the Commonwealth of Independent States (CIS), the Economic Cooperation Organization (ECO), the Economic Cooperation Organization of the Black Sea Basin, the Cooperation Council of Turkic States, GUAM (Georgia, Ukraine, Azerbaijan, Moldova).

Azerbaijan's foreign trade policy should be based on the formation and development of national competitive advantages in the country. The main directions of foreign trade policy can be formulated as follows:

- Strategic directions: implementation of state incentives in the export process; increasing the competitiveness of market participants through government programs; protection of the national market in accordance with domestic interests.
- Export activities: further improvement of exports in the country, special attention to the export of finished products and services; formation and development of the country's export potential; assessment of the existing export potential in the conditions of comparative advantage; to export more technology-intensive products; more rapid attraction of foreign investments in the development of export-oriented production.
- In the field of imports: reducing the country's economic dependence on foreign countries; organization of production of basic products to meet domestic demand; control over the structure of imports.

The foreign trade policy of our country should be formed in the conditions of mutual coordination of the above-mentioned directions and the country's foreign trade should be carried out on the basis of these principles. Foreign trade policy is considered one of the most important components of the country's policy. Even the foreign policy agencies of the Developed Countries are more closely involved in international economic relations, especially in the regulation of foreign trade.

International economic integration is a process of objective economic interaction regulated by intergovernmental bodies in an agreed form, adopting the form of interstate agreements, to bring the economic mechanisms of countries closer to each other. At the heart of international economic integration there are economic interests of freely operating entities and the international division of labor.

Due to the development of integration, international trade is growing within the integration associations. One of the main directions of Azerbaijan's foreign economic strategy is to actively participate in world economic processes and respond adequately to new developments in the geo-economic space. The main feature of Azerbaijan's foreign economic relations is to join both international, regional and local economic associations, and thus to integrate into these organizations in various spheres of public life. The first international economic organizations that Azerbaijan joined after gaining independence are:

- Organization of the Islamic Conference (OIC) - December 8, 1991;
- Economic Cooperation Organization (ECO) - February 1992;
- International Monetary Fund and International Bank for Reconstruction and Development - 1992;
- Black Sea Economic Cooperation Organization (BSEC) - 1993;
- World Trade Organization (WTO) observer status - 1993;
- Commonwealth of Independent States (CIS) - 1993;
- Council of Europe (CoE) - 25 January 2001.

One of the regional integration unions with which Azerbaijan cooperates is the European Union. The Partnership and Cooperation Agreement (PCA) between the European Union and its member states, on the one hand, and the Republic of Azerbaijan, signed in Luxembourg on 22 April 1996, forms the legal basis for Azerbaijan's multilateral relations with the European Union. This agreement covers political, trade and other important areas of cooperation between the European Union and Azerbaijan. In general, about 90% of Azerbaijan's trade relations with the EU fall to the United Kingdom, Germany, Italy and France.

Azerbaijan has also joined interstate regional programs. These include INOGATE and TRACECA programs. INOGATE is a European Commission technical assistance program that assists in the management of oil and gas supplies. The main purpose of this program is to support the renewal and modernization of regional oil and gas pipeline systems and infrastructure.



TRACECA is the New Silk Road, a Europe-Caucasus-Asia transport corridor that develops transport links between Central Asia, the Caucasus and Europe. In 1998, a multilateral agreement was signed with TRACECA. Azerbaijan is a key EU partner in this project, and the TRACECA Intergovernmental Commission Secretariat has been located in Baku since 2000.

International cooperation plays a special role in terms of bringing Azerbaijan's national trade system in line with world standards and expanding economic and trade cooperation in this area. Therefore, the country's membership in the World Customs Organization is of great importance. In order to simplify trade operations, Azerbaijan and the World Customs Organization have agreed to develop a single customs tariff based on the Commodity Nomenclature of Foreign Economic Activity, to apply customs duties, and to determine the country of origin of imported goods..

Currently, another economic union that Azerbaijan wants to join is the World Trade Organization. Azerbaijan wants to join this organization as a "developing country". The WTO was established in 1995 to replace the General Agreement on Tariffs and Trade. The WTO is a single international organization that sets global rules for international trade. Its main function is to ensure that trade is balanced, unhindered and free. The goal is to improve the welfare of the people of the member countries.

The integration of Azerbaijan's national economy into global events and the internationalization of reproduction brings it closer to the world economic community and expands its international integration ties. As a result, conditions are created for the effective organization of Azerbaijan's foreign trade relations at the regional and subregional levels. Foreign trade includes not only trade in goods and services, but also currency-credit relations, investment and labor markets, exchange of equipment and technology. From this type of multifaceted foreign trade relations, it is necessary to conduct a forecast analysis, first selecting those that have a regional and then a global perspective. In this regard, special attention should be paid to international norms, accession to the Vienna and The Hague Conventions, which regulate international trade, the World Trade Organization, and active participation in UNCTAD should be among the main issues of the day. In addition, Azerbaijan's foreign trade relations should be shaped and have a balancing basis, taking into account the trade structures of both developed and developing countries. That is, the foreign trade turnover on manufactured products, with its type and quality structure, should minimize the level of foreign dependence, based on both the steady growth of the country's export capacity and the economic efficiency of imports.

The process of globalization between the countries of the world has a positive impact on the development of both economic and political relations between the countries. Globalization also has a positive impact on free trade between countries, customs integration between countries and economic development. The formation of more efficient trade and economic relations between the countries is of great importance in accelerating this process. Therefore, countries are trying to simplify their customs systems and procedures. Foreign trade operations form the basis of the country's economic development. Carrying out customs control and customs clearance in a shorter, more transparent and simple form plays an important role in the growth of foreign trade.

Our research focuses on ways to increase the volume of Azerbaijan's foreign trade operations with world countries and improve the process of customs clearance in the import-export process. International customs integration and relations with international organizations are of special importance in this process. Integration into the international customs system is one of the main directions ensuring trade in goods and services, development of financial and economic spheres.

#### Literature

1. A.M.Maharramov, H.H.Aslanov. Regulation of foreign economic activity. Baku, 2008, 400 pages.
2. A.H.Garibov, A.A.Azizov, S.E.Ahmadova. International trade operations. Baku, "Baku Business University Publishing House", 2017, 255 pages.

3. A. Panahov. International economic policy. Baku, 2016, 171 pages.
4. A.Sh.Shakaraliyev, J.G.Nuriyev, A.A.Aliyev, Z.A.Shakaraliyeva. Customs Organization and Management. Baku, "University of Economics", 2018, 292 pages
5. A.Ə.Aliyev. Customs and the development of the world economy. Baku, "Chashyoglu", 2003, 240 pages.
6. A.Aliyev, I.Dadashov, A.Shakaraliyev. World economy. Problems of modern times. Baku, 2003, 455 pages.
7. A.Sh.Shakaraliyev, Z.A.Shakaraliyeva. Customs tariff regulation of foreign economic activity. Baku, 2006, 228 pages.
8. A.Sh.Shakaraliyev. Transition economy and the state. Baku, 2000, 278 pages.
9. A. Nadirov. Issues of development of independent Azerbaijan economy. Baku, Science, 2005
10. D.Valiyev. Azerbaijan's integration into world financial markets in the context of globalization. Baku, 2006, 242 pages.
11. G.Ganjiyev, A.Gurbanzade. Directions for improving the use of export resources. Baku, 2003, 128 pages.

## KƏLBƏCƏR TARİX DİYARŞÜNASLIQ MUZEYİ TARİXİ ABİDƏLƏRİN ÖYRƏNİLMƏSİNDƏ MƏNBƏ KİMİ

**Ramiz Nəcəfli**

*Bakı Dövlət Universiteti Tarix fakültəsinin dissertantı*

### Abstract

This article is dedicated to the study of historical monuments of Azerbaijan on the basis of materials of the Kalbajar Museum of History and Ethnography. Kalbajar Museum of History and Ethnography was established in 1980 and since 1982 has become a grand museum of world importance. The aggression of the Armenian armed forces against Azerbaijan in the early 1990s resulted not only in the killing of thousands of innocent people and their expulsion from their homes, but also in the destruction of the material and spiritual culture created by this people for thousands of years. In 1993, Armenians looted 22 museums, including the Kalbajar Museum of History and Ethnography. More than 36.000 exhibits of the museum were looted. However, on the basis of the museum, the Kalbajar Museum of History and Ethnography was re-established in Baku. The founder of the museum, Shamil Asgarov, called the museum in Kalbajar a *shehid* (martyr) museum, and the museum established in Baku a witness museum. The history of not only Kalbajar, but Azerbaijan as a whole was in the martyr museum. Here is dealt with the rock carvings of Kalbajar and the splendor of Gelin qayasi, Sultan Heydar mountain, Perichingili, Ayichingili, Gurbagali river, Turshsu gorge, Serchelidag and Sarimsagli dag (mountain) where they are located. Here we are talking about the rock carvings of Kalbajar and the splendor of the Gelin rock, Sultan Heydar mountain, Perichingili, Ayichingili, Gurbagali river, Turshsu gorge, Sarchalidagh and Sarimsagli mountains where they are located. One can see visual examples of totems of horses, oxen, rams, goats in the museum materials. The socio-economic, political, ethnic history and culture of our people, reflecting ethnographic examples (folk games – “maraloyunu”, “kilimarası”, “seven valours”, etc.) are highlighted here. At first sight, the figures of rams and horses, huge bezir stones and many items found during the excavations attracted the attention of the viewers. One of the examples of material culture destroyed by Armenian vandals in 1993 is an ancient settlement near Istisu of Kalbajar region.

**Keywords:** Kalbajar Museum, Perichingili, Turshsu gorge, Bezir Stones

Bu məqalədə erməni barbarlarının Azərbaycanı vurduğu maddi zərərlə yanaşı onun mədəni irsinin məhv edilməsinə yönəlmiş əməlləri və Azərbaycanın tarixi abidələrinin öyrənilməsində Kəlbəcər Tarix-Diyarşünaslıq Muzeyi materiallarının mənbə kimi əhəmiyyətindən söz açılır. 1990-cı illərin əvvəllərində Ermənistan silahlı qüvvələrinin Azərbaycanı təcavüzü təkcə minlərlə günahsız insanların qətl edilməsi, yurduvalarından didərgin düşməsi ilə deyil, eyni zamanda bu xalqın minillər boyu yaratdığı maddi və mənəvi mədəniyyətin məhvəsinə gətirib çıxardı. Təkcə 1993-cü ildə ermənilər 22 muzey, o cümlədən Kəlbəcər Tarix-Diyarşünaslıq Muzeyini talan etdilər. Bildiyimiz kimi, çağdaş dünyamızda mədəniyyətimizin əyani təbliğat vasitəsi kimi muzeylərin əvəzsiz rolu danılmazdır. Divarları Kəlbəcərin rəngarəng daşları ilə bəzədilmiş möhtəşəm Kəlbəcər Tarix-Diyarşünaslıq Muzeyində 36 mindən artıq eksponatı yağılar qənimət götürdülər. Başdan-başa hər daşı bir tarix olan Kəlbəcərin qaya təsvirlərini, arxeoloji abidələr və etnoqrafik nümunələrini (xalq oyunları – “maraloyunu” “kilimarası” “yeddi hünər” və.s) özündə əks etdirən bu muzey materialları, tariximizin zənginliyinin əyani göstəricilərindəndir. Araşdırma zamanı bir daha o qənaətə gəldik ki, yuxarıda qeyd etdiyimiz – “maraloyunu”, “kilimarası”, “yeddi hünər” etnoqrafik nümunələri Kəlbəcər bölgəsində meydana gəlmiş və formalaşaraq buradakı insanların tarixi ənənələrinə çevrilmişdir. Xalqımızın sosial-iqtisadi, siyasi, etnik tarixi və mədəniyyəti sahəsində



çoxsaylı materiallarla zəngin olan Kəlbəcər muzeyi, həqiqi mənada çox böyük qiymətli tarixi mənbədir. Muzeyin çöl divarlarını 2 mindən artıq rəng çaları olan daşlar bəzəyirdi. Kəlbəcərin daş xəzinələrinin 10 min rəng çalarlı nümunələri isə muzeyin salonlarında nümayiş etdirilirdi. Yəni muzeyin binası özü Azərbaycanın çox qiymətli tarixi abidələrindən biridir. Rayon ərazisinin ağac və bitgi nümunələri, qaya təsvirləri, daşdan qoç və at fiqurları, nəhəng bəzir daşları, qazıntı nəticəsində tapılmış çoxlu əşyalar muzeyin həyatında yerləşdirilmişdir.

Muzeydə rayonun ərazisində aşkar edilmiş qədim yaşayış məskəni və qaya təsvirləri haqqında materiallar, eləcə də qiymətli etnoqrafik materiallar həm ekspozisiya salonlarında, həm də eksponat fondunda xüsusi yer tuturdu. Tədqiqatçılar qayaüstü təsvirlərin tunc dövrünə aid olduğunu bildirlər. 1993-cü ildə erməni barbarları tərəfindən dağıdılmış maddi mədəniyyət nümunələrindən biri də Kəlbəcər rayonunun İstisu qəsəbəsi yaxınlığındakı qədim yaşayış məskənidir. Eramızdan əvvəl III minilliyə aid qədim yaşayış yerinin qalıqlarına aid materiallar Kəlbəcər Tarix-Diyarşünaslıq Muzeyinin qədim dövr salonunda və eksponat fondunda qorunub saxlanılırdı. Tərtərcayın hündür sol sahilində geniş bir sahəni tutan bu yaşayış yerində diametri 20 metrədən artıq olan dairəvi formalı möhtəşəm tikinti qalığı aşkarlanmışdır. Tikintinin divarları iri ölçülü qaya parçaları və çay daşları ilə hörülmüşdür. Arxeoloq Qüdrət İsmayılov yazır ki, tikintinin ətrafında aparılmış kəşfiyyat qazıntısı zamanı da maraqlı elmi dəlillər əldə edilmiş, eramızdan əvvəl III minilliyə aid gil qab parçaları, müxtəlif daşlardan düzəldilmiş əmək alətləri, silah nümunələri(dəvəgözü daşından ox ucluqları) tapılmışdır[1.52]. Tədqiqat zamanı bu tikintinin ətrafında nisbətən kiçik ölçülü başqa tikinti qalıqlarının olması da aydınlaşdırılmışdır. Bu tikililər də dairəvi formada olsalar da, yuxarıdakı təsvir edilmiş möhtəşəm tikilidən fərqli olaraq onların divarları yalnız bir sıra(cərgə) daşlardan düzülmüş, ümumi sahələri isə çox kiçikdir. Onların diametri 4 metrədən artıq deyildir. Qeyd edək ki, dairəvi tikintilər Cənubi Qafqaz və şərq ölkələrində geniş yayılmışdır. Kiçikölçülü belə binalardan bir qayda olaraq yaşayış üçün istifadə edilmişdir. Lakin Kəlbəcərdə aşkar edilmiş tikinti qədər möhtəşəm divarlı tikintiyə dünyanın heç bir yerində təsadüf edilməmişdir. Güman etmək mümkündür ki, bu tikinti qüdrətli bir tayfaya məxsus ictimai bina olmuşdur. Əminəmənlilik zamanı burada tayfanın dini və ictimai mərasimləri keçirilmiş, təhlükə zamanı isə o alınmaz istehkama çevrilmişdir[2.62].

Kəlbəcər ərazisində piktoqrafik abidələrlə bağlı muzeyin ikinci salonunda tanış olmaq mümkündür[3.inv 3]. Qobustan qayaları üzərindəki təsvirlərin bir çoxunu eyni ilə Kəlbəcər qayalarında- Gəlin qayası, Sultan Heydər dağı , Pəriçinqılı, Ayıçinqılı, Qurbağalı çay, Turşsu dərəsi, Sərçəlidağ və Sarımsaqlı dağda görmək olar. Burada at, öküz, qoç, keçi totemlərinə daha çox rast gəlinir[3.inv. 2749] .

