

# EJONS

INTERNATIONAL JOURNAL ON MATHEMATICS, ENGINEERING & NATURAL SCIENCES

## 16th INTERNATIONAL CONFERENCE ON

MATHEMATICS, ENGINEERING, NATURAL AND MEDICAL SCIENCES

November 11-13, 2023  
ISTANBUL, TÜRKİYE

## PROCEEDINGS BOOK

**Edited by**

**Prof. Dr. Osman ERKMEN**

**ISBN: 978-1-955094-58-0**



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**CONFERENCE ID**

***EJONS 16th INTERNATIONAL CONFERENCE ON MATHEMATICS,  
ENGINEERING, NATURAL & MEDICAL SCIENCES***

**DATE-PLACE**

***November 11-13, 2023 / Istanbul, Türkiye***

**EDITORS**

***Prof. Dr. Osman ERKMEN***

**EVALUATION PROCESS**

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

**TOTAL NUMBER OF PAPERS: 82**

**THE NUMBER OF PAPERS FROM TÜRKİYE: 36**

**OTHER COUNTRIES: 46**

**PARTICIPANT COUNTRIES (22):**

***Türkiye, Pakistan, Sri Lanka, Kazakhstan, Algeria, Kosovo, India,  
Sudan, Ukraine, Nigeria, Romania, Russia, Albania, Angola, Portugal,  
Spain, Germany, Georgia, Poland, Morocco, Iran, Kingdom of Saudi  
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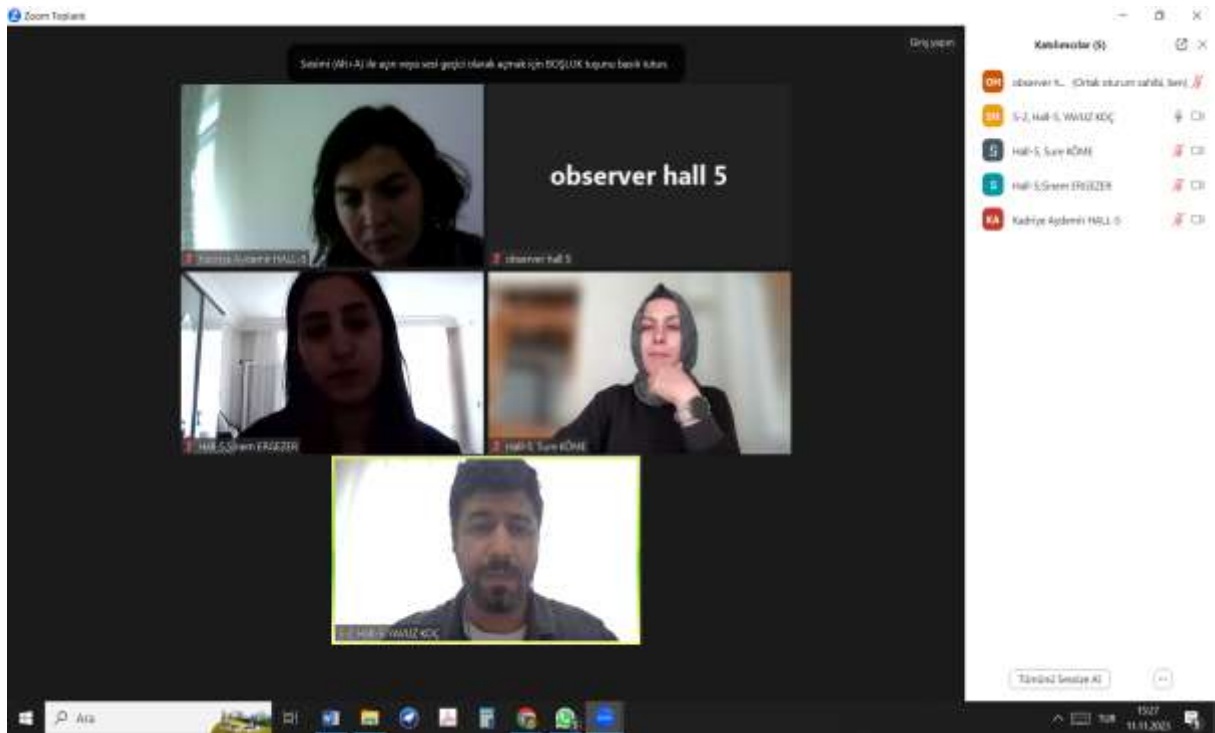
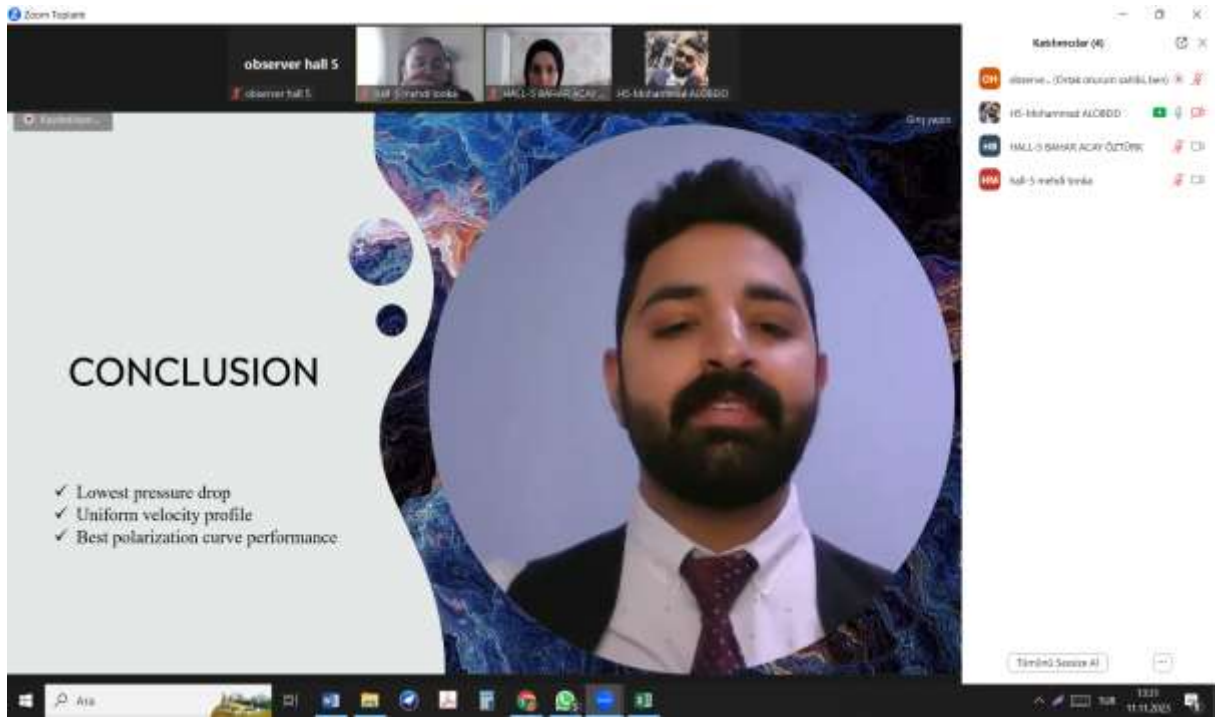
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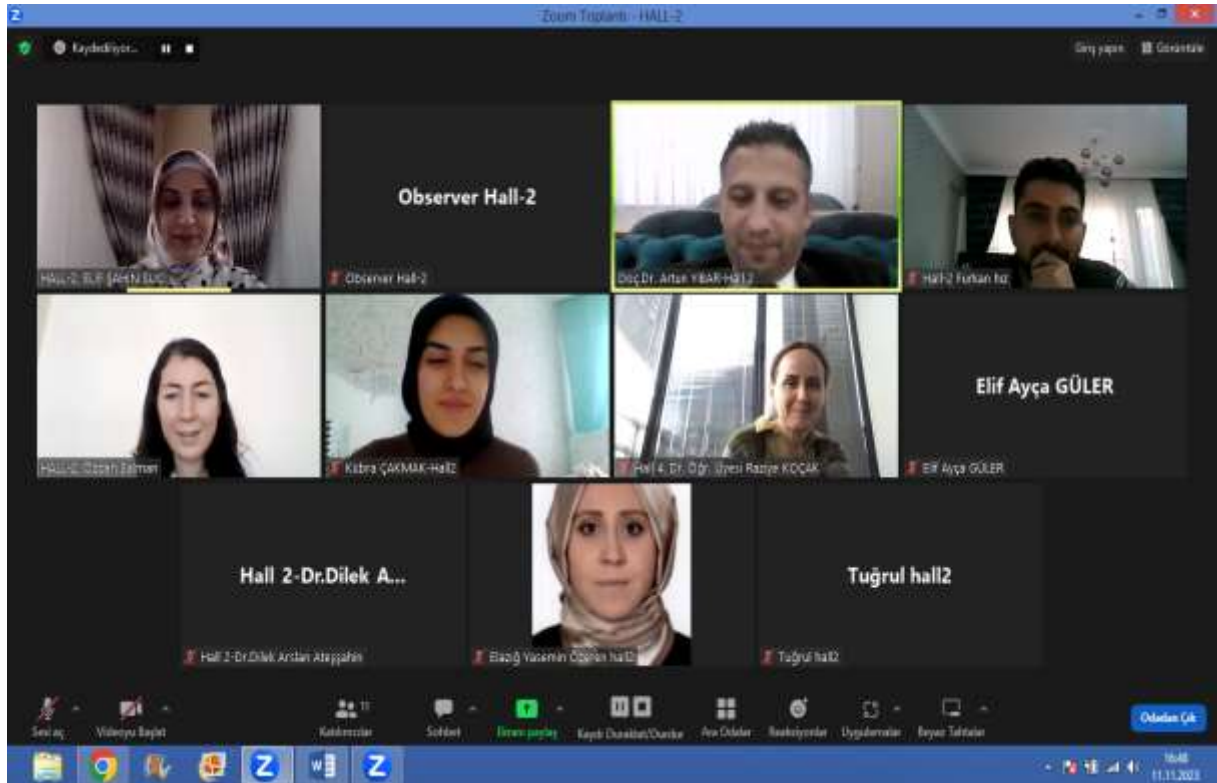
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# PHOTO GALLERY





Zoom Toplantı - HALL-1

Kaydediliyor...

Görüntü yapın Görüntüle

Hall-1, Hal Akay

Observer Hall-1

Selman Özüdü

Hall1, Eslem Kaivas

M Kartal

Omer Yunus Gu...

Sesi aç Videoyu Bağlat Katılımcılar Sohbet Ekranı paylaş Reaksiyonlar Uygulamalar Beyaz Tahtalar Daha fazla

Oturdan Çık

TR 13:27 11.11.2023

Zoom Toplantı - HALL-1

Kaydediliyor...