Kəlbəcər Muzeyinin həyatında yer alan qiymətli arxeoloji abidələrdən biri də, atın günəşə qurban kəsilməsini təcəssüm etdirən bazalt daşıdır[4.3279]. Daşın üzərinə bir əlində balta, o biri əlində isə atın cilovundan tutub onu günəşə tərəf aparan kişi rəsmi həkk olunub. Yuxarıda günəş şəkili aydın görünür. Üstündən min illər keçsə də, bu qiymətli daş, ulularımızın qədim dini-etiqadını özündə qoruyub saxlayıb. Atın günəşə qurban verilməsi türklərin, o cümlədən Azərbaycan xalqının formalaşmasında iştirak edən massagetlərin inanclarında görürük. Tarixin atası sayılan Herodoton məlumatına görə massagetlər günəşi yeganə Allah hesab etməklə ona at qurban vermişlər. Oxşar adət sarmatlarda da olmuşdur. Sibir və Altay xalqlarında da günəş və od üçün ağ at qurban kəsilirdi[5.478].

Bölgədəki qəbirüstü abidələr də Kəlbəcər Tarix-Diyarşünaslıq Muzeyinin materiallarında geniş yer almışdır. Araçadzor kəndində son tunc dövrünə aid Dovşanlı nekroloqu, Sırxəvənd kəndində son tunc, ilk dəmir dövrünə aid Ballıqaya nekropolu, Zar kəndində XVIII-XIX əsrlərə aid üstü ərəb yazısı ilə yazılmış 9 ədəd daş at fiqurları və 8 ədəd daş qoç fiquru, Zəylik kəndində XVIII-XIX əsrlərə aid 12 ədəd daş at fiquru, 10 ədəd üstü ərəb yazısı daş qoç fiquru, Geştək kəndində XVIII-XIX əsrlərə aid 7 ədəd daş at fiquru, eyni əsrə məxsus 8 ədəd daş qoç fiquru, Milli



kəndində XVIII-XIX əsrlərə aid 17 ədəd daş qoç fiquru Azərbaycanın orta əsr tarixi abidələrindəndir. Qəbirüstü abidələr içərisində daşdan at və qoç fiqurları ayrıca bir sahəni təşkil edir. At təsvirlərinin tarixi yuxarıda qeyd olunduğu kimi qədim dövrlərə gedib çıxır. Erkən tunc dövründə köçmə yaylaq maldarlığının meydana gəlməsi ata tələbatın artması ilə nəticələnmişdir. Kəlbəcər dağlıq bölgəsi olduğuna görə burada atçılıq daha yaxşı inkişaf etmişdir. Atndan həm minik, həm də yükdaşıma vasitəsi kimi istifadə olunmuşdur. Qoç təsvirləri ilə bağlı da eyni fikri söyləmək olar. Amma bu abidələrin daha çox yayılması Baharlı(Qaraqoyunlu) və Bayandurlu(Ağqoyunlu) dövlətlərinin zamanına və ondan sonrakı vaxtlara təsadüf edir.

Muzey materialları Kəlbəcər ərazisində qədim şəhər xarabalıqları ilə bağlı bizlərə xeyli notlar buraxmışdır. Kəlbəcər rayonunun Zar kəndinin yerləşdiyi ərazinin qədim şəhər(Şəhri Zar) xarabalığı olduğu barədə minillərdən bu günədək yaddaşlardan silinməyən tarixi izlər hələ də qalmaqdadır. Muzeyin qədim dövrünə həsr olunmuş ikinci salonda şəhər xarabalıqlarının maketi və ərazidən tapılmış ibtidai formada olan saxsı qab qırıntıları, muncuqlar, eksponatlar yer almışdır. Eləcə də Zar mağarasının şəkili, oradan tapılan dəvəgözündən və çay daşlarından olan alətlər, saxsı qab qırıntıları və digər tapıntılar ən qədim insanın yaşayış tərzini ifadə edir[6.302].

Zar mağarası Kəlbəcərin Zar kəndindən Zəylik kəndinə gedən daş yolun üstündə döngədə yerləşirdi. Kəlbəcər Tarix-Diyarşünaslıq Muzeyinin direktoru Şamil Əsgərov Zar kəndi ərazisindəki müşahidələrindən sonra belə bir nəticəyə gəlmişdir ki, burada qədim və zəngin mədəniyyəti olan bir şəhər mövcud olub. O, yazır ki, burada daşdan yonulmuş çox nəhəng və gözəl ornamentli, daş üzərində yonulmuş qarşı-qarşıya gələn kərgədan və pələng, silahlı atlılar, yazı nişanələri olan qədim binalar, yeraltı yollar, qazıntı nəticəsində əldə edilmiş maddi mədəniyyət əşyaları Zar kəndi ərazisində möhtəşəm bir şəhərin mövcud olmasını sübut edir. Arxeoloji qazıntılar aparıb həmin qədim şəhərin sirlərini açmaq olduqca vacib bir məsələdir[7 s.10].

Qeyd edək ki, M.Hüseynov, Ə.Cəfərov və M.Mənsurovdan ibarət Paleolit arxeoloji ekspediyası 1981 və 1987-ci illərdə Kəlbəcər rayonu ərazisində apardığı kəşfiyyat işləri zamanı Orta Şurtan və Zar açıq paleolit abidələrini qeydə almışdır[8.19]. Amma tədqiqat işləri burada davam etməmişdir. Bunun əsas səbəbi 1988-ci ildən Qarabağ və ətraf bölgələrdə başlayan Azərbaycan-Ermənistan münaqişəsinin yaratdığı ağır durum olmuşdur. Belə ki, burada işləyəcək tədqiqatçıların həyatı üçün heç kim qarant olmurdu. Doğrudan da əlçatmaz qayalarla əhatə olunmuş Kəlbəcər zirvələrini tədqiq etmək asan iş deyildir. Bu yerlərdə müasir insanın ayağı dəyməmiş minlərlə tədqiqata ehtiyacı olan ulularımızın xatirələri yatır. Beş ildən artıq mühasirə şəraitində yaşayan Kəlbəcər, yalnız yerli əhalidən və digər könüllülərdən ibarət fədakar insanların hesabına qorunurdu. Könüllülərin ləğvi və əhalinin əllərindəki ov tüfənglərinin müsadirə edilməsi ilə Kəlbəcər erməni təcavüzkarları tərəfindən işğal edildi. Bununla da sirləri açılmamış minlərlə tarixi abidələrimiz işğalçı Ermənistan dövləti əlində girov qaldı. Nəhayət ki, Kəlbəcər 44 günlük müharibədən sonra 2020-ci il noyabrın 10-da Azərbaycan, Rusiya prezidentləri və Ermənistanın baş nazirinin imzaladıqları bəyanatın nəticəsində azad edildi.

Kəlbəcər ərazisində xristian alban abidələri də az deyil. Məlum olduğu kimi Şimali Azərbaycanın Yuxarı Qarabağ hissəsində IV-cü əsrdə xristianlıq yayılmışdır. Odur ki, xristian məbədləri ilə bağlı muzeydə araşdırmalar aparılmış, səhih materiallar mövcuddur. Xotavəng kimi qeyd olunan Xudavəng məbədi Kəlbəcər rayonunun Vəng kəndində, Tərtər çayının sol sahilində yerləşir. Kəlbəcər şəhəri ilə Xudavəng abidə kompleksi arasında məsafə təxminən 29 kilometrdir. Məbəd qədim Albaniyada xristianlığın yarandığı dövrə təsadüf edir. Abidə böyük bir kompleksdən ibarətdir. Bura bir neçə bazilika, təssərrüfat və yaşayış binaları, tövlələr və qala divarları daxildir. Abidənin tikilməsi tarixi ilə bağlı məlumatlar fərqlidir. Kəlbəcər Tarix-Diyarşünaslıq



Muzeyinin apardığı tədqiqatlar zamanı ərazidən arxeoloji tapıntılar, o cümlədən saxsı qırıntıları bu tarixin aşkarlanmasına işıq saçmış olar. Saxsı qırıntıların daha çox erkən feodal dövrünə xas olmasını nəzərə alsaq, bu məbədin VI- VII əsrə məxsus olduğunu ehtimal etmək olar[9.895].

Tədqiqatçılar hesab edir ki, XII-XIII əsrdə bu məbədə bir neçə abidə əlavə edilib. Eləcə də alban knyazı Həsən Cəlal tərəfindən bərpa işləri aparıldığı bildirilir. Abidənin bir sıra yazılarından məlum olur ki, təkcə XIII əsrdə Xotavəng məbədinə ayrı-ayrı feodallar tərəfindən 50-yə yaxın kənd təsərrüfatı sahəsi, qala və kilsə bağışlanmışdır [10.67-69]. Kompleksə ümumiləndirilmiş doqquz tikili daxildir. Onlardan beşi əsas tikili, digərləri isə köməkçi və xidməti xarakterli tikililərdir. Kompleksə daxil olan abidələrin heç də hamısı dövrümüzə yaxşı vəziyyətdə çatmamış, onlardan daha qədim olanlar nisbətən dağılmışdır. Kompleksin ətrafı digər alban monastırlarında olduğu kimi möhkəm divarlarla əhatələnmişdir. Əsas tikililər Alban bazilikası və Arzu xatun kilsələridir. Həmçinin kompleksə sonradan əlavə edilmiş Müqəddəs Qriqori məbədi və Həsən Cəlal kilsəsi də diqqətə layiq memarlıq nümunələridir.

Binaların inşası zamanı əsasən yerli qara bazalt daşdan, bişmiş kərpicdən və əhəng məhlulundan istifadə edilmiş, binaların damı isə kirəmit və səliqə ilə kəsilmiş daşlarla örtülmüşdür. Arxeoloq Rəşid Göyüşov Xudavəng abidə kompleksinə daxil olan tikililər üzərindəki yazılar və “Alban bazilikası” adlı kilsədən bəhs edərək yazır ki, bu bazilika baş məbədin şimalında inşa edilmişdir. Abidənin üst hissəsi qalmadığından onun tarixini müəyyənləşdirmək çətindir. Bununla belə arxeoloq alim mənbələri diqqətlə təhlil edərək həmin tikinti kompleksin VIII- IX əsrə aid edildiyini söyləyir. Yazılardan məlum olur ki, XII əsrdə mətnin müəllifləri Xotavəngin yerində qədim məbədin və onun sakinlərindən söz açırlar. Doğrudan da Xotavəng kompleksi Azərbaycanda çoxtəbəqlə abidələrdən biri olub, alban xristianlığını öyrənmək üçün ən mühüm obyektlərdən biridir[10. 65,71].

Yeri gəlmişkən qeyd edək ki, Xotavəng abidəsi üzərində ermənilər zaman-zaman saxtalaşdırmalar aparıb. Bu saxtalaşdırmalardan biri XX əsrin 50-ci illərində olub. Belə ki, 1952-ci ildə Kəlbəcər rayonunun Bağlıpəyə kəndinin kənd sovetinin sədri İsmayilov Məhərrəm Qabil oğlu rəsmi məlumatla rayona bildirmişdi ki, bir erməni Xudəvəng(Xudavəng) abidəsi üzərində saxtalaşdırma işi aparır[11.19-20].

Muzeyin etnoqrafiya şöbəsi daha zəngindir. Burada xalqın ənənələri əyani şəkildə qorunub saxlanılır.”Aydın tutulması”, “İynə”, “Yaylıqatma”, “Tale” adlı qədim inanclar, həmçinin “Maraloyunu” və “Kilimarası” adlı xalq oyunları qədim tarixə malik olmaqla yanaşı, təkrarolunmaz və xalqımızın qeyrət və mərdlik nümunəsidir. Şamil Əsgərov etnoqraf Ə.Ələkbərova istinad edərək bildirir ki, “Kilimarası” oyunu ilk dəfə Kəlbəcərdə qeydə alınıb[11.277].

Muzeydə tamaşaçıların diqqətlə izlədiyi qədim xalq oyunlarından biri də “Yeddi hünər” oyunudur. Minilliklərdən xəbər verən “Yeddi Hünər” oyunu yeddi oyundan – “Yeddi Çoban”, “Yeddi Pəri”, “Yeddi Çapar”, “Yeddi Nər”, “Yeddi Qaçar”, “Yeddi Ovçu” və “Yeddi Gəlin” dən ibarətdir.[11.273-276]. “Yeddi Hünər”in tərkibində olan bu oyunların hər birinin adının nədən yeddi rəqəmi ilə başlanması maraqlıdır. Hər kəsə məlumdur ki, yeddi rəqəmi müqəddəs hesab olunur. Dünyanın əksər xalqları bu rəqəmi xoşbəxtlik rəmzi kimi qəbul edir. Qədim türk mənşəli şumerlərin ilahəsinin şərəfinə tikilən məbədin 7 darvazası və yeddi qapısı olub. Misirdə yeddi rəqəmi qədimdən əbədi həyatın göstəricisi hesab olunur. Planet və qitələrin yeddi olması da maraqlı və düşündürücüdür.

## ƏDƏBİYYAT VƏ MƏNBƏLƏR

1. Qüdrət İsmayilov. Abidələr, xatirələr, düşüncələr. Bakı, Gənclik.1981.105 səh.
2. Qüdrət İsmayilzadə. Arxeoloqun çöl gündəliyindən. səh 62. Bakı-2009. 269 səh
3. Şəhid muzeyin həyatında at və qoç fiqurlarının şəkili.inv. 2749.

4. Muzeyinn arxa divarında atın günəşə qurban kəsilməsi, keçi, maral və s. heyvan şəkili. Şəkil 3279.
5. Azərbaycan Etnoqrafiyası. Üç cildə. 3-cü cild. Bakı, “Şərq-Qərb”, 2007. 568 səh.
6. Zar mağarası tapıntıları. Tablo 302 .
7. Şamil Əsgər. Dağların hikməti. Bakı, “ışıq” nəşriyyatı, 1987, 100 səh.
8. Azərbaycan arxeologiyası. Altı cildə. 1-ci cild. Bakı, Şərq-Qərb, 2008. 448 səh
9. Şəhid Muzey. Inventar. 895.
10. Rəşid Göyüşov. Xotavəng məbədi və onun yazılarına dair. Tarix, Fəlsəfə və Hüquq jurnalı. Bakı, 1972. 3-cü nömrəsi.
11. Şamil Dəlidağ. Kəlbəcərin qəm dastanı, viran olan gülüstanı. Bakı. “Çıraq” 1998. 315 səh.
12. İnv 3. Kəlbəcər qaya təsvirlərinin fotosu (Zəkəriyyə Mehralıoğlu çəkib),

### *Kəlbəcər Tarix-Diyarşünaslıq muzeyi*



- 1993-cü il aprel 2-də Ermənistan silahlı qüvvələri Kəlbəcəri işğal edərək dağıtdıqları Kəlbəcər Tarix-Diyarşünaslıq Muzeyi



# Bəzir daşları



- Bəzir daşları dəyirman daşına bənzəyir
- Dəyirman daşından çox-çox böyükdür
- Bu daşların vasitəsilə bəzir yağı əldə edilir

## *Kəlbəcər Tarix-Diyarşünaslıq muzeyi*



- 1993-cü il aprelin 2-də Ermənistan silahlı qüvvələri Kəlbəcəri işğal edərək dağıtdıqları Kəlbəcər Tarix-Diyarşünaslıq Muzeyi

## JAPAN AND THE USA IN THE ERA OF HIGHLY-SKILLED IMMIGRATION: COMPARISON BETWEEN TSUKUBA SCIENCE CITY AND PALO ALTO (SILICON VALLEY)

**Dr. Gökberk DURMAZ & Dr. Güray ALPAR**

<sup>1</sup> *Lecturer, International Relations, Social Sciences University of Ankara (ASBU), Ankara, TURKEY*

*Orcid ID: 0000-0001-5031-6837*

<sup>1</sup> *Assoc. Prof., President of SDE (Institute of Strategic Thinking), Ankara, TURKEY*

*Orcid ID: 0000-0003-0122-7795*

### Abstract

Japan and the US both are still very powerful countries regarding their economy and industries. Nowadays with technological developments in robotics, needs for manual workers are decreasing, in contrast importance of highly-skilled workers are skyrocketing. Almost all countries are trying to attract international highly-skilled workers, to do this they sometimes apply to research parks where international immigrants can engage with local peers easily without interruption of other sort of difficulties of metropolitan cities. This paper aims to comparatively analyze the role of research parks for highly-skilled migrants in Japan and the US. The study based on a field research in Tsukuba Science City with doing interviews with highly-skilled migrants, their host research institutions and also with officials of local governments. The paper mainly focuses on Tsukuba and Japan's migration policies. And it will be compared with one of the most successful example in the World for creating an advanced innovation and research environment: Palo Alto, CA.

**Keywords:** japan, the us, research parks, tsukuba science city, palo alto, silicon valley,

Japan and the U.S. both are inside the most powerful economies in the world. Both countries support private enterprises for research and development by their governments. Japan has a strong economy which based on mass exportation in variety of industries from automotive to domestic appliances. Despite the fact raising of China in the East Asia, Japan and the U.S. are still getting significant attention by the world public opinion in the sense high-technological products. However, there are significant differences, what affect highly-skilled immigrants choices such as: immigration policies, cultural diversities, languages, social lives, political situations of both countries.

Research Park is a generic term to explain community of professionals, which aims to increase the wealth of its community by promoting the culture of innovation, it can also be called as "science city" if the coverage area is as big as a scale of a city (Al-Kfairi et.al., 2018). The first Research Park was settled in California as Stanford Research Park in 1951, which was branded as Silicon Valley later on. This first example followed by Cornell Business and Technology Park in 1952, and the University Research Park in Oklahoma in 1957, the Research Triangle Park, North Carolina in 1959, and the Purdue Research Park in 1960 (Bianchi and Labory 2006, 285).

## Palo Alto (Silicon Valley)



As a leading example, Silicon Valley is considered the technological capital, research and development with glittering financial numbers in today's world (Durmaz, 2020:55). The city achieved its success together with and locals' and immigrants' endeavours, who came from all around the world to build careers in Silicon Valley, the U.S. The city also is the center of "Industry 4.0" that has already altered manufacturing know-hows. Tsukuba Science city modeled of Silicon Valley. Palo Alto is known as the "birthplace of Silicon Valley". The 31 mm dark fiber ring for ultra-fast Internet services has been developed here ("City Of Palo Alto, CA - About Palo Alto", 2018).

Currently, Silicon Valley is considered one of the most richest places on the Earth with about \$128k per capita / per year (Pulkkinen 2019). The numbers are more meaningful when thinking about GDP's of oil-rich Qatar almost same with the Silicon Valley, or Europe is about \$ 107k. The general annual output of Silicon Valley is about \$ 275 bn, which ranks Silicon Valley higher than whole Finland as a country. Furthermore, Chen defines Silicon Valley as an avatar of Free-Market Capitalism (Chen 2019).

The US offers a H-1B type visa for professionals who are in specialty occupations and holds Bachelor degree or above. Furthermore, the Job position should be pre-arranged in the application date. The US government checks eligibilities of the applicant and the employer for this specific visa status. Mainly, IT / Computer professionals, University professors and teachers, Engineers, Healthcare workers, Accountants, Financial analysts, Management consultants, Lawyers, Architects, Nurses, Physicians, Surgeons, Dentists, Scientists, Systems analysts, Journalists and editors, Foreign Law advisors, Psychologists, Technical publications writers, Market research analysts, Teachers in elementary or secondary schools, colleges, etc.

Both countries compete each others to attract more highly-skilled immigrants. Immigrants establish new lives in host countries from thousands miles away from their home countries. While becoming a new residents of a city in a host country, the cities that they live provide them comfortable environment and additional opportunities as different from others. The main argument of this paper is comparing the research parks in Japan and in the US, in order to understand privileges of creating a science city.



## Tsukuba Science City



Tsukuba Science City which is called, in Japanese, *Tsukuba Kenkyū Gakuen Toshi*, is Japan's pioneering research & development environment, established by the Japanese Government for research & development. Palo Alto, on the other hand, is a city of California State, which also known for the birthplace of Silicon Valley. Highly- skilled immigrants: (in Japan) According to Japanese Immigration Legislation there is a specific visa category for “Highly-Skilled Professional” who are expected to be in Business Management, Academic Researches, Advanced Specialized Technical Activities. Japanese Government has specific pointing system for those Highly-Skilled Visa applicants such as: Master or PhD degrees, Japanese Language Knowledge, Patents, Research papers, and Research Grants especially given by National Institutes are separately scored ("Ministry of Justice" 2018a).

Tsukuba (also known as Tsukuba Science City) is one of the unique cities which are specially planned for scientific and industrial research park in Japan. About half of Japan' national research and development budget is spent in Tsukuba Science City. There are different types of research institutions from aerospace sciences to robotics, from material sciences to software. The University of Tsukuba, on the other hand, not only the flagship university of the city, but also one of the world wide known highly ranked research universities in Japan. The University has three Nobel Laureates Professors in its relatively young history, which itself is enough to attract notice of academic environments.

“The Tsukuba City Basic Guide For Globalization”, issued by Tsukuba City Hall in 2016, aims that 1- creating a multicultural society with, 2- Link to World by International Collaborative Relationships, 3- Invite People and Investments by Appealing Its Globalized Advantages. (go to the appendix)

To sum up, Tsukuba Science City is a very important place in Japan in case of gathering different public/ private research institutions and the University of Tsukuba and other Universities. Moreover, local government also tries to support International Residents for their barriers in their lives in Tsukuba as well as the Central Government.

• **Comparison Table:**

	Established with main encouragement of	Focuses	Closest Major City	Main Characteristic of Research Institutes	Flagship University	Education Level
<b>Tsukuba (Japan)</b>	Japanese Government + University of Tsukuba (National)	Robotics, Hard Sciences, Software	Tokyo	National Research Institutes + Private Companies R&D Departments	University of Tsukuba (National)	One of the highest percentage of education level with more than 9,000 PhD holders
<b>Palo Alto (USA)</b>	Private Sector + Stanford University (Private)	High Computer Technology, Software,	San Francisco, California	Private R&D Companies, High-Tech Companies, Software Companies	Stanford University (Private)	The most educated city in California <sup>4</sup> (%79.7 residents held Bachelor degree

**Tsukuba Science City vs Palo Alto (Silicon Valley)**

If both cities are compared, Tsukuba Science City was established by main investments of Japanese central government, while Palo Alto mainly created by investments of private sector. Moreover, the University of Tsukuba, the flagship university of the city, is a national (state) university, whereas, Stanford University, the pioneer university of Silicon Valley, is a private university.

In Tsukuba, although there are variety of research fields, the main focus is robotics, hard sciences, and software. On the other hand, in Silicon Valley advanced computer technologies, and software research are the main focus.

Both cities are considered “research parks” that also means they are small-scale cities with more homogeneity among their residents in the sense of educational level. However, those educated

people would need metropolitan cities where they can engaged with cultural activities and other greater advantages of metropolitan cities. Therefore, Silicon Valley was fed by San Francisco; similarly, Tsukuba Science City was located very close to Tokyo Metropolitan.

Tsukuba Science City hosts more than 300 national research institutes and nation-wide served private companies' research and development departments, whereas, Silicon Valley is mainly run by private computer technologies (software and hardware) companies such as: Twitter, Facebook, etc.

Regarding the approximate educational level of two cities, Palo Alto has been chosen the most educated city in California with almost %80 percent of its residents holds bachelor degrees (Lin, 2012). On the other hand, more than 9.000 people out of the Tsukuba Science City residents obtained PhD degrees (Bianchi and Labory. 2006).

In conclusion, although both countries main structures and features differs significantly, but they seem to understand importance of research parks; in order to, attract and facilitate highly-skilled immigrants. And main characteristics of Japan and the US, regarding public and private investments, have also been reflected on their research parks.

## BIBLIOGRAPHY

Al-Kfairy, Mousa, Khaddaj, Souheil and Mellor, Robert 2018. "A longitudinal study of corporate benefits accrued by firms inhabiting a mature science park." *In*: Scarso, E. , Bolisani, E. and Di Maria, E., (eds.) *Proceedings of the European Conference on Knowledge Management (ECKM)*. Kidmore End, U.K. : Academic Conferences International Limited. pp. 43–51. ISSN (online) 2048–8963 ISBN 9781911218944

Bianchi, Patrizio, and Sandrine Labory. 2006. *International Handbook on Industrial Policy*. Cheltenham: Edward Elgar Publishing.

Chen, Adrian. 2019. "How Silicon Valley Broke the Economy." *The Nation*. (accessed June 26, 2021). <https://www.thenation.com/article/silicon-valley-history-book-review/>

City of Palo Alto, CA - About Palo Alto. 2018. *Cityofpaloalto.Org*. (accessed June 26, 2021) [https://www.cityofpaloalto.org/visiting/about\\_palo\\_alto.asp](https://www.cityofpaloalto.org/visiting/about_palo_alto.asp).

Durmaz, Gökberk 2020, *Highly-Skilled Immigrants, Science Cities, and Japan*, Nobel Academic Publishing, Ankara

Lin, Joanna. 2012. Huffpost.Com. "California's Most Educated Cities" (accessed June 26, 2021). [https://www.huffpost.com/entry/californias-most-educated-cities\\_n\\_1100129](https://www.huffpost.com/entry/californias-most-educated-cities_n_1100129).

Ministry of Justice. 2018a | Points-Based Preferential Immigration Treatment for Highly-Skilled Foreign Professionals.. *Immi-Moj.Go.Jp*. (accessed June 27, 2021). [http://www.immi-moj.go.jp/newimmiact\\_3/en/system/index.html](http://www.immi-moj.go.jp/newimmiact_3/en/system/index.html).

Pulkkinen, Levi. 2019. "If Silicon Valley Were A Country, It Would Be Among the Richest on Earth." *The Guardian*. (accessed June 26, 2021). <https://www.theguardian.com/technology/2019/apr/30/silicon-valley-wealth-second-richest-country-world-earth>.

**TIBBİ SEKRETER ADAYLARININ MUTLULUK VE YALNIZLIK DÜZEYLERİ  
ÜZERİNDE İNTERNET BAĞIMLILIĞININ ETKİSİ****THE EFFECT OF INTERNET ADDICTION ON THE HAPPINESS AND LONELINESS  
LEVELS OF MEDICAL SECRETARY CANDIDATES****Öğr. Gör. Dr. Haydar HOŞGÖR<sup>1\*</sup>***<sup>1</sup>Uşak Üniversitesi, Sağlık Hizmetleri Meslek Yüksekokulu, Tıbbi Hizmetler ve Teknikler  
Bölümü, Uşak, Türkiye.***ORCID: 0000-0002-1174-1184****Özet**

Günlük yaşamın ayrılmaz bir parçası haline gelen internetin kullanımı, dünya çapında her geçen gün artış göstermektedir. Medya ve teknolojiye ileriyeleyle birlikte internet, insanın coğrafi engellerini ortadan kaldırmada etkili bir araç olarak ortaya çıkmıştır. Diğer yandan bu durum, özellikle gençlerde aşırı bilgisayar kullanımıyla ilişkili olan potansiyel bir sorunun ortaya çıkmasına yol açmıştır. Dolayısıyla bu çalışmada, tıbbi sekreter adaylarının mutluluk ve yalnızlık düzeyleri üzerinde internet bağımlılığının etkisini incelenmiştir. Araştırmanın çalışma grubunu, 2020-2021 Eğitim-Öğretim Dönemi Bahar Yarıyılı'nda Uşak Üniversitesi'nde Sağlık Hizmetleri Meslek Yüksekokulu Tıbbi Dokümantasyon ve Sekreterlik Programı'nda eğitim gören 188 tıbbi sekreter adayı oluşturmaktadır. Tamsayım örneklem yönteminin kullanıldığı çalışmada, araştırma evreninin %75'ine erişilmiştir. Veriler, araştırmacı tarafından oluşturulan bir e-anket vasıtasıyla çevrimiçi olarak toplanmıştır. E-anketin hazırlanmasında Google formlar altyapısından yararlanılmıştır. Araştırma verilerinin toplanmasında Young İnternet Bağımlılığı Testi Kısa Formu, Oxford Mutluluk Ölçeği Kısa Formu ve UCLA Yalnızlık Ölçeği Kısa Formu kullanılmıştır. Verilerin analizinde IBM SPSS V.22 ve IBM AMOS V.23 paket programları kullanılmıştır. Araştırma sonuçları tıbbi sekreter adaylarının internet bağımlılığı ( $2,50 \pm 0,73$ ) ve yalnızlık ( $1,88 \pm 0,66$ ) düzeylerinin düşük, mutluluk ( $3,30 \pm 0,63$ ) düzeylerinin ise orta seviyede olduğunu göstermiştir. Ayrıca internet bağımlılığının mutluluk üzerinde %9,3'lük, yalnızlık üzerindeyse %19,4'lük bir etkisi olduğu sonucuna varılmıştır.

**Anahtar Kelimeler:** tıbbi sekreter, internet bağımlılığı, mutluluk, yalnızlık, tıp sekreteri adayı

**Abstract**

The use of the internet, which has become an integral part of daily life, is increasing day by day around the world. With the progress in media and technology, the internet has emerged as an effective tool to remove the geographical barriers of people. On the other hand, this has led to the emergence of a potential problem associated with excessive computer use, especially among young people. Therefore, in this study, the effect of internet addiction on the happiness and loneliness levels of medical secretary candidates was examined. The study group of the research consists of 188 medical secretary candidates studying in the Medical Documentation and Secretarial Program of the Vocational School of Health Services at Uşak University in the 2020-2021 Academic Term Spring Semester. In the study, in which the census sampling method was used, 75% of the research population was reached. Data were collected online via an e-survey created by the researcher. Google forms infrastructure was used in the preparation of the e-survey. Young Internet Addiction Test Short Form, Oxford Happiness Scale Short Form and UCLA Loneliness Scale Short Form were used to collect research data. IBM SPSS V.22 and IBM AMOS V.23 package programs were used in the analysis of the data. The results of the research showed that the internet addiction ( $2.50 \pm 0.73$ ) and loneliness ( $1.88 \pm 0.66$ )

levels of the medical secretary candidates were low, and the happiness ( $3.30 \pm 0.63$ ) levels were moderate. In addition, it was concluded that internet addiction had effect on happiness and loneliness at 9.3% and at 19.4%, respectively.

**Keywords:** medical secretary, internet addiction, happiness, loneliness, medical secretary candidate

## GİRİŞ

Dünyanın en geniş istihdam ağına sahip işverenlerinden biri konumunda olan sağlık hizmetleri sektörünün en büyük girdisini sağlık çalışanları teşkil etmektedir (Narine, 2000). Beşeri sağlık sermayesini oluşturan sağlık insan gücü, sağlık bakım organizasyonlarının en önemli ve temel yapı taşıdır (Mosadeghrad ve Ferdosi, 2013). Bu organizasyonlarda birbirinden farklı unvan ve görevde faaliyet gösteren çok sayıda personel bulunmaktadır. Sağlık Bakanlığı tarafından 22 Mayıs 2014 tarihinde yayımlanan 29007 Sayılı Resmi Gazete'ye göre Türkiye'de 47 adet sağlık unvanı mevcuttur. Bunlardan 37'si sağlık meslek mensuplarından, 10 tanesi ise sağlık hizmetlerinde çalışan diğer meslek mensuplarından oluşmaktadır (Resmi Gazete, 2014). Bu bağlamda tıbbi sekreterler, ilgili yönetmeliğin Ek-2 kısmında yer verilen diğer sağlık mensupları başlığı altında yer almaktadırlar. Hasta ve hasta yakınlarının ilk iletişime geçtikleri kişiler olması dolayısıyla, bu meslek grupları içerisinde tıbbi sekreterlerin önemli bir yeri vardır (İ. Işıklı ve Suysal, 2019). Hastaların hastaneye başvurusundan taburculuk sürecine kadar pek çok farklı görevi yerine getiren tıbbi sekreterler (Kaplan ve Köksal, 2018), meslek yüksekokulları bünyesinde iki yıllık bir formal eğitim görmektedirler. Geleceğin tıbbi sekreterleri üzerinde gerçekleştirilen bu çalışmada, öğrencilerin internet bağımlılığı, mutluluk ve yalnızlık düzeyleri birlikte ele alınmakta ve irdelenmektedir.