Görüntü yapın Görüntüle

Moderator Assoc.Prof.Dr.Nilgun ULUTAŞDEMİR

Observer Hall-1

S-2, Hall-1, Nilay Gökbulut

Bethal

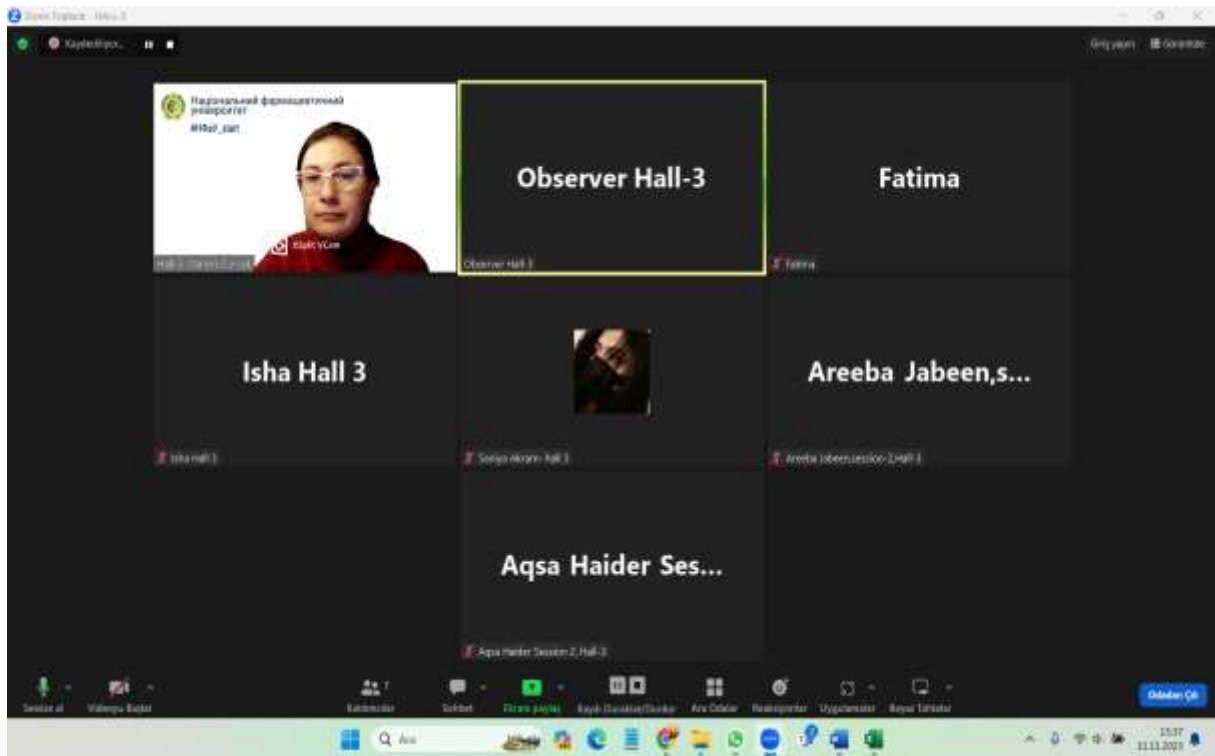
ÇİĞDEM GÖREL

Nagihan Koroğlu

Sesi aç Videoyu Bağlat Katılımcılar Sohbet Ekranı paylaş Reaksiyonlar Uygulamalar Beyaz Tahtalar Daha fazla

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TR 15:44 11.11.2023





# EJONS 16th INTERNATIONAL CONFERENCE ON MATHEMATICS, ENGINEERING, NATURAL & MEDICAL SCIENCES

November 11-13, 2023

Istanbul, Türkiye

## CONFERENCE PROGRAM



**Meeting ID: 875 0838 3006**  
**Passcode: 121212**

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- ❖ Moderatör – oturumdaki sunum ve bilimsel tartışma (soru-cevap) kısmından sorumludur.

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- ❖ Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

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**exp. Hall-1, Seda BEYAZ**



**Session-1, Hall-1****11.11.2023****Moderator: Assist. Prof. Dr. Ali AKAY****Meeting ID: 875 0838 3006 / Passcode: 121212****Ankara Local Time: 13:00 – 15:00**

Title	Author(s)	Affiliation
OBTAINING THE WINDING DISTRIBUTION OF A SIX-PHASE PERMANENT MAGNET SYNCHRONOUS MACHINE USING THE 'STAR OF SLOTS' METHOD	Ali AKAY	Karabük University, Türkiye
INVESTIGATION OF MECHANICAL PROPERTIES OF CONTINUOUS HEMP FIBER REINFORCED POLYURETHANE COMPOSITES	Serhat GÜÇLÜ Ömer Yunus GÜMÜŞ Recep İLHAN Melih YAZICI Naci UYSAL	Bursa Teknik University, Türkiye Fompak Ambalaj Ve Poliüretan San. Ve Tı. A.Ş, Ar-Ge Merkezi
EVALUATING MANUFACTURING EFFICIENCY IN A TIRE MANUFACTURING COMPANY	Mehlika KOCABAŞ AKAY Yiğit İSENCİK Gülşen AKMAN	Kocaeli University, Türkiye
THE INVESTIGATION OF THE EFFECT OF CALCIUM CARBONATE ADDITIVE ON THE MECHANICAL PROPERTIES OF POLYPROPYLENE/CORN HUSK COMPOSITES	Eslem KAVAS Pınar TERZİOĞLU Orhan BULUT	Bursa Teknik University, Türkiye Ermetal Otomotiv ve Eşya Sanayi Ticaret A.Ş., Bursa, TÜRKİYE
ECOLOGY AND COMPUTER TECHNOLOGIES	Alina AMANZHOLVA Aysun COSKUN Nurlan AKHMETOV	Gazi University, Ankara, Türkiye Khoja Akhmet Yassawi International Kazakh- Turkish University, Turkistan, Kazakhstan
ARTIFICIAL INTELLIGENCE FOR CANCER CLASSIFICATION USING GENE EXPRESSION DATA	Alina AMANZHOLVA Aysun COSKUN	Gazi University, Ankara, Türkiye

All participants must join the conference 10 minutes before the session time.

Every presentation should last not longer than 10-12 minutes.

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**Session-1, Hall-2****11.11.2023****Moderator: Assist. Prof. Dr. Hasene KESKİN ÇAVDAR****Meeting ID: 875 0838 3006 / Passcode: 121212****Ankara Local Time: 13:00 – 15:00**

Title	Author(s)	Affiliation
SYNTHESIS AND CHARACTERIZATION OF CALIX[4]ARENE DERIVATIVE BEARING PYRIDINE, 1,3,4-OXADIAZOLE AND 1,2,3-TRIAZOLE	Ali Osman KARATAVUK	Trakya University, Türkiye
INVESTIGATION OF CYTOTOXIC, APOPTOTIC/NECROTIC ACTIVITY OF AQUILARIA AGALLOCHA EXTRACT	Semih DALKILIÇ Lütfiye Kadioğlu DALKILIÇ Elgun İSBENOV Ceydanur TAŞDEMİR	Fırat University, Türkiye
STRUCTURE, MECHANICAL AND RADIATION SHIELDING PROPERTIES OF Al-BASED TUNGSTEN REINFORCED, Al-Gd <sub>2</sub> O <sub>3</sub> -W NANOSTRUCTURED COMPOSITES	Celal KURSUN Kubra NERGİZ Ali Orkun YALCIN Khursheed Ahmad PARREY Yasin GAYLAN	Kahramanmaraş Sutcu Imam University, Türkiye Zonguldak Bulent Ecevit University, Türkiye
SYNTHESIS OF NANOSTRUCTURED Al-Gd <sub>2</sub> O <sub>3</sub> COMPOSITE MATERIALS AND INVESTIGATION OF THEIR STRUCTURAL, MECHANICAL AND RADIATION SHIELDING PROPERTIES	Celal KURSUN Ali Orkun YALCIN Kubra NERGİZ Khursheed Ahmad PARREY Yasin GAYLAN	Kahramanmaraş Sutcu Imam University, Türkiye Zonguldak Bulent Ecevit University, Türkiye
UTILISATION OF SEAFOOD WASTE PRODUCTS IN FUNCTIONAL FOODS	Hasene KESKİN ÇAVDAR	Gaziantep University, Türkiye
PRODUCTION OF FUNCTIONAL YOGURT ENRICHED WITH VEGETABLE AND FRUIT WASTE	Büşra Güler UĞURLU Eda ADAL Hasene KESKİN ÇAVDAR	Gaziantep University, Türkiye
THE IMPORTANCE OF FUNCTIONAL FOOD-BASED NUTRITION IN THE DEVELOPMENT AND PREVENTION OF DIABETES	Özlem YALÇINÇIRAY	İstanbul Arel University, İstanbul, Türkiye
EVALUATION OF SUSTAINABLE FOOD SYSTEMS IN TERMS OF HEALTHY AND BALANCED NUTRITION	Özlem YALÇINÇIRAY Zeki ÖZDEMİR	İstanbul Arel University, İstanbul, Türkiye

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**Session-1, Hall-3**

**11.11.2023**

**Moderator: Moses Adeolu AGOI**

**Meeting ID: 875 0838 3006 / Passcode: 121212**

**Ankara Local Time: 13:00 – 15:00**

Title	Author(s)	Affiliation
IT-BASED SKILLS TRAINING PROJECT FOR WOMEN IN PAKISTAN WITH EVALUATION HOW EUROPEAN COUNTRIES PROVIDE THE IT SKILL TO WOMEN AND GIRLS IN THEIR COUNTRIES	Muhammad FAISAL Alquma NOOR	Allama Iqbal Open University Director (HRIMS), Ministry of Human Rights Commission, Pakistan ILMA University Karachi, Pakistan
AI FOR CONTENT GENERATION IN DIGITAL MARKETING	Ihor Ponomarenko Dmytro Ponomarenko	University of Trade and Economics, Kyiv, Ukraine
AN EXPLICIT SURVEY ON THE EFFICACY OF DIGITAL SIGNATURE VERIFICATION SYSTEM (DSVS) AND ITS IMPORTANCE TO BANKING INDUSTRY	Moses Adeolu AGOI Hojapoji Gabriel SEMAKO Solomon Abraham UKPANA Elizabeth Ayodele AGOI Oluwanifemi Opeyemi AGOI	Lagos State University of Education, Lagos Nigeria. Osun State College of Technology, Esa-Oke Osun Nigeria Obafemi Awolowo University, Osun Nigeria
CARREAU MODEL FOR LIQUID THIN FILM FLOW OF DISSIPATIVE MAGNETIC-NANOFLUIDS OVER A STRETCHING SHEET	G.P. Ashwinkumar, C. Sulochana, N.Sandeep	Vijayanagara Sri Krishnadevaraya University, India. Gulbarga University, India. Central University of Karnataka, India.
TRIDIMENSIONAL EXTENSION OF BALANCING NUMBERS	José Chimpanzo, Paula Catarino, María Otero-Espinar	Higher Polytechnic Institute of Soyo, Angola University of Trás-os-Montes e Alto Douro, Portugal University of Santiago de Compostela, Spain
IMAGE NOISE PROCESSING AND APPLICATIONS	Thippavongxay Anousith, Nguyen Van Huan, Vu Duc Thai, Nguyen Manh Hung	General Department of Economic Police TNU - University of Information and Communication Technology; Thai Nguyen high School for the Gifted
AN EFFECTIVE COMPUTATIONAL METHOD FOR THE MATHEMATICAL ANALYSIS OF THE FRACTIONAL DIABETES MODEL	Vinod Gill	Govt. College Nalwa (Hisar), Haryana-125037, India
THE 4-FIBONACCI SEQUENCES OF $G_m$	Mina Pirzadeh, Mansour Hashemi	University of Guilan, Rasht, Iran