Günlük yaşamın ayrılmaz bir parçası haline gelen internetin kullanımı, dünya çapında her geçen gün artış göstermektedir. Medya ve teknolojiye ilerlemeyle birlikte internet, insanın coğrafi engellerini ortadan kaldırmada etkili bir araç olarak ortaya çıkmıştır. Diğer yandan bu durum, özellikle gençlerde aşırı bilgisayar kullanımıyla ilişkili olan potansiyel bir sorunun ortaya çıkmasına yol açmıştır (Kumar ve Mondal, 2018). Bu sorun internet bağımlılığıdır. Klasik psikoloji ve psikiyatri açısından internet bağımlılığı yeni bir olgu olmasına rağmen literatürde bu kavramın sorunlu internet kullanımı, patolojik internet kullanımı ve zorunlu internet kullanımı gibi terimlerle de kullanıldığı bilinmektedir. Bağımlılık davranışları alanında en tanınmış otoritelerden biri olan Mark Griffiths'e göre internet bağımlılığı, makine-insan etkileşimini içeren kimyasal olmayan bir davranışsal bağımlılık türüdür (Zenebe vd., 2021). Genel olarak pedagoji, sosyoloji ve psikoloji uzmanlarının ilgi alanına giren internet bağımlılığından çocuklar ve gençler daha fazla etkilenmektedirler. Ayrıca yetişkinler de internet bağımlılığından muzdarip olsalar da, özellikle üniversite öğrencileri üzerinde bu olumsuz etkilerin daha şiddetli ve sık görüldüğü bilgisi literatürde geniş yer tutmaktadır (Wyległy, 2021). Amerikalı üniversite öğrencileri üzerinde yapılan bir araştırmada (Jelenchick vd., 2012), öğrencilerin %12'sinin internet bağımlısı olduğu, İran'daki tıp fakültesi öğrencilerinin katılımıyla yapılan bir çalışmada (Ghamari vd., 2012) bu oranının yaklaşık %11, Sırbistan'da 14-18 yaş aralığındaki ergenlerde yapılan bir çalışmada ise (Ac-Nikolić, 2015) yaklaşık %19 olduğu rapor edilmiştir. Balcı ve Günar (2009) tarafından Türkiye'deki üniversite öğrencileri üzerinde yapılan bir çalışmada, öğrencilerin %23,2'sinin internet bağımlısı olduğu saptanmışken; Doğan vd. (2021)'nin çalışmasında ise bu oranın yaklaşık %50 olduğu ortaya konulmuştur. Karasu vd. (2017) tarafından gerçekleştirilen başka bir araştırma sonucundaysa, öğrencilerin yaklaşık %6'sının patolojik internet kullanıcısı olduğu belirlenmiştir.

İnternetin faydalarının daha sık farkına varıldığı günümüz dünyasında, dikkat çeken bir diğer durum ise aşırı internet kullanımının neden olduğu çeşitli sorunlardır. Wang vd. (2016) internet bağımlılığı ile fiziksel ve ruhsal sağlık sorunları, düşük benlik saygısı, kötüleşen aile ilişkileri,



dürtüsellik, sinirlilik hali, sosyal izolasyon, her şeye karşı olma tutumu ve düşük akademik performans arasında ilişkilerin olduğuna dikkat çekmektedir. Sharma ve Sharma (2018) ise aşırı internet kullanımının, bireylerin aile ve arkadaşlarıyla geçirecekleri yüzyüze etkileşime engel olacağına ve bunun da bireylerin yalnızlık ve depresyon düzeylerini artıracağına, psikolojik iyilik hallerini ise azaltacağına atıfta bulunmaktadır. Ayrıca Ansari vd. (2016) ise düşük mutluluk düzeyine sahip bireylerin, daha uzun süre internet kullandıklarına değinmekte ve internet bağımlılığına daha fazla meyilli olduklarına dikkat çekmektedir. Dolayısıyla bu çalışmada, tıbbi sekreter adaylarının mutluluk ve yalnızlık düzeyleri üzerinde internet bağımlılığının etkisi incelenmiştir. Ulusal literatürde ilgili değişkenleri tıbbi sekreter adayları üzerinden ele alan herhangi bir çalışmaya rastlanılmamış olması dolayısıyla bu çalışmada örneklem olarak tıbbi sekreterlik programı öğrencileri seçilmiştir.

## YÖNTEM

### Araştırmanın Amacı, Kapsamı ve Sınırlılıkları

Bu çalışmanın amacı, tıbbi sekreter adaylarının mutluluk ve yalnızlık düzeyleri üzerinde internet bağımlılığının etkisini incelemektir. Çalışmanın kapsamını bir devlet üniversitesinin Tıbbi Dokümantasyon ve Sekreterlik Programı'nda okumakta olan önlisans öğrencileri oluşturmaktadır. Çalışmanın yalnızca bir üniversite örneklemine, tek bir program dâhilinde ve belirli bir zaman aralığında gerçekleştirilmiş olması çalışmanın en temel sınırlılığını teşkil etmektedir.

### Araştırmanın Çalışma Grubu

Araştırmanın çalışma grubunu, 2020-2021 Eğitim-Öğretim Dönemi Bahar Yarıyılı'nda Uşak Üniversitesi'nde Sağlık Hizmetleri Meslek Yüksekokulu Tıbbi Dokümantasyon ve Sekreterlik Programı'nda eğitim gören 188 tıbbi sekreter adayı oluşturmaktadır. Tamsayım örnekleme yönteminin kullanıldığı çalışmada, araştırma evreninin %75'ine erişilmiştir.

### Veri Toplama Yöntemi ve Araçları

Veriler, araştırmacı tarafından oluşturulan bir e-anket vasıtasıyla çevrimiçi olarak toplanmıştır. E-anketin hazırlanmasında Google formlar altyapısından yararlanılmıştır. Araştırma verilerinin toplanmasında şu ölçekler kullanılmıştır.

### Young İnternet Bağımlılığı Testi Kısa Formu:

Young (1998) tarafından geliştirilen ve Pawlikowski vd. (2013) tarafından kısa forma dönüştürülen bu ölçek, Kutlu vd. (2016) tarafından Türkçe diline uyarlanarak geçerlik ve güvenirliği sağlanmıştır. 12 ifade ve tek boyuttan oluşan ölçek beşli Likert (1: Hiçbir zaman, 5: Her zaman) türündedir. Ölçeğin belirli bir kesim noktası ve tersten puanlanan herhangi bir maddesi yoktur. Ölçek puan ortalamasının yükselmesi, bireylerin internet bağımlılık düzeylerinin arttığı şeklinde yorumlanmaktadır. Orijinal ölçeğin Cronbach  $\alpha$  iç güvenirlik katsayısı 0,85, Türkçe'ye uyarlanan ölçeğinse 0,91 (üniversite öğrencilerinde) ve 0,86 (ergenlerde)'dir. Bu çalışmanın Cronbach  $\alpha$ 'sı ise 0,88 olarak bulunmuştur.

### Oxford Mutluluk Ölçeği Kısa Formu

Hills ve Argyle (2002) tarafından geliştirilen ölçeğin Türkçe diline geçerlik ve güvenirliği Doğan ve Akıncı Çötök (2011) tarafından yapılmıştır. Orijinali 8 ifade, tek boyut ve altılı Likert'ten oluşan ölçeğin Türkçe'ye uyarlanmış versiyonu ise 7 ifade, tek boyut ve beşli Likert (1: Hiç katılmıyorum, 5: Tamamen katılıyorum)'ten meydana gelmektedir. Orijinal ölçekten farklı olarak Türkçe'ye uyarlanan versiyonda beşli Likert tipi ölçek kullanılarak, muhtemel anlam kargaşalarının önüne geçilmesinin amaçlandığı ifade edilmiştir. Belirli bir kesim noktası olmayan ölçeğin 1. ve 7. maddeleri tersten puanlanmaktadır. Ölçek puan ortalamasının yükselmesi, bireylerin mutluluk düzeylerinin arttığı şeklinde yorumlanmaktadır. Ölçeğin Cronbach  $\alpha$  iç güvenirlik katsayısı 0,74 ve test-tekrar test güvenirlik katsayısı ise 0,85 olarak bulunmuştur. Bu çalışmanın Cronbach  $\alpha$ 'sı ise 0,74 olarak bulunmuştur.

### UCLA Yalnızlık Ölçeği Kısa Formu

Hays ve DiMatteo (1987) tarafından geliştirilen ölçeğin Türkçe diline geçerlik ve güvenirliği Yıldız ve Duy (2014) tarafından yapılmıştır. 7 ifade ve tek boyuttan oluşan ölçek dörtlü Likert

(1: Hiç, 4: Her zaman) türündedir. Belirli bir kesim noktası olmayan ölçeğin 5. maddesi tersten puanlanmaktadır. Ölçek puan ortalamasının yükselmesi, bireylerin yalnızlık düzeylerinin arttığı şeklinde yorumlanmaktadır. Ölçeğin Cronbach  $\alpha$  iç güvenirlik katsayısı 0,74 olarak bulunmuştur. Bu çalışmanın Cronbach  $\alpha$ 'sı ise 0,81 olarak bulunmuştur.

### Verilerin Analizi

Çalışma kapsamında ne tür istatistiklerin kullanılacağına karar vermek için öncelikle verilerin normal dağılıma uygun olup olmadığı incelenmiştir. Bunun için verilerin basıklık ve çarpıklık değerleri göz önünde bulundurulmuştur. Basıklık ve çarpıklık değerlerinin -1 ve +1 aralığında saptanmış olması verilerin normal dağılıma uygunluğunu işaret etmektedir (Seçer, 2015). Dolayısıyla çalışma kapsamında frekans, yüzde, ortalama, standart sapma, minimum ve maksimum gibi betimsel istatistiklerin yanı sıra Pearson Korelasyon analizi kullanılmıştır. Ayrıca gözlem değişkenleri arasındaki ilişkilerin analizinde Yapısal Eşitlik Modeli'nden faydalanılmıştır. Verilerin analizinde IBM SPSS V.22 ve IBM AMOS V.23 paket programları kullanılmıştır. Ayrıca %95 güven aralığında değerlendirilecek olan verilerin anlamlılığı için p değeri 0,05 kabul edilmiştir. Çalışma verileri, ilgili program başkanlığının izniyle toplanmış olup, öğrencilerden bilgilendirilmiş onam formu da alınmıştır. Böylelikle öğrenciler; bu işin gönüllülük kapsamında yapıldığı, bir katılım zorunluluğu içermediği, diledikleri zaman anket uygulamasından çıkabilecekleri hususunda bilgilendirilmiştir. Ayrıca bu form vasıtasıyla çalışmanın adı, amacı, önemi, kim tarafından uygulandığı, yaklaşık ne kadarlık bir zaman alacağı, elde edilen verilerin yalnızca bilimsel amaçlar doğrultusunda kullanılacağı tüm katılımcılara açıklanmıştır.

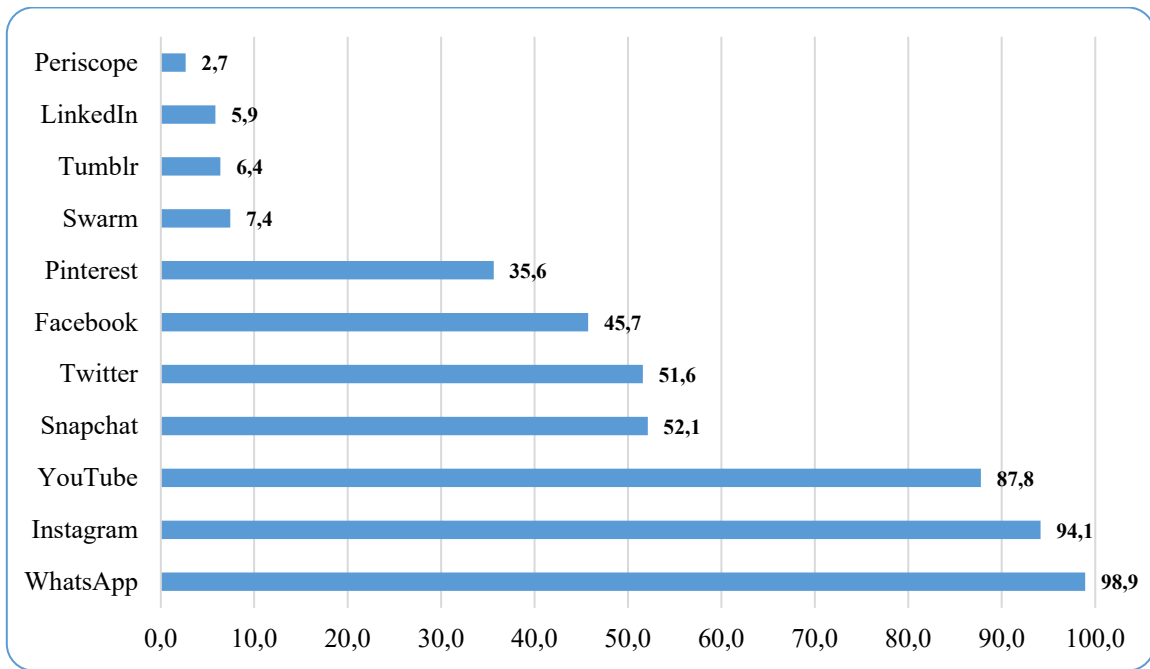
**Tablo 1.** Katılımcıların Tanımlayıcı Özellikleri

Cinsiyet	n (Sayı)	% (Yüzde)
Kadın	151	80,3
Erkek	37	19,7
<b>Yaş (<math>\bar{x}</math>: 20,3 <math>\pm</math> 1,35)</b>		
17-19	43	22,9
20-21	123	65,4
22 ve üzeri	22	11,7
<b>Sınıf</b>		
1. Sınıf	95	50,5
2. Sınıf	93	49,5
<b>Kardeş</b>		
Var	173	92,0
Yok	15	8,0
<b>Aile Gelir Algısı</b>		
Kötü	11	5,9
Orta	157	83,5
İyi	20	10,6
<b>Evde İnternet</b>		
Var	168	89,4
Yok	20	10,6
<b>Çevrimiçi Oyun Oynama Durumu</b>		
Evet	83	44,1
Hayır	105	55,9
<b>İnternette Kalma Süresi (<math>\bar{x}</math>: 3,84 <math>\pm</math> 2,63)</b>		
1 saatten az	46	24,5
1-3 saat	47	25,0

4-6 saat	63	33,5
7 saat ve üzeri	32	17,0
<b>TOPLAM</b>	<b>188</b>	<b>100,0</b>

$\bar{x}$ : Ortalama  $\pm$ : Standart Sapma

Katılımcıların tanımlayıcı özelliklerini özetleyen Tablo 1 incelendiğinde; tıbbi sekreter adaylarının büyük bir bölümünün (%80,3) kadın öğrencilerden, yarıdan fazlasının (%65,4) 20-21 yaş aralığındaki ( $20,3 \pm 1,35$ ) gençlerden oluştuğu ve %92'sinin kardeşe sahip olduğu görülmektedir. Her ne kadar birinci ve ikinci sınıf öğrenci sayıları birbirine yakın olsa da, birinci sınıf öğrencilerinin oranı (%50,5) daha fazladır. Katılımcıların büyük bir çoğunluğu (%83,5) orta düzey bir aile geliri algısına sahiptir. Tıbbi sekretelik öğrencilerinin %89,4'ünün evde internet bağlantılarının olduğu, yarıdan daha azının (%44,1) çevrimiçi oyun oynadığı, %33,5'inin ise günlerinin 4-6 saatlik bölümlerini ( $3,84 \pm 2,63$ ) internette geçirdikleri görülmektedir.



**Şekil 1.** Katılımcıların Kullandıkları Sosyal Ağların Dağılımları

Katılımcıların kullandıkları sosyal ağların dağılımlarını içeren Şekil 1 incelendiğinde; en fazla kullanım alanı bulan ilk üç platformun sırayla WhatsApp (%98,9), Instagram (%94,1) ve YouTube (%87,8) olduğu, bunları ise Snapchat (%52,1), Twitter (%51,6), Facebook (%45,7) ve Pinterest (%35,6) platformlarının takip ettiği görülmektedir. Swarm (%7,4), Tumblr (%6,4), LinkedIn (%5,9) ve Periscope (%2,7) platformlarının ise geleceğin tıbbi sekreterleri tarafından en az kullanılan uygulamalar olduğu belirlenmiştir.

**Tablo 2.** Ölçeklere İlişkin Betimleyici İstatistiki Göstergeler

İstatistiki Göstergeler	Ölçekler		
	İnternet Bağımlılığı	Mutluluk	Yalnızlık
İfade Sayısı	12	7	7
$\bar{x}$ [Düzye]	2,50 [Düşük]	3,30 [Orta]	1,88 [Düşük]
$\pm$	0,73	0,63	0,66
Minimum	1	2	1
Maksimum	5	5	4

<b>Basıklık</b>	0,546	-0,098	-1,001
<b>Çarpıklık</b>	0,528	0,411	0,278
<b>Cronbach Alfa (C<math>\alpha</math>)</b>	0,880	0,744	0,813

1,00-1,80: Çok Düşük; 1,81-2,60: Düşük; 2,61-3,40: Orta; 3,41-4,20: Yüksek; 4,21-5,00: Çok Yüksek

Ölçeklere ilişkin betimleyici istatistiki göstergelerin yer aldığı Tablo 2 incelendiğinde; tıbbi sekreter adaylarının düşük düzeyde internet bağımlılığı ( $2,50 \pm 0,73$ ) ve yalnızlık ( $1,88 \pm 0,66$ ), orta düzeyde mutluluk ( $3,30 \pm 0,63$ ) algısına sahip oldukları görülmektedir. Basıklık ve çarpıklık değerlerinin -1 ve +1 aralığında yer aldığı belirlenmiştir. Ayrıca 0,744-0,878 aralığında yer alan C $\alpha$  katsayıları, ölçeklerin yüksek bir iç güvenirlik düzeyine sahip olduğunu göstermektedir (Kalaycı, 2016).

**Tablo 3.** Değişkenler Arası İlişkiler

Ölçekler		(1)	(2)	(3)
<b>İnternet Bağımlılığı (1)</b>	Pearson Korelasyon	1		
	P değeri			
	N	188		
<b>Mutluluk (2)</b>	Pearson Korelasyon	-0,305**	1	
	P değeri	0,000		
	N	188	188	
<b>Yalnızlık (3)</b>	Pearson Korelasyon	0,441**	-0,440**	1
	P değeri	0,000	0,000	
	N	188	188	188

\*\*. Korelasyon 0,01 düzeyinde anlamlıdır.

Değişkenler arası ilişkilerin yer aldığı Tablo 3'deki korelasyon analizi bulguları incelendiğinde; internet bağımlılığı ile mutluluk arasında negatif yönde ( $r: -0,305$ ), yalnızlık arasında ise pozitif yönde ( $r: 0,441$ ) anlamlı bir ilişki olduğu görülmektedir. Buna ek olarak mutluluk ve yalnızlık değişkenleri arasındaysa negatif yönde ( $r: -0,440$ ) ve anlamlı bir ilişki tespit edilmiştir.

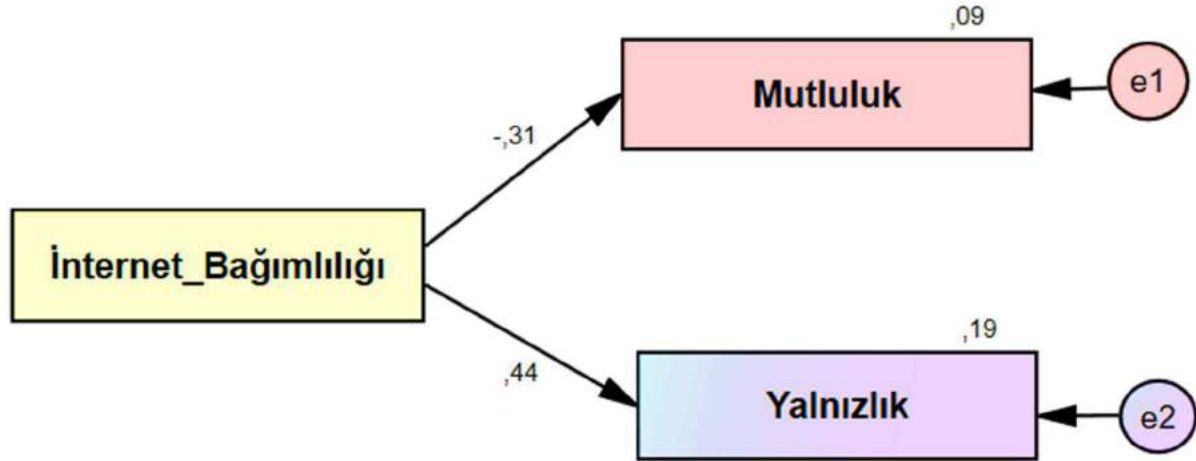
Şekil 2'de yer alan modelde “Mutluluk” ve “Yalnızlık” değişkenlerinin Endojen, “İnternet Bağımlılığı” değişkeninin ise Egzojen nitelikte olduğu görülmektedir. Modelde yer alan her bir yolun anlamlı olduğu belirlenmiştir. Yapısal eşitlik modelinin uyumuna ilişkin değerlerin yer aldığı Tablo 4 incelendiğinde; modelin genel olarak iyi düzeyde uyum iyiliği değerlerine sahip olduğu görülmektedir ( $X^2/SD$ : 3,67;  $CFI$ : 0,98;  $NFI$ : 0,99;  $GFI$ : 0,99;  $TLI$ : 0,97;  $RMSEA$ : 0,02;  $SRMR$ : 0,02).

**Tablo 4.** Yapısal Eşitlik Modelinin Uyumuna Dair Değerler

Ölçüm	İyi Uyum Değerleri*	Kabul Edilebilir Uyum Değerleri*	Modelin Uyum İndeksi Değerleri
$X^2/SD$	$\leq 3$	$\leq 4-5$	3,67
CFI	$\geq 0,97$	$\geq 0,95$	0,98
NFI	$\geq 0,95$	$\geq 0,90$	0,99
GFI	$\geq 0,90$	$\geq 0,85$	0,99
TLI	$\geq 0,95$	$\geq 0,90$	0,97
RMSEA	$\leq 0,05$	0,06-0,08	0,02
SRMR	$\leq 0,05$	0,06-0,08	0,02

\* Browne ve Cudeck (1993), Byrne (2010), Kline (2011)

Çalışma kapsamında test edilen model Şekil 2’de yer almaktadır. Modelde yer alan tüm yollar 0,01 düzeyinde anlamlıdır.



Şekil 2. Modele İlişkin Yol Analizi

Tablo 5. Değişkenler Arasındaki Yordayıcı İlişkilere Dair Model

Yordayıcı Değişken	Değişkenler Arası İlişkiler	Bağımlı Değişken	Standardize Regresyon Ağırlığı	Standart Hata	t	p	R <sup>2</sup>
İnternet Bağımlılığı	→	Mutluluk	-0,305	0,060	-4,383	0,000*	0,093 (%9,3)
İnternet Bağımlılığı	→	Yalnızlık	0,441	0,059	6,715	0,000*	0,194 (%19,4)

\* p<0,01

Şekil 2’de yer alan model incelendiğinde; mutluluk değişkeninin internet bağımlılığı değişkeni tarafından etkilendiği görülmektedir. Geleceğin tıbbi sekreter adaylarının internet bağımlılığı ve mutluluk düzeyleri arasındaki yordayıcı ilişkiler incelendiğinde, negatif yönlü ( $\beta$ : -0,31; t: -4,383; p: 0,000) doğrusal bir ilişki olduğu tespit edilmiştir. Bir diğer ifadeyle elde edilen bulgular, tıbbi sekreter adaylarının internet bağımlılığı düzeyleri arttıkça, mutluluk düzeylerinin azalacağını ortaya koymaktadır. R<sup>2</sup> değeri incelendiğinde, tıbbi sekreterlik öğrencilerinin mutluluk düzeyleri üzerinde internet bağımlılığının %9,3’lük bir yordayıcılığa sahip olduğu görülmektedir.

Modelde yalnızlık değişkeninin internet bağımlılığı değişkeni tarafından etkilendiği görülmektedir. Geleceğin tıbbi sekreter adaylarının internet bağımlılığı ve yalnızlık düzeyleri arasındaki yordayıcı ilişkiler incelendiğinde, pozitif yönlü ( $\beta$ : 0,44; t: 6,715; p: 0,000) doğrusal bir ilişki olduğu tespit edilmiştir. Bir diğer ifadeyle elde edilen bulgular, tıbbi sekreter adaylarının internet bağımlılığı düzeyleri arttıkça, yalnızlık düzeylerinin de artacağını ortaya koymaktadır. R<sup>2</sup> değeri incelendiğinde, tıbbi sekreterlik öğrencilerinin yalnızlık düzeyleri üzerinde internet bağımlılığının %19,4’lük bir açıklayıcılığa sahip olduğu görülmektedir.

#### TARTIŞMA-SONUÇ VE ÖNERİLER

Günlük yaşamın ayrılmaz bir parçası haline gelen internetin kullanımı, dünya çapında her geçen gün artış göstermektedir. Medya ve teknolojiye ilerlemeye birlikte internet, insanın coğrafi engellerini ortadan kaldırmada etkili bir araç olarak ortaya çıkmıştır. Diğer yandan bu



durum, özellikle gençlerde aşırı bilgisayar kullanımıyla ilişkili olan potansiyel bir sorunun ortaya çıkmasına yol açmıştır. Dolayısıyla bu çalışmada, tıbbi sekreter adaylarının mutluluk ve yalnızlık düzeyleri üzerinde internet bağımlılığının etkisini incelenmiştir. Araştırma sonuçları tıbbi sekreter adaylarının internet bağımlılığı düzeyinin düşük olduğunu göstermiştir. Literatür incelendiğinde Yılmazsoy ve Kahraman (2017)'in çalışmasında öğrencilerin %82'sinin internet bağımlılığı semptomu göstermeyen grupta yer aldığı, benzer şekilde Akdağ vd. (2014) tarafından gerçekleştirilmiş olan bir başka çalışmada yaklaşık %84'ünün genel internet bağımlılığı düzeyinin düşük olduğu rapor edilmiştir. Bu bağlamda, ilgili çalışma sonuçları ile bu çalışmada elde edilen sonuçların örtüştüğünü belirtmek mümkündür. Bir diğer yandan mevcut alan yazında, bu çalışmada elde edilen sonuçlar ile örtüşmeyen bulguların olduğu da görülmüştür. Örneğin; Amerikalı üniversite öğrencileri üzerinde yapılan bir araştırmada (Jelenchick vd., 2012), öğrencilerin %12'sinin internet bağımlısı olduğu, İran'daki tıp fakültesi öğrencilerinin katılımıyla yapılan bir çalışmada (Ghamari vd., 2012) bu oranının yaklaşık %11 olduğu, Türkiye'deki üniversite öğrencileri üzerinde yapılan bir çalışmada (Balcı ve Günar, 2009) öğrencilerin %23,2'sinin internet bağımlısı olduğu ortaya konulmuştur.

Çalışma kapsamında tıbbi sekreter adaylarının düşük düzeyde yalnızlık duygusuna sahip oldukları sonucuna varılmıştır. Bu çalışmanın sonuçları Korkut ve Gençtürk (2020) ile paralellik göstermekteyken, Yelpaze (2021)'nin çalışma sonuçlarıyla farklılık göstermektedir. Tıbbi sekreter adaylarının düşük düzeyde saptanan internet bağımlılığı ve yalnızlık düzeylerinin aksine, mutluluk düzeylerinin orta seviyede olduğu sonucuna varılmıştır. Literatür incelendiğinde bu sonuçların Bektaş ve Karagöz (2020) ile benzerlik, Ergün ve Meriç (2020) ile farklılık gösterdiği görülmektedir.

Çalışmanın değişkenleri arasındaki ilişki sonuçları ele alındığında; internet bağımlılığı ile mutluluk arasında negatif yönde, yalnızlık arasında ise pozitif yönde anlamlı bir ilişki olduğu ortaya konulmuştur. Buna ek olarak mutluluk ve yalnızlık değişkenleri arasındaysa negatif yönde ve anlamlı bir ilişki olduğu sonucuna varılmıştır. Elde edilen bulgulardan hareketle internet bağımlılığı, mutluluk ve yalnızlık değişkenleri arasındaki ilişkilerin düşük düzeyde olduğunu ifade etmek mümkündür. Gülaçtı (2020)'nin çalışmasında da, öğretmen adaylarının, Totan vd. (2019)'nin çalışmasında da üniversite öğrencilerinin internet bağımlılığı ile yalnızlık düzeyleri arasında anlamlı pozitif yönde düşük düzeyde ilişkilerin olduğu ortaya konulmuştur. Bunun aksine K. Çimen (2018)'in çalışmasında değişkenler arasında negatif yönde ve düşük düzeyde anlamlı bir ilişki olduğu rapor edilmiştir. Durualp ve Çiçekoğlu (2013)'nin çalışmasındaysa internet bağımlılığı ve yalnızlık arasında anlamlı bir ilişki olmadığı bildirilmiştir. İnternet bağımlılığı ve mutluluk değişkenleri arasındaki ilişkilerin sonuçları göz önünde bulundurulduğunda; Totan vd. (2019)'nin çalışma sonuçları ile bu çalışmada elde edilen bulguların paralellik gösterdiği, Ergün ve Meriç (2020)'in sonuçlarıyla ise örtüşmediği sonucuna erişilmiştir. Tıbbi sekreter adaylarının mutluluk ve yalnızlık düzeyleri arasındaki ilişki sonuçları ele alındığında; bu çalışmada elde edilen bulguların Traş vd. (2020) ile Demir ve Kutlu (2016)'yla benzerlik gösterdiği görülmüştür.

Bu çalışmanın literatüre en önemli katkısı, internet bağımlılığı değişkeninin yordanan bir yapıda olmayıp, gençlerin yalnızlık ve mutluluk gibi birtakım duyguları üzerinde açıklayıcılığa/yordayıcılığa sahip olup olmadığının ele alınmış olmasıdır. Zira literatür incelendiğinde, genellikle internet bağımlılığının bağımlı değişken olarak ele alındığı görülmektedir. Buradan hareketle, çalışma kapsamında elde edilen bulguların mevcut alan yazına farklı bir bakış açısı sunabileceğini belirtmek olasıdır. Bu çalışma kapsamında; tıbbi sekreterlik öğrencilerinin mutluluk düzeyleri üzerinde internet bağımlılığının %9,3'lük, yalnızlık düzeyleri üzerinde ise %19,4'lük bir yordayıcılığa/etkiye sahip olduğu sonucuna varılmıştır. Mevcut çalışma sonuçlarından farklı olarak D. Batıgün ve Hasta (2010) ile Demir ve Buğa (2019)'nin çalışmalarında, internet bağımlılığı üzerinde yalnızlığın anlamlı bir etkisinin olduğu rapor edilmiştir. Yavuz (2019) tarafından yapılan bir çalışmada, bu çalışma sonuçlarına benzer olarak internet bağımlılığının mutluluk üzerinde anlamlı bir etkisi olduğu

ve bu etkinin %18 düzeyinde olduğu belirtilmiştir. Totan vd. (2019)'nin çalışmasında ise, bu çalışma sonuçlarından farklı olarak mutluluğun internet bağımlılığı üzerinde anlamlı bir etkisi olduğu sonucuna varılmıştır.