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**Session-1, Hall-4**

**11.11.2023**

**Moderator: Mohamed AIT OUMERACI**

**Meeting ID: 875 0838 3006 / Passcode: 121212**

**Ankara Local Time: 13:00 – 15:00**

Title	Author(s)	Affiliation
INFLUENCE OF SHRINKING PARAMETERS OF THIN WALL CROSSLINKED POLYOLEFIN TUBES USED OVER WIRES INSULATED WITH LOW WORKING TEMPERATURE MATERIALS	Sandra Matos Natasa Babic Natasa Babic	University of Minho, Portugal University Ostbayerische Technische Hochschule Amberg-Weiden, Germany University IPAM, Lisbon, Portugal
AN REVIEW ON ANTIOXIDANTS: SOLUTION TO OXIDATIVE STRESS	Adan Naeem, Syed Makhdoom Hussain, Danish Riaz, Zubair-ul-Hassan Arsalan, Adnan Khalid, Muhammad Faisal, Zeeshan Yousaf and Eman Naeem	Government College University, Faisalabad, Pakistan
A REVIEW ON HARMFUL ALGAL BLOOMS: ITS CAUSES, IMPACTS AND MITIGATION	Eman Naeem, Syed Makhdoom Hussain, Danish Riaz, Zubair-ul-Hassan Arsalan, Adnan Khalid, Muhammad Faisal, Muhammad Amjad and Adan Naeem	Government College University, Faisalabad, Pakistan
DEGRADATION OF MG DYE USING H <sub>2</sub> O <sub>2</sub> //UV/ZnO and UV/ZnO NANOPARTICLES: A COMPARATIVE STUDY	Mohamed AIT OUMERACI Tarek BERRAMA Hayet TIZI Yassine KADMI	University of Sciences and Technology Houari Boumediene, Algiers, Algeria
PHOTOCATALYTIC DEGRADATION OF MALACHITE GREEN DYE USING BIO-GREEN SYNTHESIS NANOPARTICLES	Mohamed AIT OUMERACI Tarek BERRAMA Hayet TIZI Yassine KADMI	University of Sciences and Technology Houari Boumediene, Algiers, Algeria
CHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITIES OF THE MEDICINAL PLANT ERINACEA PUNGENS	Soumia Mouffouk, Chaima Mouffouk and Hamada Haba	Laboratoire de Chimie et Chimie de l'Environnement (L.C.C.E), Algérie.
TOXICITY OPTIMIZATION OF GREEN ZINC OXIDE QUANTUM DOTS IN ZEBRAFISH USING BOX-BEHNKEN DESIGN: A NOVEL APPROACH FOR SAFER NANOPARTICLE SYNTHESIS	R. Mary Nancy Flora, M. Chamundeeswari, S. Palani	Arunai Engineering College, India St. Joseph's College of Engineering, India
$\mathfrak{g}^{**\beta}$ -Continuous and $\mathfrak{g}^{**\beta}$ -Irresolute Mappings in Topological Spaces	Dr. Raja Mohammad LATIF	Prince Mohammad Bin Fahd University, Kingdom of Saudi Arabia
$\mathfrak{g}^{**\beta}$ -Open and $\mathfrak{g}^{**\beta}$ -Closed Mappings in Topological Spaces	Dr. Raja Mohammad LATIF	Prince Mohammad Bin Fahd University, Kingdom of Saudi Arabia

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**Session-1, Hall-5****11.11.2023****Moderator: Dr. Bahar Acay ÖZTÜRK****Meeting ID: 875 0838 3006 / Passcode: 121212****Ankara Local Time: 13:00 – 15:00**

Title	Author(s)	Affiliation
COMPARISON OF OPTICAL AND STRUCTURAL PROPERTIES OF UNDOPED AND AL-DOPPED ZNO THIN FILM OBTAINED BY SPIN COATING TECHNIQUE	Mehdi TONKA Osman ÜRPER Feyza Güzelçimen Nilgün BAYDOĞAN	İstanbul University, Türkiye Şırnak University, Türkiye University of South-Eastern
CFD SIMULATION OF PEMWE FLOW-FIELD DESIGN BASED ON A BIO INSPIRED	Mohammed ALOBEID Selahattin ÇELİK	Ankara Yıldırım Beyazıt University, Türkiye
ANALYSIS OF STURM-LIOUVILLE PROBLEM INCLUDING PROPORTIONAL DERIVATIVE IN CONTROL THEORY	Bahar Acay ÖZTÜRK	Fırat University, Türkiye
FRACTIONAL METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS INFECTION MODEL UNDER CAPUTO OPERATOR	Bahar Acay ÖZTÜRK	Fırat University, Türkiye
EFFECT OF MAGNETIC FIELD ON REMOVAL OF DENSE NON AQUEOUS PHASE LIQUID FROM UNSATURATED ZONE USING STEAM INJECTION	A.A Adegbola and Y.O Yakub	Ladoke Akintola University of Technology, Ogbomosho, Oyo State
INVESTIGATING NOVEL Cyclohexane-1,3-dione DERIVATIVES AS POTENTIAL ANTI-NSCLC CANCER AGENTS THROUGH QSAR AND DOCKING STUDIES	Khaoula Mkhayar, Souad Elkhattabi, Kaouakeb Elkhattabi	Sidi Mohamed Ben Abdellah-Fez University, Fez, Morocco. Mohammed V University, Rabat, Morocco.
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**Session-1, Hall-6**

**11.11.2023**

**Moderator: Dr. R. Devi**

**Meeting ID: 875 0838 3006 / Passcode: 121212**

**Ankara Local Time: 13:00 – 15:00**

Title	Author(s)	Affiliation
NANOMATERIALS FOR CANCER THERAPY	Parthasarathi.V, Devi.R, Dr.R.Srinivasan, Venkateshwaran.S, Aswin.A	Bharath institute of Higher Education and Research, Chennai, India
A SHORT REVIV ON POLYMERIC NANOPARTICLES FOR DRUG DELIVERY	J. Yeshwanth, R. Devi, R. Jyothi Lakshmi, S. Kalaivanan, Dr. R. Srinivasan	Bharath institute of Higher Education and Research, Chennai, India
EFFECTIVE USE OF NANOCARRIERS AS DRUG DELIVERY SYSTEM FOR THE TREATMENT OF SELECTIVE TUMOURS	S.Keerthiga, R.Devi, Dr.R.Srinivasan.	Bharath institute of Higher Education and Research, Chennai, India
PHARMACY SERVICES FOR PATIENTS WITH GENERALIZED ANXIETY DISORDER	V. Varalakshmi, R.Devi, Dr. R. Srinivasan	Bharath institute of Higher Education and Research, Chennai, India
ACUTE TOXICITY STUDIES OF MEDICINAL PLANTS: A SHORT REVIEW	J. Yeshwanth, R. Devi, R. Jyothi Lakshmi, S. Kalaivanan, Dr. R. Srinivasan	Bharath institute of Higher Education and Research, Chennai, India
TOXICITY ASSESSMENT OF 7 ANTICANCER COMPOUNDS IN ZEBRAFISH	Sriram.R, Devi.R, Dr. R. Srinivasan, Mohamed Ashik Ali.M, Akash.M	Bharath institute of Higher Education and Research, Chennai, India
IMMUNOTHERAPY	G.Premanand, Dr.R.Saravanan, Dr.R.Srinivasan	Bharath institute of Higher Education and Research, Chennai, India
GOLD NANOPARTICLES APPLICATION IN WOUND HEALING	R. Devi	Bharath Institute of Higher Education and Research, Chennai.
IN SILICO DESIGN OF NEW QUINOLINE DERIVATIVES AGAINST BREAST CANCER	Said EL RHABORI, Samir CHTITA, Fouad KHALIL	Sidi Mohamed Ben Abdellah University, Morocco Hassan II University of Casablanca, Morocco
DEVELOPMENT AND IN VIVO EVALUATION OF A COMMERCIALY VIABLE SPRAY BANDAGE FOR WOUND HEALING	Bushra Ahmed, Rahmuddin Khan, Mohd Aamir Mirza, Zeenat Iqbal	School of Pharmaceutical Education & Research, India

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**Session-2, Hall-1****11.11.2023****Moderator: Assoc. Prof. Dr. Nilgun ULUTASDEMİR****Meeting ID: 875 0838 3006 / Passcode: 121212****Ankara Local Time: 15:30 – 17:30**

Title	Author(s)	Affiliation
CASE MANAGEMENT	Nilgun ULUTASDEMİR	Gümüşhane University, Türkiye
PROGRAM MANAGEMENT	Nilgun ULUTASDEMİR	Gümüşhane University, Türkiye
VALIDITY AND RELIABILITY TESTING OF THE TURKISH VERSION OF THE SELF-ACCEPTANCE SCALE FOR PREGNANT WOMEN	Emine İBİCİ AKÇA Nilay GÖKBULUT Yeşim AKSOY DERYA	Amasya University, Türkiye Çankırı Karatekin University, Türkiye İnönü University, Türkiye
EVALUATION OF SEXUAL PROBLEMS USING THE PLISSIT MODEL	Nilay GÖKBULUT Demet AKTAŞ	Çankırı University, Türkiye
HEMŞİRELİK ÖĞRENCİLERİNDE KLİNİK MUHAKEMİYİ GELİŞTİRMEK	Betül BAL Nagihan KÖROĞLU KABA	Yozgat Bozok University, Türkiye Bayburt University, Türkiye
HEMŞİRELİK HİZMETLERİNDE İŞ YERİ NEZAKETSİZLİĞİ	Nagihan KÖROĞLU KABA Betül BAL	Bayburt University, Türkiye Yozgat Bozok University, Türkiye
THE EFFECT OF MULTIDRUG RESISTANCE PROTEIN 1 IN ALLERGIC ASTHMA	Cigdem BAYRAM-GUREL Suzan Adin CINAR Muge SAYITOGU Bulent TUTLUOGLU Ilhan ONARAN Gunnur DENİZ Gonul KANIGUR-SULTUYBEK	Istanbul University-Cerrahpasa, Türkiye Aziz Sancar Institute of Experimental Medicine Istanbul University, Türkiye

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Session-2, Hall-2

11.11.2023

Moderator: Dr. Elif ŞAHİN SUCİ

Meeting ID: 875 0838 3006 / Passcode: 121212

Ankara Local Time: 15:30 – 17:30

Title	Author(s)	Affiliation
GENOME-BASED ANTIMICROBIAL RESISTANCE and VIRULENCE GENE ANALYSIS of <i>Rhodococcus qingshengii</i> STRAIN S58 ISOLATED from the COASTAL SEAWATER of BURSA PROVINCE	Artun YIBAR	Bursa Uludag University, Türkiye
EFFECT ON GRAIN WAREHOUSES OF INCREASED SOLAR RADIATION DUE TO CLIMATE CHANGE	Elif ŞAHİN SUCİ Nuh UĞURLU	Selçuk University, Konya, Türkiye
EVALUATION OF THE ENVIRONMENTAL IMPACTS OF A FABRIC DYEING MILL WITH LIFE CYCLE ASSESSMENT	İslam Furkan HIZ Afşin Y. ÇETİNKAYA Adem YURTSEVER	Hasan Kalyoncu University, Türkiye Yıldız Teknik University, Türkiye İstanbul Üniversitesi-Cerrahpaşa, Türkiye
INVESTIGATION OF CYTOTOXIC, ANTIMICROBIAL AND ANTIOXIDANT ACTIVITY OF <i>ECHIUM VULGARE</i> L. SEED	Dilek ARSLAN ATEŞŞAHİN Lütfiye KADIOĞLU DALKILIÇ Yasemin ÖZEREN Semih DALKILIÇ Kübra ÇAKMAK Tuğrul ARSLAN ÇİÇEK	Fırat University, Türkiye
ZEYTİN İŞLETMESİ YAN ÜRÜNLERİNDEN ZEYTİN ACI SUYU VE KARA SUYUNUN ANTİMİKROBİYAL ÖZELLİKLERİ	Elif Ayça GÜLER Elif ÖZBEY	Turgut Ozal University, Türkiye
DETERMINATION OF THE EFFECTIVENESS OF <i>BACILLUS AMYLOLIQUEFACIENS</i> AGAINST <i>SCLEROTINIA SCLEROTIUM</i> IN SUNFLOWER IN <i>IN VITRO</i> CONDITIONS USING DIFFERENT METHODS	Özden SALMAN Raziye KOÇAK Ece AKALIN	Selçuk University, Türkiye

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**Session-2, Hall-3**

**11.11.2023**

**Moderator: Major Gheorghe GIURGIU**

**Meeting ID: 875 0838 3006 / Passcode: 121212**

**Ankara Local Time: 15:30 – 17:30**

Title	Author(s)	Affiliation
EFFECT OF LIPID-BASED MULTIPLE MICRONUTRIENTS SUPPLEMENTATION IN UNDERWEIGHT PRIMIGRAVIDA PRE-ECLAMPTIC WOMEN ON MATERNAL AND PREGNANCY OUTCOMES: RANDOMIZED CLINICAL TRIAL	Dr. Saima Shaheen Dr. Nabila Sher Dr. Mashal Zafar Hafsa Zafar	Khyber Medical University Peshawar Pakistan
IMPACT OF BASKETBALL TRAINING ON FUNCTIONAL PARAMETERS OF FRESH-YEAR YOUTH STUDENTS	Ilya Nikolaevich Medvedev	Kursk State University, Russia
DYSLIPIDEMIA AS A RISK FACTOR FOR CARDIOVASCULAR DISEASE DISEASES	PhD.Cand. Klara Hysenaj; Prof. Dr. Shpetim Qyra; Dr. Blerina Bani; Ph.Cand. Rezarta Stena	Alexander Xhuvani University, Elbasan, Albania Institute of Public Health, Tirana, Albania
SLEEP TROUBLES IN THE CARDIAC WORLD: A LOOK INTO LIFESTYLE-INDUCED INSOMNIA	Javeria Sheikh, Najaf Farooq, Noor Us Saba, Areeba Jabeen, Aqsa Haider	Jinnah University for Women, Karachi, Pakistan. Sohail University, Karachi, Pakistan.
MicroRNAs IN TAKOTSUBO SYNDROME	Yash Sailesh Kumar, Angela Thomas, Janethree Ganehiarachchi, Riya Gulati, Saniya Akram, Shiona Maria Benedict Fernandes	Tbilisi State Medical University, Georgia
ANALYSIS OF THE REQUIREMENTS OF PHARMACOPEIAS FOR THE PREPARATION INFUSION AND DECOCTION IN PHARMACIES	Liliia Vyshnevskaya, Marina Buryak	National university of pharmacy, Kharkiv, Ukraine
SLEEP DURATION, SOCIAL SUPPORT AND LIFE SATISFACTION AMONG HOSTILITIES AND NON-HOSTILITIES UNIVERSITY STUDENTS	Fatima, Liaqat Abbas, Hira Farhan	University of Management and Technology, Lahore
THE INFLUENCE OF PLANTS ON THE MICROBIOME IN PATIENTS WITH AUTOIMMUNE DISEASES	Major Gheorghe GIURGIU, Prof dr Manole COJOCARU, Prof dr Georgeta SINIȚCHI	Deniplant-Aide Sante Medical Center, Romania Titu Maiorescu University, Romania Atopy Allergological Medical Center, Iasi
MULTIDRUG RESISTANCE OF ENTEROBACTERIACEA FROM ASYMPTOMATIC CHILDREN CARRIERS IN KETU ADIE-OWE COMMUNITY OGUN STATE, NIGERIA	OLAITAN, Abiodun J, Ass Prof. AGBAJE-DANIELS, Folashade, Prof. OLADIPUPO, Basirat.O, Prof. MAKINDE, Sunday C, ADETUTU, Faith. O	Lagos State University, Nigeria. Crawford University Igbesa Ogun State, Nigeria.
THE NEGATIVE IMPACT OF ANOREXIA NERVOSA AND BULIMIA NERVOSA ON PREGNANCY	Sakina, Naga Harika korrapati, Riya Gulati	Tbilisi State Medical University

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**Session-2, Hall-4**

**11.11.2023**

**Moderator: Dr. Ghanshyam Barman**

**Meeting ID: 875 0838 3006 / Passcode: 121212**

**Ankara Local Time: 15:30 – 17:30**

Title	Author(s)	Affiliation
OPERANDO X-RAY SCATTERING STUDIES DURING INJECTION OF MOULDING OF BIOPLASTICS	Anabela P. Massano Geoffrey R Mitchell	Polytechnic of Leiria, Portugal
AZEOTROPIC DISTILLATION OF NATURAL PRODUCTS	Dr. Ghanshyam Barman	Uka Tarsadia University, India
CHEMICAL, PHYSICAL AND BIOLOGICAL ANALYSIS OF RIVER WATER AND SEDIMENT; SITNICA, IBRI, TREPÇA AND DRENICA - CORRELATION WITH EU STANDARDS - FOR SURFACE WATERS	Skender Demaku, Donika Sylejmani, Ermond Frangu, Arbnorë Aliu, Dafina Mehmeti, Diana Zabeli	University of Pristina, Kosovo
STRUCTURE-BASED DRUG REPURPOSING TO INHIBIT THE DNA GYRASE OF MYCOBACTERIUM TUBERCULOSIS	Balasubramani G L, Rinky Rajput, Manish Gupta, Pradeep Dahiya, Jitendra K Thakur, Rakesh Bhatnagar and Abhinav Grover	Jawaharlal Nehru University National Institute of Plant Genome Research Banaras Hindu University, India
INFLUENCE OF AGRICULTURAL PRACTICES AND SEASON INTERACTIONS ON VEGETATIVE GROWTH, SEED YIELD, AND OIL CONTENT OF BLACK MAHALAB (MONECHMA CILIATUM) A PROMISE OIL CROP	B. E. E. Babikir, S. A. Rayis, A. A. Mariod	University of Sinnar Faculty of Agriculture, Sudan University of Jeddah, Saudi Arabia Ghibaish College of Science and Technology, Ghibaish, Sudan
ANALYZING FOREST RESIDENTS' PERCEPTION AND KNOWLEDGE OF FOREST ECOSYSTEM SERVICES TO GUIDE FOREST MANAGEMENT IN THE IFRANE NATIONAL PARK (MOROCCO)	Hassana Ismaili Alaoui	Ibn Tofail University
THE EFFECT OF GLOBAL WARMING AND CLIMATE CHANGE ON SUSTAINABLE AGRICULTURAL PRODUCTION	Atilgan ATILGAN, Hasan ERTOP, Joanna KOCIECKA	Alanya Alaaddin Keykubat University, Turkey Isparta University of Applied Science, Turkey Poznań University of Life Sciences, Poland
HEAVY METALS AS WATER AND SEDIMENT POLLUTANTS OF THE LLAP RIVER, DISTRICT; PODUJEV-LLUZHAN-BARILEV	Skender Demaku, Donika Sylejmani, Alma Ejupi, Aurita Muji, Arbnorë Aliu	University of Prishtina "Hasan Prishtina"

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**Session-2, Hall-5****11.11.2023****Moderator: Yavuz KOÇ****Meeting ID: 875 0838 3006 / Passcode: 121212****Ankara Local Time: 15:30 – 17:30**

Title	Author(s)	Affiliation
SOME PROPERTIES OF GENERALIZED BIVARIATE BIHYPERBOLIC POLYNOMIALS	Sure KÖME Sinem ERGEZER	Nevşehir Hacı Bektaş Veli University, Türkiye
FUNDAMENTAL RESULTS ON DISCONTINUOUS BOUNDARY VALUE PROBLEM WITH PERIODIC BOUNDARY CONDITIONS	Oktay Sh. MUKHTAROV Kadriye AYDEMİR Merve YÜCEL	Gaziosmanpaşa University, Türkiye Amasya University, Türkiye Hitit University, Türkiye
DIFFERENTIAL TRANSFORMATION TECHNIQUE TO SOLUTION OF TWO-INTERVAL BVP'S	Merve YÜCEL Oktay Sh. MUKHTAROV Kadriye AYDEMİR	Gaziosmanpaşa University, Türkiye Amasya University, Türkiye Hitit University, Türkiye
GENERALIZED TOPOLOGIES, PERFORMANCE AND EFFICIENCY COMPARISON OF THE HIGH STEP-UP NON-ISOLATED STACKED COUPLED INDUCTOR DC-DC BOOST CONVERTERS	Yavuz KOÇ	Marmara University, Türkiye Yüzüncü Yıl University, Türkiye
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ALTI-FAZLI SÜREKLİ MIKNATISLI SENKRON MAKİNEİNİN 'STAR OF SLOTS'  
METODU KULLANARAK SARGI DAĞILIMININ YAPILMASI

OBTAINING THE WINDING DISTRIBUTION OF A SIX-PHASE PERMANENT  
MAGNET SYNCHRONOUS MACHINE USING THE 'STAR OF SLOTS' METHOD

*Ali Akay*

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**ÖZET**

Son zamanlarda, çok fazlı makineler araştırmacıların ilgisini çekmeye başlamıştır. En çok çalışılan çok fazlı makineler beş fazlı ve altı fazlı makinelerdir. Altı fazlı makineler simetrik ve asimetrik makine olmak üzere ikiye ayrılır. Altı fazlı makine, araştırmacılar tarafından genelde iki tane üç fazlı makinenin statorda birleştirilmesi ile elde eder. Altı fazlı makineler, literatürde çift üç fazlı makine olarak da geçmektedir. Eğer, bu iki üç fazlı makine arasındaki faz farkı  $60^\circ$  ise simetrik,  $30^\circ$  ise asimetrik altı fazlı makine olarak adlandırılır. Bu çalışmada simetrik altı fazlı sürekli mıknatıslı senkron makinenin (PMSM) 'star of slots' metodu kullanılarak sarımlarının dağılımı yapılmıştır. Bu metotta, sarım dağılımı yapılırken yoğunlaştırılmış (concentrated) sarım metodu kullanılır. Yoğunlaştırılmış sargı metodu makinenin üretim aşamasında üreticiye kolaylıklar sağladığı için çok tercih edilen bir yöntemdir. Sarımları belirlenen altı fazlı makine sonlu elemanlar metodu (SEM) kullanan yazılımlarla başarılı bir şekilde tasarlanmıştır. Makineye ait zıt-emk ve tork grafiklerinin çıktısı sunulmuştur.