Çalışma sonuçları tıbbi sekreter adaylarının düşük bir internet bağımlılığı düzeyinde olduğunu göstermektedir. Bu durum olumlu bir sonuç olarak değerlendirilebilir. Çalışma sonuçları katılımcıların her ne kadar düşük bir internet bağımlılığı düzeyine sahip olduklarını gösterse de, bu durumun onların mutluluk düzeylerini anlamlı derecede azalttığı, yalnızlık düzeylerini ise anlamlı derecede artırdığı görülmüştür. Buradan hareketle eğitimin her kademesinde, özellikle de internet bağımlılığı yaygınlığının en yüksek olduğu bilinen üniversite çağında, internetin nasıl daha çok akılcı olarak kullanılabileceğine yönelik eğitim programlarının tasarlanması önerilebilir. Ayrıca internet bağımlılığı ile psikolojik durumlar arasındaki ilişkiler hususunda öğrencilerin bilgi ve farkındalık düzeylerini iyileştirecek girişimlerin planlanması, internetin sorunlu kullanım düzeyini en aza indirme noktasında faydalı olabilir. Küçük bir örneklem grubunda kıyaslamasız olarak gerçekleştirilen bu çalışmanın sonuçlarını, tüm tıbbi sekreter adaylarına genellemek söz konusu değildir. Dolayısıyla ileriki çalışmaların daha geniş örneklem gruplarında farklı programları içerecek şekilde kıyaslamalı olarak planlanması ve öznel iyilik hali, anksiyete, depresyon, özgüven, iletişim becerisi ve akademik performans gibi birtakım farklı değişkenlerin de araştırma modeline dahil edilmesi önerilebilir.

## KAYNAKLAR

- Aç-Nikolić, E., Zarić, D., & Nićiforović-Šurković, O. (2015). Prevalence of Internet addiction among schoolchildren in Novi Sad. *Srpski arhiv za celokupno lekarstvo*, 143(11-12), 719-725.
- Akdağ, M., Ş. Yılmaz, B., Özhan, U., & Şan, İ. (2014). Üniversite öğrencilerinin internet bağımlılıklarının çeşitli değişkenler açısından incelenmesi (İnönü Üniversitesi örneği). *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, 15(1), 73-96.
- Ansari, H., Ansari-Moghaddam, A., Mohammadi, M., Peyvand, M., Amani, Z., & Arbabisarjou, A. (2016). Internet addiction and happiness among medical sciences students in southeastern iran. *Health Scope*, 5(2), e33600.
- Balcı, Ş., & Gülnar, B. (2009). Üniversite öğrencileri arasında internet bağımlılığı ve internet bağımlılarının profili. *Selçuk İletişim*, 6(1), 5-22.
- Bektaş, M., & Karagöz, Ş. (2020). Mutluluk ve Yalnızlık Düzeylerinin Demografik Değişkenler Temelinde İncelenmesi: Finlandiya Örneği. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, (1), 411-435.
- Browne, M. W. & Cudeck, R. (1993). Alternative ways of assessing model fit. *Sage Focus Editions*, 154, 136-136.
- Byrne, B. M. (2010). Structural equation modeling with AMOS: Basic concepts, applications, and programming (2nd ed.). New York: Taylor and Francis.
- D. Batıgün, A., & Hasta, D. (2010). İnternet bağımlılığı: Yalnızlık ve kişilerarası ilişki tarzları açısından bir değerlendirme. *Anadolu Psikiyatri Dergisi*, 11(3), 213-219.
- Demir, S., & Buğa, A. (2019). Üniversite öğrencilerinde yalnızlık ve internet bağımlılığı arasındaki ilişki: bilişsel çarpıtmaların aracı rolü. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, 20(3), 859-875.
- Demir, Y., & Kutlu, M. (2016). Üniversite öğrencilerinde sosyal etkileşim kaygısı ile mutluluk arasındaki ilişki: yalnızlığın aracı rolü. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, 36(1), 195-210.
- Doğan, S., Acar, Füsün, & B. Doğan, T. G. (2021). İnternet bağımlılığı ve sağlık anksiyetesinin siberkondria davranışları üzerine etkisi. *Erciyes Akademi*, 35(1), 281-298.
- Doğan, T., & Akıncı Çötök, N. (2011). Oxford mutluluk ölçeği kısa formunun Türkçe uyarlaması: Geçerlik ve güvenirlik çalışması. *Turkish Psychological Counseling and Guidance Journal*, 4(36), 165-172.

- Durualp, E., & Çiçekoğlu, P. (2013). Yetiştirme yurdunda kalan ergenlerin yalnızlık düzeylerinin internet bağımlılığı ve çeşitli değişkenler açısından incelenmesi. *Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 15(1), 29-46.
- Ergün, G., & Meriç, M. (2020). Üniversite Öğrencilerinin İnternet Kullanımı İle Mutluluk ve Yaşam Doyumu Düzeyleri Arasındaki İlişkinin İncelenmesi. *Anadolu Hemşirelik ve Sağlık Bilimleri Dergisi*, 23(2), 233-240.
- Ghamari, F., Mohammadbeigi, A., Mohammadsalehi, N., & Hashiani, A. A. (2012). Internet addiction and modeling its risk factors in medical students, Iran. *Indian journal of psychological medicine*, 33(2), 158-162.
- Gülaçtı, F. (2020). İnternet Bağımlılığı ile Yalnızlık Düzeyleri Arasındaki ilişkisi. *Uluslararası Türk Kültür Coğrafyasında Sosyal Bilimler Dergisi*, 5(2), 213-229.
- Hays, R. D., & DiMatteo, M. R. (1987). A short-form measure of loneliness. *Journal of personality assessment*, 51(1), 69-81.
- Hills, P., & Argyle, M. (2002). The Oxford Happiness Questionnaire: a compact scale for the measurement of psychological well-being. *Personality and individual differences*, 33(7), 1073-1082.
- İ. Işıklı, E. ve Suysal, M. (2019). Tıbbi Sekreterlerin Yaşadığı Sorunların İncelenmesi: Düzce İlinde Bir Alan Araştırması. *Asya Studies Akademik Sosyal Araştırmalar*, (8), 41-52.
- Jelenchick, L. A., Becker, T., & Moreno, M. A. (2012). Assessing the psychometric properties of the Internet Addiction Test (IAT) in US college students. *Psychiatry research*, 196(2-3), 296-301.
- K. Çimen, L. (2018). Üniversite öğrencilerinin internet bağımlılığı ile sanal ortam yalnızlık düzeyleri arasındaki ilişkinin incelenmesi. *Elektronik Sosyal Bilimler Dergisi*, 17(68), 1431-1452.
- Kalaycı, Ş. (2010). SPSS uygulamalı çok değişkenli istatistik teknikleri. Ankara: Asil Yayın Dağıtım.
- Karasu, F., Bayır, B., & Çam, H. H. (2017). Üniversite öğrencilerinin internet bağımlılığı ile sosyal destek arasındaki ilişkinin incelenmesi. *Kilis 7 Aralık Üniversitesi Sosyal Bilimler Dergisi*, 7(14), 372-386.
- Kline, R. B. (2011). Principles and practice of structural equation modeling. New York: The Guilford Press.
- Korkut, G., & Gençtürk, Z. (2020). Üniversite Öğrencilerinin Yalnızlık Düzeyleri İle Aile Aidiyeti Arasındaki İlişkinin İncelenmesi. *Avrasya Uluslararası Araştırmalar Dergisi*, 8(24), 209-231.
- Köksal, A., & Kaplan, A. (2018). Sağlık Hizmetlerinde Tıbbi Sekreterliğin Meslekleşme Süreci Açısından İncelenmesi. *Başkent University Journal of Education*, Özel Sayı (1), 103-112.
- Kumar, M., & Mondal, A. (2018). A study on Internet addiction and its relation to psychopathology and self-esteem among college students. *Industrial psychiatry journal*, 27(1), 61-66.
- Kutlu, M., Savcı, M., Demir, Y., & Aysan, F. (2016). Young internet bağımlılığı testi kısa formunun Türkçe uyarlaması: Üniversite öğrencileri ve ergenlerde geçerlilik ve güvenilirlik çalışması. *Anadolu Psikiyatri Dergisi*, 17(1), 69-76.
- Mosadeghrad, A. M., & Ferdosi, M. (2013). Leadership, job satisfaction and organizational commitment in healthcare sector: Proposing and testing a model. *Materia socio-medica*, 25(2), 121-126.
- Narine, L. (2000). Impact of health system factors on changes in human resource and expenditures levels in OECD Countries. *Journal of Health and Human Services Administration*, 22(3), 292-307.

- Pawlikowski, M., Altstötter-Gleich, C., & Brand, M. (2013). Validation and psychometric properties of a short version of Young's Internet Addiction Test. *Computers in Human Behavior*, 29(3), 1212-1223.
- Resmi Gazete, 2014. <https://www.resmigazete.gov.tr/eskiler/2014/05/20140522-14-1.pdf>
- Seçer, İ. (2015). Psikolojik Test Geliştirme ve Uyarlama Süreci. Ankara: Anı Yayıncılık.
- Sharma, A., & Sharma, R. (2018). Internet addiction and psychological well-being among college students: A cross-sectional study from Central India. *Journal of family medicine and primary care*, 7(1), 147-151.
- Totan, T., Ercan, B., & Öztürk, E. (2019). Mutluluk ve benlik saygısının yalnızlıkla internet bağımlılığına etkilerinin incelenmesi. *Edu 7: Yeditepe Üniversitesi Eğitim Fakültesi Dergisi*, 8(10), 20-35.
- Traş, Z., Öztemel, K., & Koçak, M. (2020). Üniversite Öğrencilerinin Mutluluk, Yalnızlık ve Sabır Düzeyleri Arasındaki İlişkinin İncelenmesi. *OPUS Uluslararası Toplum Araştırmaları Dergisi*, 15(22), 878-894.
- Wang, Y., Wu, A. M., & Lau, J. T. (2016). The health belief model and number of peers with internet addiction as inter-related factors of Internet addiction among secondary school students in Hong Kong. *BMC Public Health*, 16(272), 1-13.
- Wylęły, K. (2021). The Internet-a risk-taking space for university students. *Journal of Education Culture and Society*, 12(1), 413-425.
- Yavuz, C. (2019). Does internet addiction predict happiness for the students of sports high school? *International Online Journal of Educational Sciences*, 11(1), 91-99.
- Yelpaze, İ. (2021). Uluslararası Üniversite Öğrencilerinin Yalnızlık Düzeylerinin Yordayıcısı Olarak Bilişsel Esneklik ve Psikolojik Sağlamlık. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, 22(1), 105-131.
- Yıldız, M. A., & Duy, B. (2014). Adaptation of the short-form of the UCLA loneliness scale (ULS-8) to Turkish for the adolescents. *Düşünen Adam*, 27(3), 194-203.
- Yılmazsoy, B., & Kahraman, M. (2017). Uzaktan eğitim öğrencilerinin internet bağımlılık düzeylerinin incelenmesi. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi*, 3(4), 9-29
- Young, K. S. (1998). *Caught in the net: How to recognize the signs of internet addiction--and a winning strategy for recovery*. John Wiley & Sons.
- Zenebe, Y., Kunno, K., Mekonnen, M., Bewuket, A., Birkie, M., Necho, M., ... & Akele, B. (2021). Prevalence and associated factors of internet addiction among undergraduate university students in Ethiopia: a community university-based cross-sectional study. *BMC Psychology*, 9(4), 1-10.

## SOCIAL LOAFERS' CONTINUOUS SOCIAL LOAFING – A MEDIATOR IN THE RELATIONSHIP BETWEEN TEAMMATES' SOCIAL COMPENSATION AND TEAM PERFORMANCE

**Phạm Thu Hằng**

*VNU University of Social Sciences and Humanities, Vietnam National University, Faculty of  
Psychology, Hanoi, Vietnam.*

### **Abstract**

Social loafing, the tendency of an individual in a team to put forth less effort and rely on other members, is a great hindrance to every learning team of students in higher education. Team members have several ways of reaction to social loafing including exerting more effort to compensate for their peers. A survey was conducted with 351 students of a university in Vietnam in 2021 in order to find out whether an association exists among three variables consisting of social compensation of team members for social loafers, response of social loafers to their teammates' compensatory actions and team performance. The study's result demonstrates that continuous social loafing of the social loafers can account for the relationship between the social compensation and the team performance. It is recommended that the research finding be spread to not only students but also lecturers so as to deal with social loafing in learning teams effectively and enhance team performance.

**Key words:** *social loafing, social loafers, learning teams, social compensation, team performance, Vietnam.*

### **INTRODUCTION**

Social loafing, which is a reduction of effort when individual works collectively compared to individually (Karau and Williams, 1993), is a major issue when it comes to teamwork. A social loafer in a team is considered as an individual who does not make an effort in teamwork and rely on other team members. It is possible that other members will react in different manners when they perceive social loafing in their team. Social compensation, which is a way of teammates' response to social loafing, was found by Williams and Karau (1991) referring to the tendency of team members to work harder to make up for the inadequate contributions of social loafers. Social compensation is also shown in a study on 168 employees by Liden et al. (2004). In line with previous research, Jassawalla et al. (2009) realised that students took compensatory actions such as doing more and picking up the slack when members of their teams produced insufficient contribution and did poor quality work. When conducting a study in 2014, Schippers indicated that if there was a high degree of conscientiousness and agreeableness within the team executing difficult task, team members would compensate for social loafers. Furthermore, Schippers (2014) discovered that social compensation prevented the negative impact of social loafing on team performance.

The research to date has tended to focus on social compensation as a consequence of social loafing rather than its impact on other factors like social loafers' responses or team performance.

On the issue of consequences of social loafing, while previous studies had investigated the response of social loafers' teammates only, the study by Jassawalla et al. (2008) captured reactions of social loafers in response to the compensatory actions taken by the teammates. Nonetheless, Jassawalla et al. did not examine the relationship of social loafers' reactions with other variables such as social compensation or team performance.

So far, in the literature on social loafing field, there has been no discussion about the association among team members' compensatory actions for social loafers, the response of social loafers to their peers' compensation, team performance. Taking the close connections



of these three psychological phenomena into consideration, the present study assumes that social loafers' continuous social loafing (SLCSL) can serve as a mediator between teammates' social compensation (TSC) and team performance (TP). The empirical findings in this study will make several noteworthy contributions to the current literature.

## **METHODS**

### **• Participants**

The research was conducted in the second semester of the 2020-2021 academic year. Participants of the study consists of 351 students who are educated at a university in Vietnam and had experienced social loafing in their learning teams.

### **• Measures**

There are three scales utilized in this study:

*Team performance scale* (5 items): A scale was developed from 3 items in the scale of Jassawalla et al. (2009) and 2 added items based on the data collected from observation, the participants' answers for opened – ended questions and in-depth interviews. This scale examined the performance of the teams with social loafers.

*Social compensation scale* (4 items): A scale was taken from Jassawalla et al. (2009) in order to assess the compensatory reaction of the social loafers' teammates. In each item, the subject "team members/other team members" was replaced by "I" to refer to the respondent's own compensatory reaction to social loafing.