**Anahtar Kelimeler:** Sürekli mıknatıslı makine, çok fazlı makine, altı fazlı makine, çift üç fazlı makine.

**ABSTRACT**

Recently, multiphase machines have begun to attract the attention of researchers. The most commonly studied multiphase machines are five-phase and six-phase machines. Six-phase machines are divided into symmetrical and asymmetrical machines. The six-phase machine is generally obtained by researchers by combining two three-phase machines in the stator. Six-phase machines are also referred to as double three-phase machines in the literature. If the phase difference between these two three-phase machines is  $60^\circ$ , it is called symmetric, and if it is  $30^\circ$ , it is called asymmetric six-phase machine. In this study, the distribution of the windings of the symmetrical six-phase permanent magnet synchronous machine (PMSM) has been designed using the 'star of slots' method. In this method, concentrated winding method is used while winding distribution. The concentrated winding method is a highly preferred method as it provides convenience to the manufacturer during the production of the machine. The six-phase machine, whose windings was determined, has been successfully designed with software using the finite element method (FEM). The output of the back-emf and torque graphs of the machine is presented.

**Key Words:** Permanent magnet machine, multiphase machine, six-phase machine, double three-phase machine.

## GİRİŞ

Güç elektroniği dönüştürücülerinin gelişmesiyle birlikte, elektrik makinelerinin işlemleri artık güç kaynağındaki mevcut faz sayısı ile sınırlı değildir. Bu nedenle çok fazlı makineler yenilendi ve güvenlik ve hata toleransının birinci derecede önem taşıdığı uygulamalarda yerini buldu. Farklı faz sayıları arasında altı fazlı makine, mevcut üç fazlı teknolojiye kolay uyum sağlamaya olanak tanıyan modüler üç fazlı yapısı nedeniyle en çok araştırılan çok fazlı makine türlerinden biridir. Üstelik, geleneksel üç fazlı makinelerin geri sarılmasıyla nispeten daha az çabayla altı fazlı makineler elde edilebiliyor ve bu da onları diğer çok fazlı makinelere göre daha kullanışlı hale getiriyor[1]–[4].

Genel olarak mevcut altı fazlı makineler, iki üç fazlı sargı arasındaki yer değiştirme açısına bağlı olarak üç ana tipte sınıflandırılabilir[5]–[7].  $30^\circ$ ,  $60^\circ$  veya  $0^\circ$  yer değiştirme açısıyla makine, asimetrik altı fazlı, simetrik altı fazlı veya ikili üç fazlı olarak yapılandırılabilir. Geleneksel olarak asimetrik altı fazlı makine, altı adımlı bir invertörle çalıştırıldığında düşük tork dalgalanmaları nedeniyle diğer altı fazlı makinelere göre daha fazla tercih edilmiştir. Ancak modern yüksek frekanslı darbe genişlik modülasyonu (PWM) yöntemiyle simetrik altı fazlı makinelerin asimetrik altı fazlı makinelerle benzer tork performansına sahip olabileceği gösterilmiştir. Bu nedenle simetrik altı fazlı ve çift üç fazlı makine, asimetrik altı fazlı makinelere umut vaat eden iki alternatif olarak düşünülebilir.

## STAR OF SLOTS METODU

Star of slots, her stator slotunun bir iletkeninde indüklenen elektromotor kuvvetin (EMF) ana harmoniğinin fazörlerini gösterir[8]–[10]. Diğer bir ifade ile, star of slots, stator slotları içindeki her bir bobinin bir tarafında indüklenen EMF'nin fazörlerini temsil etmektedir. Fazör sayısı slot sayısına eşittir ve her bir fazör, karşılık gelen iletkeni içeren slotun numarasına göre numaralandırılır.

Makinenin elektriksel periyodikliği  $t$ ,  $Q$  slot sayısı ile  $p$  kutup çifti sayısı arasındaki en büyük ortak bölen (EBOB) olmasıyla tanımlanır.

$$t = EBOB(Q, p) \quad (1)$$

Denklem (2)  $m$  çok fazlı bir makinenin faz sayısını göstermek üzere,  $m$ -fazlı bir makine için belirli bir sarım düzeni, aşağıdaki koşul sağlandığında mümkündür.

$$\frac{Q}{mt} = \text{tam sayı} \quad (2)$$

Star of slots  $Q/t$  referans yönlerden oluşur ve her referans yön  $t$  fazör içerir. İki bitişik slotun fazörleri arasındaki elektriksel açı  $\alpha_s^e = p\alpha_{ph}$  dir. İki referans yön arasındaki açı aşağıdaki gibidir:

$$\alpha_{ph} = \frac{360}{(Q/t)} = \frac{\alpha_s^e}{p} t \quad (3)$$

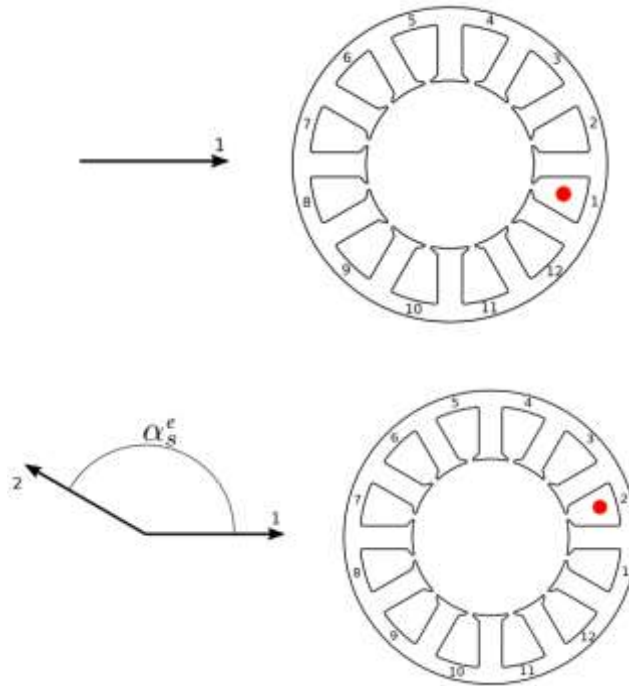
Birinci faza ait fazörler, her biri  $180/m$  dereceyi kapsayan iki zıt sektör (bir daire bölümü) çizilerek belirlenir. Dolayısıyla iki sektör içerisinde yer alan fazörler birinci faza aittir. Bir sektördeki bobin sarımları pozitif akım yönüne göre sarılırken, diğer sektör içindeki bobin sarımları negatif negatif akım yönüne göre sarılır. Diğer fazlar için, iki sektörü  $2k\pi/m$  radyan açısı kadar döndürmek yeterlidir; burada  $k = 1, 2, 3, \dots (m - 1)$ . Bu işlemlerle her bir faza ait

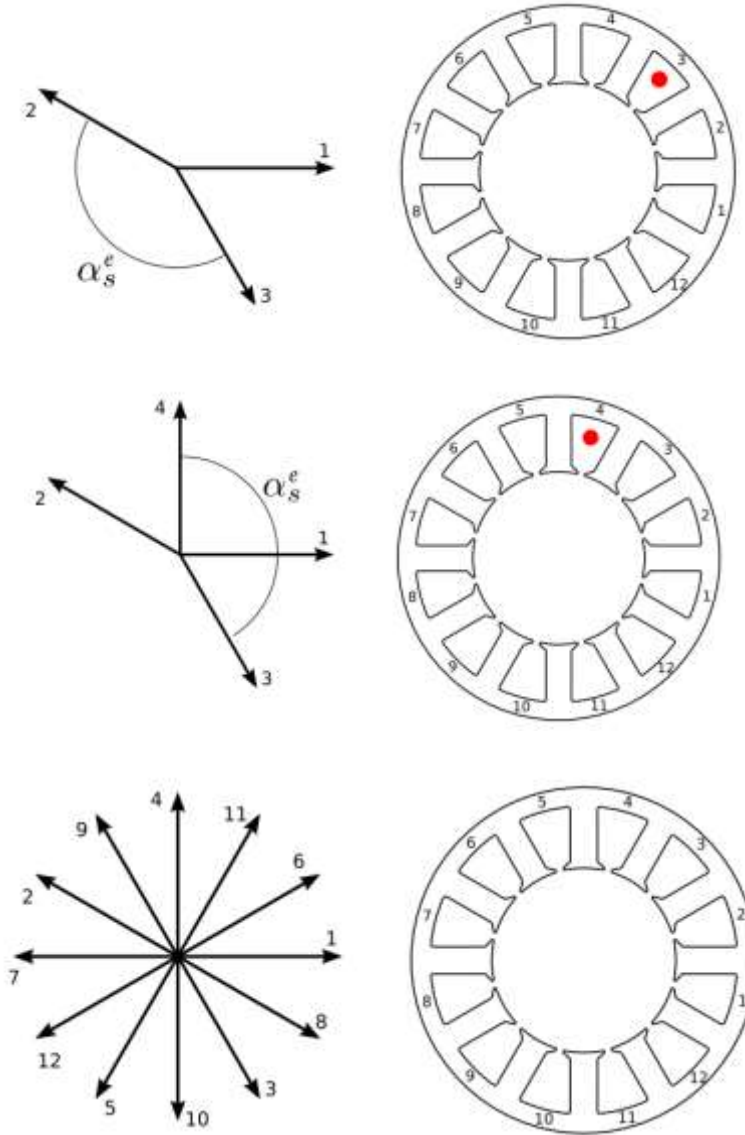


sarım dağılımı belirlenmiş olur. Ya da her bir faza ait sarımlar  $360/m$  dereceyi kapsayan sektördeki fazörler olarak da belirlenebilir. Bu durumda bir sektördeki bobin sarımları sadece pozitif akım yönüne göre sarılır

### STAR OF SLOTS METODU İLE ALTI-FAZLI MAKİNEİNİN SARGI DAĞILIMININ YAPILMASI

Bu bölümde, bir önceki bölümde tanıtılan yöntem kullanılarak, 12 slot ve 10 kutuptan oluşan simetrik (her bir faz arası açı  $60^\circ$ ) altı-fazlı makinenin sarım dağılımı belirlenmiştir. Sarım dağılımına başlamadan önce makinenin seçilen slot sayısı ile kutup sayısının uygun değerler olduğu kontrol edilmelidir. Slot sayısı ile kutup sayısının en büyük ortak böleni  $t = EBOB(12,5) = 1$  dir. Elde edilen EBOB değeri, denklem (3) de yerine konduğunda elde edilen değer tam sayı olması gerekiyor. Buradaki işlemler sonucunda çıkan sonucun tam sayı olduğu görülmektedir. Dolayısı ile sarım dağılımı yapmak için herhangi bir engel yoktur. Bir sonraki işlemde referans yön sayısının belirlenmesi gerekmektedir.  $Q/t = 12/1 = 12$  tane referans yön vardır. İki komşu referans yön arasındaki açı  $\alpha_{ph} = (360 \cdot t)/12 = (360 \cdot 1)/12 = 30^\circ$  dir. İki bitişik (komşu) slotun fazörleri arasındaki elektriksel açı  $\alpha_s^e = p\alpha_{ph} = 5 \cdot 30 = 150^\circ$  dir. Buna göre bir (1) numaralı slotu temsil eden 1 nolu fazör  $0^\circ$  yi referans açı olarak kullanırsa bir sonraki slot olan ikinci slotu temsil eden 2. fazör elektriksel olarak  $150^\circ$  de, onu takip üçüncü slotu temsil eden 3. fazör  $150^\circ + 150^\circ = 300^\circ$  de bulunur. Bu şekilde diğer fazörler de oluşturulur. Fazörlerin oluşumu 4. Fazöre kadar adım adım aşağıdaki Şekil 1’de gösterilmiştir. Yine Şekil 1’de tüm fazörleri gösteren “star of slots” gösterilmiştir.





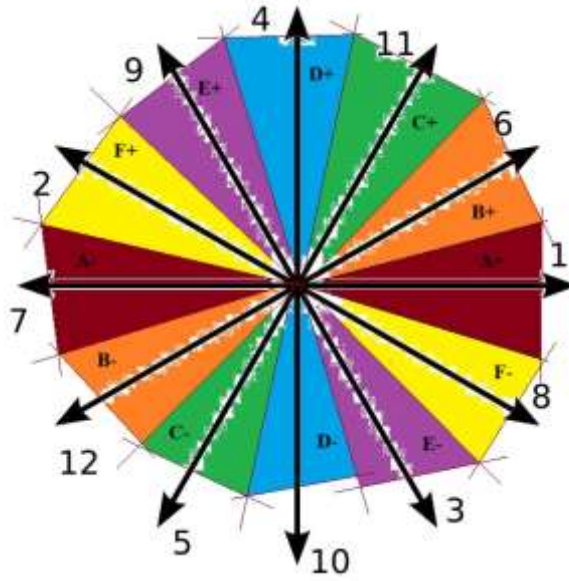
Şekil 1: 12 Slot/10 kutuplu altı fazlı makinenin slotlarının “star of slots” dağılımı[9], [10].

Tüm fazörler yerleştirildikten sonra elde edilen bu fazörler her bir faz için sektörlere ayrılması gerekir. Bu fazörler iki şekilde sektörlere paylaşılabilir. Birinci yöntemde 12 sektöre ayrılmıştır. 12 sektör Şekil 2 de gösterilmiştir. Bu sektör artı yönde sarım ve eksi yönde sarım olarak her bir faza iki sarım düşmüştür. Örneğin A fazının A+ sarımını yaparken birinci (1.) slottan iki (2) nolu slota birinci sarımın yapılacağıdır ve A- sarımını yaparken bu sefer sarım pozitif sarım yönünün tersi yönünde olacak şekilde yedinci (7.) slottan sekizinci (8.) slota olacak şekilde yapılır. Bu şekilde diğer fazlara ait olan sarımlarda Şekil 2’ye bakılarak belirlenir. Tüm fazlara ait sarım dağılımı Tablo 1’de gösterilmiştir.

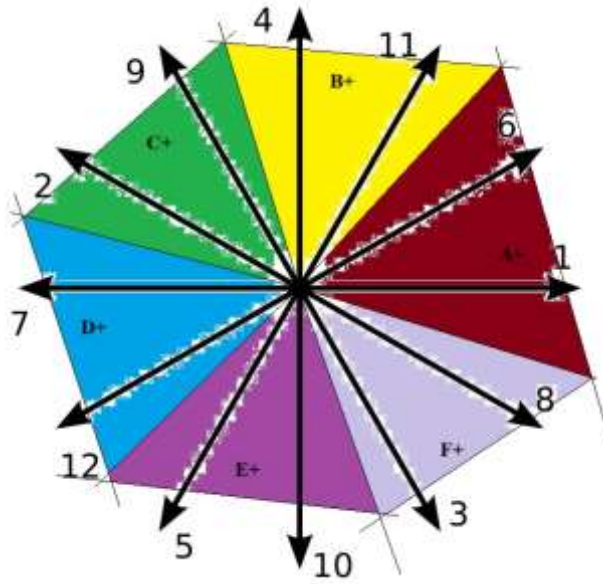
Tablo 1: Yöntem 1; 12 sektör faz sarım dağılımı.

Faz A		Faz B		Faz C		Faz D		Faz E		Faz F	
Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış
1	2	6	7	11	12	4	5	9	10	2	3
8	7	1	12	6	5	11	10	4	3	9	8

Diğer yöntemde fazörler Şekil 3'teki gibi altı sektöre bölünür. Burada elde edilen her bir sektör sadece bir sarım yönünü (pozitif) göstermektedir. Örneğin A fazı için sarımlar 2 tanedir. 1 nolu fazör ve 6 nolu fazörden gelir. Fazlara ait sarımlar Tablo 2'de gösterilmiştir.



Şekil 2: 12 sektöre bölünüp faz sarımlarının dağılımının elde edilmesi.

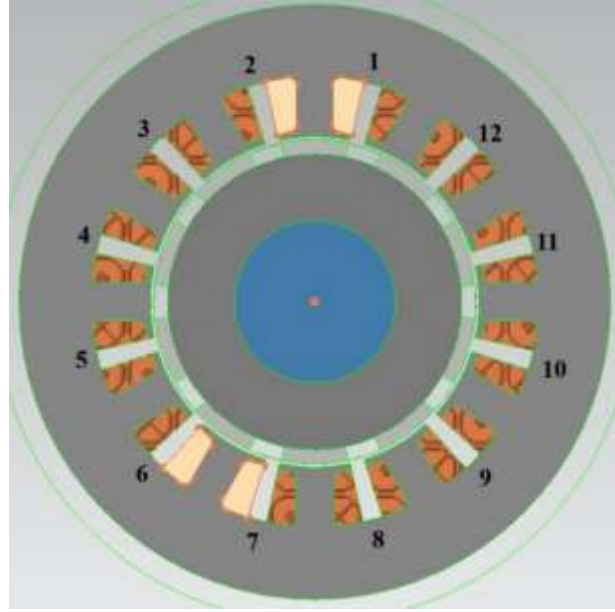


Şekil 3: 6 sektöre bölünüp faz sarımlarının dağılımının elde edilmesi.

Tablo 2: Yöntem 2; 6 sektör faz sarım dağılımı.

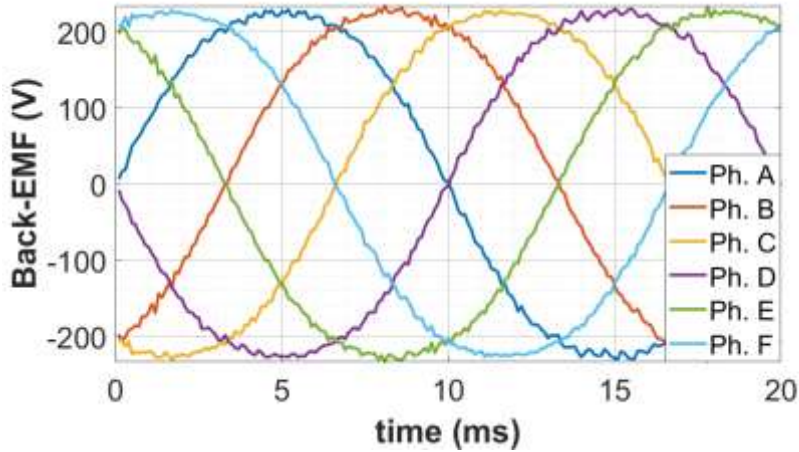
Faz A		Faz B		Faz C		Faz D		Faz E		Faz F	
Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış	Giriş	Çıkış
1	2	11	12	9	10	7	8	5	6	3	4
6	7	4	5	2	3	12	1	10	11	8	9

## ALTI-FAZLI MAKİNEİNİN SEM ANALİZİ



Şekil 4: SEM yazılımında tasarlanan altı fazlı PMSM.

Bu bölümde simetrik altı-fazlı makine için bir önceki bölümde elde edilen sarım dağılımı yöntemlerinden ikinci yöntem ile elde edilen sarım dağılımı kullanılmıştır. Bu yöntem ile sonlu elemanlar yöntemi (SEM) kullanan yazılım ile tasarlanan altı fazlı makinenin görünümü aşağıda Şekil 4’de verilmiştir. Tasarlanan makinenin slot numaraları ve A fazının sarımlarının yapıldığı slotlar Şekil 4’de gösterilmiştir. Tablo 2’de verilen sarım dağılımları kullanılarak diğer fazlara ait sarımlar her bir faz için ayrı ayrı atanmıştır. Tasarlanan altı fazlı PMSM makinenin zıt-EMK’sını Şekil 5’de görebilirsiniz. Altı fazlı makinenin istenilen bir zıt-EMK’ya sahip olduğu göstermektedir. Zıt-EMK grafiğine bakıldığında, fazlar arasındaki açının eşit olduğu net bir biçimde görülmektedir.



Şekil 5: SEM yazılımında tasarlanan altı fazlı PMSM makine zıt-EMK çıktısı.