*Social loafer' continuous social loafing scale* (3 items): A checklist of three items was adapted from Jassawalla et al. (2008) to capture the effort changes of the social loafer in response to the compensatory actions taken by their teammate.

The respondents were required to respond on 5 score points ranging from (1) *absolutely true* to (5) *absolutely false*. Four items in social compensation scale and two items in social loafer' continuous social loafing scale were scored in reverse. Total score of each scale was computed with higher score corresponding to higher amount of social compensation, higher amount of social loafer' continuous social loafing, higher amount of team performance.

A pilot study with 79 students was conducted to assess reliability of all scales. This study used a measuring instrument reliability test internal consistency with Cronbach alpha technique and by using IBM-SPSS software version 21.0 for windows. Cronbach alpha technique criteria research instrument with reliability coefficients  $\geq 0.6$  are acceptable and an item-total correlation cut-off limit as low as 0.3 was used according to Nunnally and Bernstein (1994). Therefore, two items in the team performance scale and one item in the social compensation scale that did not meet this cut-off criterion threshold were eliminated (Table 1). Table 1 shows that after item reduction, both of the scales' Cronbach alphas had a certain degree of increase and were used in the main survey. For the main survey with 351 students, Cronbach's Alpha reliability of the three scale were more than 0.7, which indicated acceptable internal consistency.

Table 1. The Cronbach alpha reliability coefficient for each scale used in the study

Scale	THE PILOT SURVEY										THE MAIN SURVEY				
	Number of items	Item <i>(*)</i> : item was scored in reverse	Cronbach's Alpha	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Number of items	Item	Cronbach's Alpha	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Number of items	Item	Cronbach's Alpha	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Team performance <i>(Source: Developed from the scale of Jassawalla et al., 2009)</i>	05	1. The team had fewer good ideas than the other teams	0.618	0.252	0.623										
		2. The team missed deadlines		0.343	0.580										
		3.The team's final presentation was not as high quality as that of other teams		0.462	0.519										
		4. The total group output was not as good as that which would result from summing the outputs of all group members working in isolation		0.491	0.499										
		5. Team effectiveness was lower than expected		0.328	0.585										
	The first variable deletion					The second variable deletion					The main survey				
	04		0.623			3		0.673			03		0.710		
		2.		0.245	0.673										
		3.		0.456	0.516		3.		0.444	0.630		3.		0.438	0.724
		4.		0.509	0.471		4.		0.496	0.565		4.		0.566	0.571
5.		0.427		0.537	5.		0.518		0.536	5.		0.587		0.548	
Social compensation <i>(Source: Jassawalla et al., 2009)</i>	04	1. I had to waste their time explaining things to the social loafer*	0.633	0.217	0.705	03		0.705			03		0.783		
		2. I had to do more than my share of work*		0.582	0.428		2.		0.549	0.581		2.		0.617	0.713
		3. I had to redo or revise the work done by the social loafer*		0.415	0.564		3.		0.535	0.604		3.		0.639	0.691
		4. The work had to be reassigned to other members of the team and I*		0.475	0.518		4.		0.489	0.655		4.		0.612	0.717
Social loafer' continuous social loafing <i>(Source: Developed from questions of Jassawalla et al., 2008)</i>	03	1. The social loafer contributed more than before	0.764	0.589	0.692						03	1.	0.717	0.304	0.887
		2. The social loafer lowered his/her effort than before*		0.632	0.646							2.		0.671	0.456
		3. The social loafer continued to reduce effort as before*		0.570	0.712							3.		0.681	0.439

## RESULTS

**Correlation analyses among variables under study.** The result of the study revealed a positive relationship between TSC and SLCSL with  $r(354) = 0.195$ ,  $p < 0.001$ . In the opposite direction, SLCSL is negatively correlated with TP,  $r(351) = -0.284$ ,  $p < 0.001$ . A negative relationship was also found between TSC and TP,  $r(351) = -0.398$ ,  $p < 0.001$ . That is to say, the more the teammates compensated, the more the social loafers continued loafing, and the more the social loafers continued loafing, the lower the team performance became.

Table 2. The mediating effect of SLCSL in the relationship between TSC and TP

	B	se	t	p	95% CI	
<b>TSC → SLCSL</b>	0.2573	0.0696	3.6977	0.0003	0.1204	0.3941
<b>SLCSL → TP</b>	-0.1704	0.0388	-4.3963	0.0000	-0.2466	-0.0942
<b>TSC → TP</b>						
<b>Total effect</b> (TSC → TP)	-0.4190	0.0517	-8.1063	0.0000	-0.5206	-0.3173
<b>Direct effect</b> (TSC → TP)	-0.3751	0.0514	-7.3045	0.0000	-0.4761	-0.2741
<b>Indirect effect</b>	-0.0438	0.0151	-	-	-0.0766	-0.0175

Note:  $N = 351$ ; Arrow (→) refers to the effect

**The mediating effect of SLCSL in the relationship between TSC and TP.** The indirect effect of TSC on TP through SLCSL was conducted using SPSS Macro Process (Hayes, 2013). A total of 1000 bootstrapping sample were generated and 95% of bias correlated confidence intervals (CI) were observed. A value of 0 represents no difference, the difference is statistically significant because the range excludes no difference. Significant indirect effect was assumed when the CI does not intersect through zero.

The result of the mediation analysis in Table 2 indicated that TSC was significantly and positively associated with SLCSL,  $B = 0.2573$ ,  $t = 3.6977$ ,  $se = 0.0696$ ,  $p = 0.0003 < 0.001$ , 95% CI [0.1204, 0.3941]. Furthermore, SLCSL had significant negative link with TP,  $B = -0.1704$ ,  $t = -4.3963$ ,  $se = 0.0388$ ,  $p = 0.0000 < 0.0001$ , 95% CI [-0.2466, -0.0942]. The total effect of TSC on TP was statistically significant,  $B = -0.4190$ ,  $t = -8.1063$ ,  $se = 0.0517$ ,  $p = 0.0000 < 0.0001$ , 95% CI [-0.5206, -0.3173]. The direct effect of TSC on TP, after controlling for the effect of SLCSL, was significantly negative,  $B = -0.3751$ ,  $t = -7.3045$ ,  $se = 0.0514$ ,  $p = 0.0000 < 0.0001$ , 95% CI [-0.4761, -0.2741]. As predicted, the indirect effects of SLCSL in the relationship between TSC and TP were statistically significant,  $B = -0.0438$ , 95% CI [-0.0766, -0.0175] does not include 0. This suggests that social loafers' continuous social loafing is a significant mediator in the relationship between teammates' social compensation and team performance.

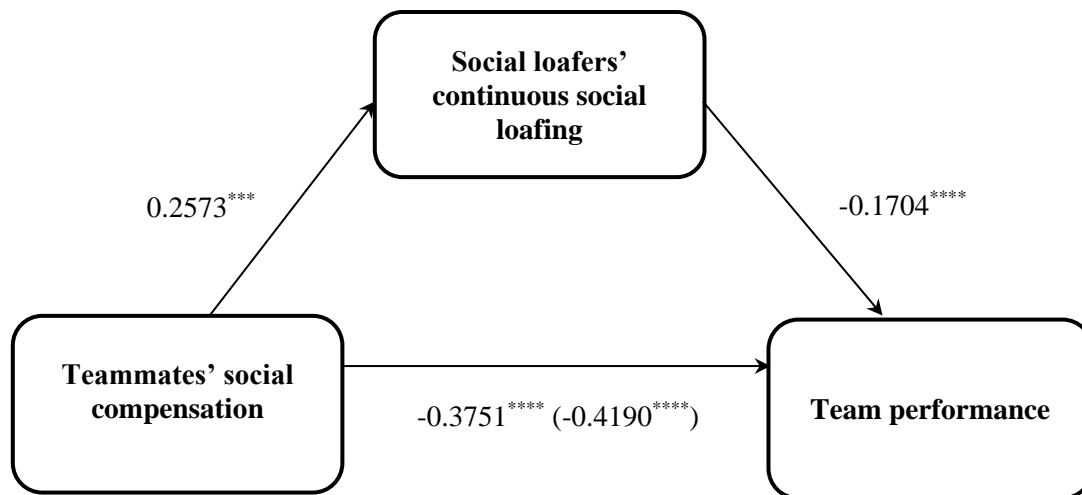


Figure 1: Mediation model showing the effect of TSC on TP through SLCSL.

Total effect of TSC was shown in parenthesis; \*\*\*\*  $p < 0.001$ ; \*\*\*  $p < 0.0001$

## DISCUSSION AND CONCLUSION

While previous studies had discussed the effect of social loafing on team performance, this study focused on the consequences of social loafing by addressing how social compensation influenced team learning performance, and specifically examining the mediating role of SLCSL as a response to TSC. In contrast to the proposition given by Simms and Nichols (2014) that social compensation helps each team member save their energy to do their own tasks whereas the group results are still preserved, the research results derived from this study revealed the fact that social compensation negatively affected not only the person who was doing the slacking but also the whole group. When students in classroom teams perceived others to be withholding effort, they were more likely to make up for this lost effort. This phenomenon of social compensation then decreased the motivation of social loafers and made them keep social loafing that eventually led to low group performance.

The most obvious finding to emerge from this study is when perceiving social loafing in classroom team, students had better not pick up the slack for social loafers due to the fact that their social compensation can lead to social loafers' continuous social loafing, which can lead to low team performance. Another important practical implication is that lecturers should pay attention to motivate each student in learning teams and help them respond appropriately to social loafers for the sake of not only each team member but also the whole team.

## LIMITATION AND SUGGESTIONS FOR FURTHER STUDY

The research findings are limited by the use of a cross sectional design which collected data at a single point in time. In a cross-sectional study, owing to the fact that exposure and outcome are measured simultaneously, the ascertainment of the exposure as well as the outcome might be influenced by participants' prior knowledge of the condition, which results in recall bias. This limitation can be resolved by longitudinal studies in future.

In addition, considerably more work will need to be done to assess the association among the ways of reaction of team members to social loafing, the manners of response of social loafers to their teammates' actions and team performance so as to effectively prevent continuous social loafing in classroom teams.

## REFERENCES

Hayes, A. F. (2013). Mediation, moderation, and conditional process analysis. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach* edn. New York: Guilford Publications, 1-20.

Jassawalla, A. R., Malshe, A., & Sashittal, H. (2008). Student perceptions of social loafing in undergraduate business classroom teams. *Decision Sciences Journal of Innovative Education*, 6(2), 403-426.

Jassawalla, A., Sashittal, H., & Sashittal, A. (2009). Students' perceptions of social loafing: Its antecedents and consequences in undergraduate business classroom teams. *Academy of Management Learning & Education*, 8(1), 42-54.

Karau, S. J., & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of personality and social psychology*, 65(4), 681.

Liden, R. C., Wayne, S. J., Jaworski, R. A., & Bennett, N. (2004). Social loafing: A field investigation. *Journal of management*, 30(2), 285-304.

Nunnally, J.C. , & Bernstein, J.H. (1994). *Psychometric theory* (3rd ed.). New York, NY: McGraw-Hill.

Schippers, M. C. (2014). Social loafing tendencies and team performance: The compensating effect of agreeableness and conscientiousness. *Academy of Management Learning & Education*, 13(1), 62-81.

Simms, A., & Nichols, T. (2014). Social loafing: a review of the literature. *Journal of Management Policy and Practice*, 15(1), 58.

Williams, K. D., & Karau, S. J. (1991). Social loafing and social compensation: The effects of expectations of co-worker performance. *Journal of Personality and Social Psychology*, 61(4), 570-581.



## REPRESSİYA İLLƏRİNDƏ AZƏRBAYCAN FOLKLORŞÜNASLIĞI FUNKSIONAL STRUKTUR SİSTEMİ KONTEKSTİNDƏ

Sərxan XAVƏRİ

Azərbaycan Milli Elmlər Akademiyası, Folklor İnstitutu

ORCID: <https://orcid.org/0000-0002-3501-8898>

### Özet

Məqalədə repressiya illərində folklorşünaslığın nəzəri məsələlərindən söhbət gedir. Azərbaycan folklorşünaslığının 30-cu illər mərhələsi repressiya illərinə təsadüf edir. Bu illərdə folklorşünaslıq olduqca ağır təzyiqlərə məruz qalmışdır. XX əsrin əvvəllərində Qərb nəzəri görüşləri əsasında formalaşan S.Mümtaz, Ə.Abid, V.Xulufu, H.Zeynallı, H.Əlizadə və b. kimi folklorşünasların məhsuldar yaradıcılıq dövrü bu mərhələyə təsadüf edir. Onlar folklorə sosial kontekstə yanaşmağa meyilli olmuşdular. Buna görə də onların dünyagörüşü sovet ideologiyası ilə ziddiyyət təşkil etmişdir. Məqalədə müəyyən edilmişdir ki, ötən əsrin otuzuncu illərində Azərbaycan folklorşünaslarının represiyaya məruz qalmasının əsas səbəblərindən biri də onların milli dəyərlərin daşıyıcısı olması olmuşdur.

**Açar sözlər:** repressiya, folklorşünaslıq, ağız ədəbiyyatı, şifahi ədəbiyyat, folklorşünas

### Abstract

The article deals with an analysis of theoretical matters of the folklore studies during repression. The stage of 30s years of Azerbaijani folklore studies coincides with years of repression. Within this year, the folklore studies were exposed to severe pressure. At the beginning of 20-th century, the productive creative period of the folklore specialists such as S.Mumtaz, A.Abid, V.Khulufu, H.Zeynalli, H.Alizade and so on formed based on the western theoretical ideas. They preferred to approach the folklore from the social point of view. Therefore their outlook contradicted the soviet ideology. By this article it was revealed that one of the reasons of exposing Azerbaijani folklore studies to repression within 30s years of the last century was that they were carrier of national values.

**Key words:** repression, folklore studies, folklore, simpleton literature, folklorist

### GİRİŞ

Folklorun funksional struktur aspektdən araşdırılması təbii olaraq onun milli folklorşünaslığımızda tədqiq təcrübəsinin nəzərdən keçirilməsini və mövcud nəzəri qənaətlərin ümumiləşdirilməsini zəruri edir. Milli filoloji fikrimizdə həmin anlayışın ifadə etdiyi elmi problemlərə tarixi aspektdən maraq ötən əsrin əvvəllərindən, yeni nəzəri-metodoloji paradigma aspektdən maraq isə 1980-ci illərdən müşahidə edilməyə başlanmışdır. Zahirə belə görünür ki, repressiya illəri bu problemlərə marağın ən az təsadüf olunduğu illərdir. Əslində isə elmi təfəkkürləri XX əsrin əvvəllərində Qərb elmi-nəzəri düşüncəsinin təsiri altında formalaşan alimlərin bu mərhələdə yaşamasının nəticəsidir ki, bu illərdə nəzəri problemlərə maraq olduqca güclü olmuşdur. Bu prosesi aydın təsəvvür etmək üçün repressiya illərində yaradıcılığının ən məhsuldar dövrünü yaşayan alimlərin elmi təfəkkürlərinin ilkin formalaşma mərhələsindən başlamaq lazımdır.

## PROMBLEMİN MÜZAKİRƏSİ

Azərbaycanda folklorşünaslıq elminin tarixi XIX əsrin sonlarından başlayır. Əslində tədqiqatların əksəriyyətində qeyd edildiyi kimi, bu dövrdə folklorlara maraq daha çox folklor mətnlərinin toplanılması, qeydə alınması və folklor nümunələrinin yeni tipli pedaqoji fəaliyyətə cəlb edilməsi ilə məhdudlaşmış, folklorla bağlı nəzəri-metodoloji məsələlərə isə demək olar ki, toxunulmamışdır. Açıq etiraf edək ki, həmin tarixi mərhələdə Azərbaycanda humanitar elmi fikrin səviyyəsi folklorşünaslığın nəzəri məsələlərinə dünyanın həmin dövr üçün məqbul olan professional elmi səviyyəsində maraq göstərməyə imkan verməmişdir.