## SONUÇ

Bu çalışmada star of slots metodu kullanılarak simetrik altı fazlı bir PMSM makinenin sarım dağılımı yapılmıştır. Star of slots metodu ile zıt-EMK’ya ait fazörler referans yönlerine göre ilgili açılar kullanılarak dairesel bir düzleme yerleştirilmiştir. Bu fazörlerin sırası ve yerleşimi  $\alpha_{ph}$ ,  $\alpha_s^e$  ve  $p$  değerlerinden elde edilen açı değerine göre yapılmıştır. Dairesel düzlemde elde

edilen bu fazörler faz sayısına göre sektörlere (daire dilimlerine) ayrılarak, ilgili faz için olması gereken sarımların giriş ve çıkış slotları bu sektör içinde kalan fazörler kullanılarak elde edilir. Her bir faz için sarımların giriş ve çıkış slotları belirlenmiş ve tablolar oluşturulmuştur. Oluşturulan bu tablolar faydalanılarak, SEM yazılımında tasarlanan altı fazlı makinenin sarım dağılımı yapılmıştır. Yapılan test sonucunda altı fazlı makinenin zıt-EMK grafikleri elde edilmiş ve grafiklerden de anlaşılacağı üzere makinenin zıt-EMK dalgaları arasında eşit açılarının olduğu görülmektedir. Sonuç olarak star of slots metodu ile başarılı bir şekilde altı fazlı makinenin sarılım dağılımı gerçekleştirilmiştir.

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SYNTHESIS AND CHARACTERIZATION OF CALIX[4]ARENE DERIVATIVE  
BEARING PYRIDINE, 1,3,4-OXADIAZOLE AND 1,2,3-TRIAZOLE

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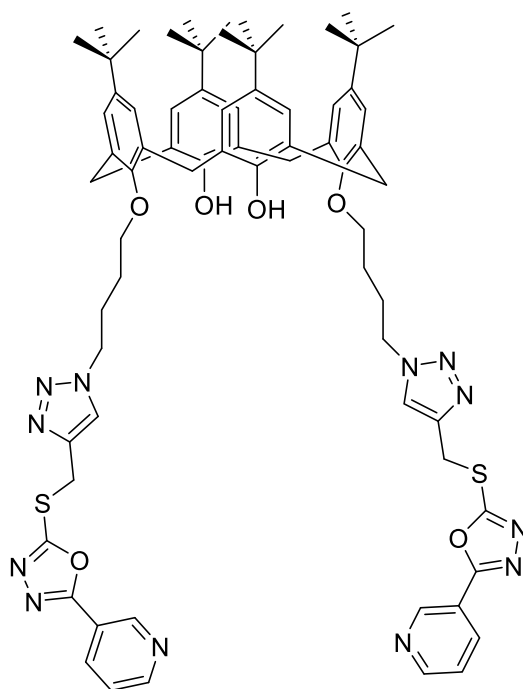
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ABSTRACT

In this study, we aimed to synthesize calixarene derivative compound containing heterocyclic compounds. It was desired to synthesize a molecule that could form a complex based on the cavity and functionalizability properties of the calixarene molecule. For this purpose, p-tert-butylcalixarene molecule was first synthesized and then a four-carbon alkyl group bearing two bromines was bonded on this molecule. Bromine groups were converted to azide groups and the final product was synthesized by performing a click reaction with 2-(prop-2-yn-1-ylthio)-5-(pyridin-3-yl)-1,3,4-oxadiazole group. The structure of the resulting compound was illuminated by taking <sup>1</sup>H NMR and <sup>13</sup>C NMR.

**Keywords:** Calix[4]arene, click chemistry, 1,3,4-oxadiazole, 1,2,3-triazole



INVESTIGATION of CYTOTOXIC, APOPTOTIC/NECROTIC ACTIVITY of  
AQUILARIA AGALLOCHA EXTRACT

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**ÖZET**

*Aquilaria agallocha*, *Thymelaeaceae* familyasına ait olup genellikle Doğu Asya ülkelerinde (Bangladeş, Hindistan, Malezya, Singapur, Tayland) endemik bir tür olarak bulunur. Halk arasında Agar Ağacı gibi isimlerle de anılan bir bitki türüdür. Sinonim olarak *A.agallocha*, *A. secundaria* gibi isimlerle de anılır. Bu bitkinin soyunun tehlike altında olduğu bildirilmiştir. Bunun sebebi halk arasında tedavi yöntemi olarak bilinçsiz kullanım düzeyi, bu bitkinin illegal ticari araç olarak kullanılması ve bunlardan kaynaklı bu ağacın sıklıkla kesilmesine dayanmaktadır. Halk arasında kalp rahatsızlıkları, astım, öksürük, ülser, gut ve iltihaplanma, ağrı gibi durumlar için de kullanıldığı bilinmektedir. Yapılan bazı çalışmalarda *A.agallocha* bitkisinin antikanser özelliği tespit edilmiştir. Antikanser özellik olarak bu bitkide yer alan metabolitlerden olan skualen ve oleik asit gibi metabolitler rapor edilmiş ve buna ek olarak bu etkiye aday moleküller belirlenmiştir. Yapılan çalışmada *A. agallocha* bitki gövdesinden elde edilen ekstraktın, sitotoksik etkisinin belirlenmesi amaçlandı. Bitki gövdesi Elazığ ilinden ticari olarak temin edilip metanol, aseton ve hekzan çözücülerini ile ekstraksiyon işlemi yapıldı. Bu çalışmada insan meme kanseri (MCF-7) ve insan karaciğer karsinomu (HepG2) hücre hatları kullanıldı.

*A. agallocha* bitki gövdesinden elde edilen ekstraktın hücre hatlarından kullanılması sonucunda sitotoksik etkisine yönelik önceden bir çalışma olmaması, tıbbi kullanımda fayda mekanizmalarına ışık tutacağı düşünülmektedir. Yapılan deneyler sonucunda bu bitki ekstraktının hem antikanser hem de antioksidan etkisinin yüksek olduğu görüldü. HepG2 hücre

hattında MCF-7 hücre hattına göre daha yüksek olduğu belirlenmiştir. HepG2 hücre hattında *A. Agallocha* bitkisinin hekzan, metanol ve aseton ekstralarında en yüksek sitotoksik etkiyi 1000 µg/ml konsntrasyonu verdi. MCF-7 hücre hattında aseton ve metanol ekstralarında en yüksek sitotoksik etkiyi 1000 µg/ml verirken hekzan ekstresinde 250 µg/ml verdi.

Elde edilen sonuçlara göre ikinci aşamada bu doğal ürünün in vivo olarak hayvan deneylerinde kullanılması düşünülmektedir. Yapılacak bu tür ileri analizler ile kanser araştırmaları, farmakoloji ve eczacılık alanına önemli katkılar sağlanabilecektir. Bu çalışma ulusal ve uluslararası literatüre önemli bir sonuç kazandırdı. Elde edilen veriler bilimsel dergilerde yayımlandıktan sonra, ulusal veya uluslararası bilimsel organizasyonlarda bildiri olarak sunulacak ve hem ülkemizde hem de dünyadaki bilim insanları ile paylaşılacaktır. Elde edilen sonuçlarda bir yüksek lisans çalışması olarak genişletilme veya daha kapsamlı yeni çalışmalara kaynak oluşturma potansiyeli bulunmaktadır.

**Anahtar kelimeler:** *Aquilaria agallocha*, MTT Assay, sitotoksik aktivite, HepG2, MCF-7

## ABSTRACT

In this template, the congress formatting requirements are described. The abstract should be at least 350 words, including spaces and summarise the main points of the paper. Font should be Times New Roman, font size 12 pt. Page Margins: Top, bottom, left and right margins must be set to 2,5 cm. Do not add paragraph spacing. All papers should be written as \*.doc or \*.docx format and they should be submitted to email address of conference website.

*Aquilaria agallocha* belongs to the Thymelaeaceae family and is generally found as an endemic species in East Asian countries (Bangladesh, India, Malaysia, Singapore, Thailand). It is a type of plant that is also known as Agar Tree among the public. It is also referred to synonymously as *A. agallocha*, *A. secundaria*. It has been reported that this plant is endangered. The reason for this is the unconscious use of this plant as a treatment method among the public, the use of this plant as an illegal commercial tool and the frequent cutting down of this tree due to these. It is known that it is also used for conditions such as heart diseases, asthma, cough, ulcers, gout, inflammation and pain. In some studies, the anticancer properties of the *A. agallocha* plant have been determined. Metabolites such as squalene and oleic acid, which are among the metabolites in this plant, have been reported to have anticancer properties, and in addition, candidate molecules for this effect have been identified.

The aim of the study was to determine the cytotoxic effect of extracts obtained from *A. agallocha* plant body. The plant body was commercially obtained from Elazığ province and extracted with methanol, acetone and hexane solvents. Human breast cancer (MCF-7) and human liver carcinoma (HepG2) cell lines were used in this study.

It is thought that since there is no previous study on the cytotoxic effect of the extract obtained from the *A. agallocha* plant body using cell lines, it will shed light on the beneficial mechanisms in medical use. As a result of the experiments, it was seen that this plant extract had both anticancer and antioxidant effects. It was determined that it was higher in the HepG2 cell line than in the MCF-7 cell line. In the HepG2 cell line, 1000 µg/ml concentration gave the highest cytotoxic effect in hexane, methanol and acetone extracts of *A. Agallocha* plant. In the MCF-7 cell line, 1000 µg/ml gave the highest cytotoxic effect in acetone and methanol extracts, while 250 µg/ml in hexane extract. According to the results obtained, it is planned to use this natural product in in vivo animal experiments in the second stage. With such advanced analyses, significant contributions can be made to the fields of cancer research, pharmacology and pharmacy. This study brought an important result to the national and international literature.

After the data obtained are published in scientific journals, they will be presented as papers in national or international scientific organizations and shared with scientists both in our country and around the world. In the results obtained It has the potential to be expanded as a master's degree study or to serve as a source for more comprehensive new studies.