Azərbaycanda elmi-nəzəri mənada folklorlara marağın tarixi XX əsrin əvvəllərinə təsadüf edir. Milli folklorşünaslıq tarixini xronoloji mərhələ ardıcılığı və nəzəri ümumiləşdirmələr əsasında (müxtəlif nəzəri problem paradigmlər üzrə) araşdıran görkəmli folklorşünas alim Muxtar Kazımoğlu bu barədə yazır: “XX əsrin 20-30-cu illərində folklorun xüsusi elmi qurumlar səviyyəsində tədqiq edilməsi folklorşünaslıq sahəsində təməl prinsipləri müəyyənləşdirmək, “folklor nədir və necə öyrənilməlidir?” (kursiv bizimdir – S.X.) kimi suallara cavab vermək zərurətini ortaya çıxarırdı. Əlbəttə, XIX əsrin sonlarından etibarən H.Zərdabi, M.Mahmudbəyov, R.Əfəndiyev, E.Sultanov, F.Köçərli, S.Hüseyn və b. ziyalıların dövrü mətbuatda çap olunan məqalələrində şifahi xalq ədəbiyyatının bir sıra özünəməxsus cəhətlərinə az-çox münasibət bildirilirdi. Amma etiraf etmək lazımdır ki, Azərbaycan folklorşünaslığının ilkin terminoloji bazası (kursiv bizimdir – S.X.) XX əsrin 20-30-cu illərində daha çox formalaşmağa başlayıb. Diqqət yetirdikdə aydın olur ki, bizim folklorşünaslıqda şifahi xalq ədəbiyyatı istilahına qədər ağız ədəbiyyatı, el ədəbiyyatı, avam ədəbiyyatı, xalq ədəbiyyatı, şifahi ədəbiyyat, xalq şifahi ədəbiyyatı, xalq ağız ədəbiyyatı, folklor və s. kimi istilahlər işlənib” (Kazımoğlu, 2014, 117).

Daha sonra müəllif XX əsrin 20-30-cu illərində folklorun nəzəri məsələlərinə münasibətdə əsas istiqamətləri aşağıdakı kimi müəyyənləşdirir: “XX əsrin 20-30-cu illərində Azərbaycan folklorşünaslığının təməl prinsiplər əsasında xüsusi formalaşma mərhələsi keçməsinə bir tərəfdən terminoloji bazanın yaradılması ilə, “şifahi xalq ədəbiyyatı nədir və onun yazılı ədəbiyyatdan başlıca fərqi nədədir?” kimi suallara cavab axtarılması ilə izah etmək mümkündürsə, digər tərəfdən də folklorşünaslıq tarixinə və nəzəriyyələrinə baş vurulması ilə izah etmək mümkündür. Folklorşünaslıq nəzəriyyələrini ümumi şəkildə gözdən keçirmək həm dünya folklorşünaslığındakı əsas təmayüllər barədə təsəvvür yaratmaq, həm də xalq ədəbiyyatı ilə bağlı məlum mübahisəli məsələlərə aydınlıq gətirmək məqsədi daşıyırdı (kursiv bizimdir – S.X.). Zaman-zaman mübahisələrə səbəb olmuş məsələlərdən biri səyyar süjetlərin mənşəyi məsələsidir. 20-30-cu illər Azərbaycan folklorşünasları (xüsusən də H.Zeynallı və Y.V.Çəmənəminli) əsatirçilər (mifoloji), iqtibas, antropoloji və tarixi kimi adlarla tanınan nəzəriyyələri məhz konkret problemlər, o cümlədən beynəlxalq ortaq mifoloji görüşlər, beynəlxalq obraz, motiv və süjetlər baxımından qiymətləndirirlər (Kazımoğlu, 2014, 121).

Müəllifin ümumiləşdirmə və dəyərləndirilməsindən aydın olur ki, repressiya dövründə milli folklorşünaslığımız qeyd olunan tədqiqatçıların təmsalında folklorun nəzəri məsələlərinə kifayət qədər diqqət ayırırdı. Həmin dövr dünyada “mətn mərkəzli” folklorşünaslıq mərhələsi olduğundan bu araşdırmaları dünya elminin nəzəri axtarışları kontekstində kifayət qədər mütərəqqi hesab etmək mümkündür. Yəni bu mərhələdə elmi problemlərə maraq baxımından Azərbaycan folklorşünaslığı dünya folklorşünaslığının tələblərinə normativ səviyyədə cavab verirdi. Həmin tarixi mərhələdə dünya folklorşünaslığında da aktual müzakirə mövzusu qeyd olunan problemlər idi.

1937-ci ildə Azərbaycan folklorşünaslığının S.Mümtaz, Ə.Abid, V.Xulufu, H.Zeynallı, H.Əlizadə və digərləri kimi folklorlara dünya elminin standartları səviyyəsində münasibət bildirməyi bacaran nümayəndələrinin repressiyalara məruz qalması folklorşünaslığımızda özünü göstərən nəzəri istiqamətin ciddi olaraq zəifləməsinə, hətta elmi-nəzəri boşluğun yaranmasına səbəb oldu. Məhz bunun nəticəsi olaraq Azərbaycan folklorşünaslığı 40-50-ci illər mərhələsini

dünya folklorşünaslıq elminin nəzəri axtarışlarından mütləq izolyasiya mərhələsi kimi yaşamışdır. Bütün digər ictimai-humanitar elm sahələri kimi folklorşünaslığın da sovet ideologiyasına tabe etdirilməsi nəticəsində bu sahə dünya elminin inkişaf qanunauyğunluğu kontekstində deyil, əsasən rus folklorşünaslığının nəzəri-filoloji müddəalarına əsaslanan sovet folklorşünaslığı müstəvisində inkişaf etmişdir.

Bir məsələni xüsusi olaraq qeyd etmək istərdik ki, ötən repressiya mərhələsində folklorlara qarşı olan hücumların birbaşa hədəfi elmi-nəzəri təmayül deyildir. Həmin dövrdə ictimai şüurda “türk dili”, “türk ədəbiyyatı”, “türk mədəniyyəti və s. anlayışlar aktiv işlənmə tezliyinə malik idi. Folklor isə həmin anlayışların məzmun bazasını özündə əks etdirirdi. Təbii ki, bu, müttəfiq respublikalarda milli assimilyasiya siyasəti həyata keçirən hakim ideologiyayı qane etmirdi. Məhz buna görə də əsas hədəf milli məzmun idi. Gənc folklorşünas Samir Mustafayev repressiya dövründə həyata keçirilən antifolklor əməliyyatlarını aşağıdakı istiqamətlər üzrə qruplaşdırır:

1. Folklor mətnləri etnogenezi etibarilə saxtalaşdırılır: İran folkloru “Avesta” abidəsi timsalında türk, Azərbaycan folkloru kimi tədqiq edilir;
2. Folklor mətnləri ideya-məzmun istiqaməti üzrə saxtalaşdırılır. Mətnlərə müdaxilə yolu ilə türk dövlət və dövlətçilik ənənələri, milli mübarizə ideyaları, milli-mənəvi və dini-ruhani dəyərlərlə bağlı anlayışlar arxa plana keçirilir, sinfi mübarizə, sosial təbəqələr arasında münasibətlər qabardılır;
3. Aşıq sənəti inzibati-təşkilati təlimlər hesabına tarixi məzmunundan mərhum edilərək sosialistləşdirilməyə başlandı. Aşıqlar birliklərinin yaradılması, təntənəli qurultayların keçirilməsi məhz bu məqsədlərə xidmət edirdi;
4. “Kitabi-Dədə Qorqud” kimi milli-mənəvi varlığımızı coğrafiyasından etnoqrafiyasına, dini görüşlərdən estetik görüşlərə, dövlətçilik ənənələrindən məişət münasibətlərinə qədər hər şeyi özündə yaşadan abidə yasaq edilir və s.

40-50-ci illərdə davam edən bu siyasət folkloru forma etibarilə müasir ictimai yaddaşlardan silinmək cəhdi idi” (Mustafayev, 2008, 40).

Repressiya mərhələsindən sonrakı dövrlər, 60-70-ci illər Azərbaycan folklorşünaslığında ifrat ideoloji təmayüllərdən uzaqlaşmaq, folklor materiallarının daha çox milli mədəniyyət kontekstində tədqiq və təbliği aparıcı istiqamət kimi özünü göstərməyə başlayır. Azərbaycan folklorşünaslığının görkəmli nümayəndələri H.Araslı (Araslı, 1939; Araslı 1960), M.Təhmasib (Təhmasib, 2011), A.Nəbiyev ( Nəbiyev 2002; Nəbiyev 2006), V.Vəliyev (Vəliyev 1981; Vəliyev 1985), B.Abdulla (Abdullayev 1999; Abdullayev 2004) İ.Abbaslı (Abbaslı, 2007; Abbaslı 2009 ; Abbaslı, 2010), P.Əfəndiyev (Əfəndiyev, 1992; Əfəndiyev, 1999 ), M.Həkimov (Həkimov, 1982; Həkimov, 1983), S.Paşayev (Paşayev, 1985) və b. əsərlərində folklorun ayrı-ayrı janrları filoloji-nəzəri baxış bucağından geniş təhlil olunur, xüsusən folklorun epik və lirik janrları üzrə tədqiqat olduqca genişlənməyə başlayır. Bu mərhələdə Azərbaycan folklorşünaslığının nəzəri-medodoloji paradigmasını müəyyənləşdirməyə çalışsaq, aşağıdakı istiqamətləri ayıraraq fərqləndirə bilərik:

“Şifahi xalq ədəbiyatı” adı ilə işarələnən sözlü mətn fakturası folklorun birmənalı identifikasiyası kimi qəbul və təqdim edilir;

Folklorun identifikasiyası kimi qəbul və təqdim edilən sözlü mətn fakturası keçmiş nəsillərə məxsus sənət hadisəsi kimi dərk edilir;

Folklorun sözlü mətn fakturası öz mənşəyini Aristotelin “Poetika”sından götürən məşhur filoloji “növ və janr” prinsipi əsasında təsnif edilir;

Folklor fakturasının mətn subyekti kimi “xalq” adı altında diaxron olaraq keçmişdə, sinxron olaraq əyalətlərdə yaşayan, urbanizasiya prosesindən kənarda qalmış tarixi kateqoriya mənasında etnik toplum başa düşülür;

Folklorun elmi mahiyyətinin müəyyənləşdirilməsinə-də filoloji rakurs alternativsiz yanaşma kimi çıxış edir;

Folklor mətnlərinin filoloji araşdırılmasında bədii-estetik dəyərləndirmə prioritet təşkil edir;

Yazılı ədəbiyyatın inkişafında şifahi xalq ədəbiyyatının rolunun müəyyənəşdirilməsi istiqamətində zəngin araşdırmalar aparılır;  
Folklor milli tarixin öyrənilməsində etibarlı mənbə kimi aktiv iştirak edir;  
İctimai fikirdə folklorizm problemi geniş araşdırılır;  
Nəşr olunan xalq ədəbiyyatı mətnlərinin öyrənilməsi üçün, əsasən, filoloji olmaqla elmi prinsiplər işlənib hazırlanır və realizasiya olunur;  
Folklor abidələrinin janr spesifikasiyası baxımından fundamental filoloji araşdırılması həyata keçirilir;  
Diqqətin poetik xalq klassikasına yönəldilməsi ilə şifahi xalq ədəbiyyatına məxsus əsərlərin xüsusi bədii keyfiyyətlərinin və məzmununun aşkarlanması üzrə prinsiplər və xüsusi metodika işlənib hazırlanır;  
Xüsusi sənət fenomeni olan aşiq sənəti, onun genezisi, tarixi inkişafı, nümayəndələri, bədii mətn fakturası geniş şəkildə araşdırılır və s. g

## NƏTİCƏ

Beləliklə, 60-70-ci illərdə bir sıra görkəmli filoloq folklorşünasların fəaliyyəti nəticəsində zəngin Azərbaycan folklor nümunələrinin toplanılması, arxivləşdirilməsi, ka-taloqlaşdırılması, tədqiqi və təbliği istiqamətində olduqca mühüm işlər həyata keçirilmişdir. Lakin folklorun nəzəri-metodoloji dəyərləndirilməsi istiqamətindəki araşdırmalar, yuxarıda qeyd edildiyi kimi, əsasən, rus folklorşünaslığının “folklor-şifahi xalq ədəbiyyatı identifikasiyası” elmi paradigmasının təsiri altında aparılmışdır. Bu nəzəri müddəanın həddləri daxilində inkişaf edən Azərbaycan folklorşünaslığının nəzəri səviyyəsi son nəticədə nəinki ayrıca elmi paradigmasının yaranmasına, heç paradiqmatik təşəbbüsdə bulunmağa belə imkan verməmişdir.

Beləliklə, Azərbaycan folklorşünaslığının repressiya və ondan sonrakı illərdəki təcrübəsi onu göstərir ki, XX əsrin əvvəllərində folklorun funksional mahiyyətini sosial-mədəni kontekstdə izaha meyilli olan, eyni zamanda milli baxışları ilə fərqlənən ziyalılar, folklorşünaslar ağır repressiyalara məruz qalmalarına bəməyaraq 50-60-cı illərdə nəzəri istiqamət yenidən güclənməyə başlayır.

## QAYNAQLAR

- Abbaslı, İ. (2007). Azərbaycan dastanlarının yayılması və təsiri məsələləri. Bakı: Nurlan.  
Abbaslı, İ. (2009). Folklorşünaslıq axtarışları. İki cildə, I cild. Bakı: Nurlan.  
Abbaslı, İ. (2010). Folklorşünaslıq axtarışları. İki cildə, II cild. Bakı: Nurlan.  
Abdullayev, B. (1999). “Kitabi-Dədə Qorqud”un poetikası. Bakı: Elm.  
Abdulla, B. (2004). “Kitabi-Dədə Qorqud”da rəng simvolikası. Bakı: Çapıoğlu.  
Araslı, H. (1939). “Kitabi-Dədə Qorqud” (müqəddimə) // Kitabi-Dədə Qorqud. Bakı: Azərnəşr.  
Araslı, H. (1960). Aşiq yaradıcılığı / H.Araslı. Bakı: Birləşmiş Nəşriyyat.  
Əfəndiyev, P. (1992). Azərbaycan şifahi xalq ədəbiyyatı. Bakı: Maarif.  
Əfəndiyev, P. (1999). Dastan yaradıcılığı. Bakı: ADPU.  
Həkimov, M. (1982). Azərbaycan klassik aşiq yaradıcılığı. Bakı: API.  
Həkimov, M. (1983) Azərbaycan aşiq ədəbiyyatı (qədim və orta əsrlər). Bakı: Yazıçı.  
Kazımoğlu, İ. (2014). Muxtar. Folklor həm keçmiş, həm də bu gündür (məqalələr). Bakı: Elm və təhsil.  
Mustafayev, S. (2008). Azərbaycan folkloru və milli düşüncə sistemi: Fil. elm. nam. dissertasiya. Bakı: Nurlan.  
Nəbiyev, A. (2002). Azərbaycan xalq ədəbiyyatı. I hissə / Ali məktəblər üçün dərslik. Bakı: Turan.  
Nəbiyev A. (2006). Azərbaycan xalq ədəbiyyatı. II hissə / Ali məktəblər üçün dərslik Bakı: Turan.

Elm.

Paşayev S. (1985). Azərbaycan əfsanələrinin öyrənilməsi. Bakı: Bilik.

Təhmasib M.H.(2011). Seçilmiş əsərləri. 2 cildə. I c. Bakı: Kitab aləmi NPM.

Vəliyev V. (1981). Qaynar söz çeşməsi. Bakı: Yazıçı.

Vəliyev V. (1985). Azərbaycan folkloru. Bakı: Maarif.