**Keywords:** *Aquilaria agallocha*, MTT Assay, cytotoxic activity, HepG2, MCF-7

ENGEREK OTU (*Echium vulgare* L.) TOHUMUNUN SİTOTOKSİK,  
ANTİMİKROBİYAL VE ANTİOKSİDAN AKTİVİTESİNİN ARAŞTIRILMASI  
INVESTIGATION OF CYTOTOXIC, ANTIMICROBIAL AND ANTIOXIDANT  
ACTIVITY OF *ECHIUM VULGARE* L. SEED

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## ÖZET

*Echium vulgare* (*E. vulgare*), Engerek otu olarak da bilinen *Boraginaceae* familyasına ait *Echium* cinsinin çiçekli bir türüdür ve antimikrobiyal, antiviral, antioksidan, antiinflamatuvar gibi çok sayıda biyolojik özelliklere sahip bir bitkidir. Bu çalışmada, insan meme kanseri (MCF-7) ve insan karaciğer kanseri (HepG2) hücre hatlarında *E. vulgare* tohumunun metanol ve hekzan çözücülerinde ekstraktları hazırlanmıştır. Sitotoksik aktivite tayini için hazırlanan iki farklı çözücüde dört farklı konsantrasyon (100, 200, 400, 800 µg/mL) hazırlanmış ve MTT (3-(4,5-dimetiltiazol-2-il)-2,5 difeniltetrazolyum bromür) yöntemi ile hücre canlılığını ölçülmüş olup pozitif kontrol olarak Doksorubisin kullanılmıştır. Antioksidan aktivite ise 2,2-Difenil-1-Pikrilhidrazil (DPPH) radikal süpürücü kapasitesi yöntemi ile belirlenmiştir. Metanol ve hekzan çözücülerini kullanarak, antimikrobiyal aktivite için dört farklı konsantrasyon (25, 50, 75, 100 mg/mL) hazırlanmış olup; *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Escherichia coli*, *Bacillus megaterium* ve *Candida albicans* mikrorganizmaları kullanılarak disk difüzyon yöntemi ile tayin edilmiştir. Araştırma sonuçlarına göre, *E. vulgare* tohumundan elde edilen metanol ekstraktının *E. coli*'ye karşı 16±4 mm zon çapında en etkili antimikrobiyal aktiviteyi gösterdiği tespit edilmiştir. *E. vulgare* tohumlarından elde edilen ekstraktlar arasında, hekzanla



hazırlanan ekstraktın HepG2 hücre hattı üzerinde en yüksek sitotoksik etkiye sahip olduğu (%20) belirlenmiştir. *E. vulgare* tohumundan elde edilen hekzan ekstraktı, MCF-7 hücre hattında  $IC_{50}=62,6435 \mu\text{g/mL}$  ve HepG2 hücre hattında  $IC_{50}=287,6299 \mu\text{g/mL}$  değerleri ile en yüksek sitotoksik etkiyi göstermiştir. *E. vulgare* tohumunun metanol ile hazırlanan ekstraktı, %36 antioksidan aktiviteyi sağlamıştır. Araştırmadan elde edilen verilere göre, *E. vulgare* tohumu antimikrobiyal, antioksidan ve sitotoksik özelliklere sahip olduğu tespit edilmiştir. Bu özellikleri sebebiyle, hem antikanser hem de antimikrobiyal tedavilerde kullanılabilir potansiyel bir araç olarak öngörülmektedir.

**Anahtar Kelimeler:** *Echium vulgare*, sitotoksik, antimikrobiyal, antioksidan aktivite, MCF7 ve HepG2 hücre hatları.

## ABSTRACT

*Echium vulgare* (*E. vulgare*) is a flowering species of the genus *Echium* belonging to the family *Boraginaceae*, also known as viper grass, and is a plant with numerous biological properties such as antimicrobial, antiviral, antioxidant and anti-inflammatory. In this study, extracts of *E. vulgare* seed were prepared in methanol and hexane solvents in human breast cancer (MCF-7) and human liver cancer (HepG2) cell lines. Four different concentrations (100, 200, 400, 800  $\mu\text{g/mL}$ ) were prepared in two different solvents and cell viability was measured by MTT (3-(4,5-dimethylthiazol-2-yl)-2,5 diphenyltetrazolium bromide) method and Doxorubicin was used as positive control. Antioxidant activity was determined by 2,2-Diphenyl-1-Picrylhydrazyl (DPPH) radical scavenging capacity method. Four different concentrations (25, 50, 75, 100  $\text{mg/mL}$ ) were prepared for antimicrobial activity using methanol and hexane solvents and determined by disk diffusion method using *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Escherichia coli*, *Bacillus megaterium* and *Candida albicans* microorganisms. According to the results of the study, it was determined that the methanol extract obtained from *E. vulgare* seeds provided the most effective antimicrobial activity against *E. coli* with a zone diameter of  $16\pm 4$  mm. Among the extracts obtained from *E. vulgare* seeds, the extract prepared with hexane was found to have highest cytotoxic effects (20%) on HepG2 cell line. The hexane extract from *E. vulgare* seed showed the highest cytotoxic effect with  $IC_{50}=62.6435 \mu\text{g/mL}$  in MCF-7 cell line and  $IC_{50}=287.6299 \mu\text{g/mL}$  in HepG2 cell line. The methanol extract obtained from *E. vulgare* seed provided 36% antioxidant activity. According to the data obtained from the study, *E. vulgare* seed was found to have antimicrobial, antioxidant and cytotoxic properties. Due to these properties, it is envisioned as a potential tool for both anticancer and antimicrobial therapies.

**Keywords:** *Echium vulgare*, cytotoxic, antimicrobial, antioxidant activity, MCF7 and HepG2 cell lines.

SELF-ACCEPTANCE SCALE FOR PREGNANT WOMEN'IN TÜRKÇE  
VERSIYONUNUN GEÇERLİK VE GÜVENİRLİK ÇALIŞMASI  
VALIDITY AND RELIABILITY TESTING OF THE TURKISH VERSION OF THE  
SELF-ACCEPTANCE SCALE FOR PREGNANT WOMEN

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## ÖZET

**Amaç:** Araştırma Brezilya'da geliştirilen Self-Acceptance Scale for Pregnant Women (SAS-PW)'in Türkçe versiyonunu oluşturmak ve psikometrik özelliklerini test etmek amacıyla yapılmıştır.

**Gereç ve Yöntem:** Metodolojik türde olan araştırma Aralık 2021-Nisan 2022 tarihleri arasında, Türkiye'nin kuzeyinde bir Eğitim Araştırma Hastanesinin gebe polikliniklerine başvuran gebeler ile gerçekleştirilmiştir. Gebelerin örnekleme alınmasında basit rastgele örnekleme yöntemi kullanılmıştır. Araştırmaya okuma yazma bilen, tek fetüsü olan ve gebeliğinde risk faktörü olmayan gebeler dahil edilmiş olup anket formunun tamamını doldurmayan 9 gebe araştırmadan çıkarılmıştır. İstatistiksel analiz aşamasında dışlanan 35 gebe sonrasında araştırma 576 gebe ile tamamlanmıştır. Araştırmada SAS-PW'nin geçerlik analizinde dil, kapsam, yapı; güvenirlik analizinde iç tutarlılık ve test-tekrar test analizleri kullanılmıştır. Sonuçlar yorumlanırken %95 güven aralığı ve  $p < 0.05$  yanlışlığı düzeyi istatistiksel olarak önemli kabul edilmiştir.

**Bulgular:** Açıklayıcı faktör analizi sonrasında ölçeğin açıklanan varyans yüzdesi ve maddelerin faktör yükleri yeterli; doğrulayıcı faktör analizi sonrasında ölçeğin uyum indeksleri uygun aralıkta bulunmuştur. Orijinal SAS-PW'nin iki alt boyut ve 10 maddelik yapısı faktör analizleri ile doğrulanmıştır. İç tutarlılık analizinde ölçek maddelerinin madde toplam puan korelasyonları yeterli ve SAS-PW toplam Cronbach alfa katsayısı 0.933 olarak hesaplanmıştır. Ölçeğin test-tekrar test sonuçları arasındaki ilişkiye ait korelasyon değeri ise yüksek bulunmuştur.

**Sonuç:** Türkiye'de farklı ölçüm araçları kullanılarak gebeliğin kabulü, annelik algısı veya vücut algısına ilişkin yapılan araştırmalar mevcuttur. Gebelerin mevcut durumlarına (gebelik) yönelik olumlu tutumları gebeliği kabullenmeleri olarak nitelendirilebilir ve temelde kendini kabullenmeyi yansıtır. SAS-PW var olan ölçüm araçlarından farklı olarak gebelerde beden kabulü ve gebeliğin kabulü olmak üzere kendini kabul etmenin iki yönünü desteklemektedir.

SAS-PW'nin Türkçe versiyonunun gebelerde kendini kabul (self acceptance) düzeylerinin değerlendirilmesinde Türk toplumu için geçerli ve güvenilir bir araç olduğunu göstermektedir.

**Anahtar kelimeler:** Gebelik, Geçerlik, Güvenirlik, Kendini Kabul, Türkçeye Uyarlama

## ABSTRACT

**Objective:** This study was conducted to adapt the Self-Acceptance Scale for Pregnant Women (SAS-PW), which was developed in Brazil, to Turkish and test the psychometric properties of its Turkish version.

**Methods:** The methodological research was conducted between December 2021 and April 2022 with pregnant women who applied to the pregnancy outpatient clinics of a Training and Research Hospital in the north of Turkey. Simple random sampling method was used to sample pregnant women. Pregnant women who were literate, had a single fetus, and had no risk factors during pregnancy were included in the study and 9 pregnant women who did not fill out the entire survey form were excluded from the study. After 35 pregnant women were excluded during the statistical analysis stage, the study was completed with 576 pregnant women. In the validity analysis of SAS-PW in the research, language, scope, structure; Internal consistency and test-retest analyzes were used in reliability analysis. When interpreting the results, 95% confidence interval and  $p < 0.05$  error level were considered statistically significant.

**Results:** According to the results of the exploratory factor analysis, the factor load values of the items and the rates of the total variance in scale scores explained by the factors were sufficient. The confirmatory factor analysis results demonstrated that the goodness-of-fit indices of the scale were within suitable ranges. The 2-factor and 10-item construct of the original SAS-PW was confirmed based on the factor analyses. The item-total score correlations of the scale were found sufficient, and the total Cronbach's alpha coefficient of SAS-PW was determined to be 0.933. The test-retest analysis of the scale scores revealed a strong correlation between the scores of the two implementations.

**Conclusion:** Turkey have examined the acceptance of pregnancy, the perception of motherhood, and body perceptions using different measurement instruments. The positive attitudes of pregnant women toward their current status (pregnancy) can be considered their acceptance of pregnancy, and they fundamentally reflect self-acceptance. The Self-Acceptance Scale for Pregnant Women, which is different from other current measurement instruments, evaluates two aspects of self-acceptance in pregnant women, namely body acceptance and pregnancy acceptance. The Turkish version of SAS-PW is a valid and reliable measurement instrument to evaluate the self-acceptance levels of pregnant women in Turkish society.

**Keywords:** pregnancy, reliability, self-acceptance, Turkish adaptation, validity

**INVESTIGATION OF MECHANICAL PROPERTIES OF CONTINUOUS HEMP  
FIBER REINFORCED POLYURETHANE COMPOSITES**

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**ABSTRACT**

In recent years, there has been a growing interest in developing sustainable and environmentally friendly materials to address the challenges posed by traditional, petroleum-based composites. This study focuses on the development and characterization of continuous hemp fiber reinforced polyurethane composites, aimed at providing an alternative material that combines strength, durability, and sustainability. For this purpose, composites were obtained by preparing continuous hemp fiber and laying it in the mold followed by pouring the mixture of diisocyanate and polyol, which are polyurethane components. Afterwards, the mechanical properties of these composites, including breaking strength, elongation at break and elastic modulus values, were examined by tensile tests. From the results, it was seen that the breaking strength, breaking elongation and elastic modulus values of the polyurethane polymer were 18.8 MPa, 33% and 784 MPa, respectively. These values were determined as 8.97 MPa, 3.11% and 340 MPa, respectively, for continuous hemp fiber reinforced composite. It was understood that this decrease in the mechanical values of the composite was due to its porous structure. Due to the porous structure of the composite, it is thought that it can be used as a heat and sound insulation material in industries such as automotive, construction and aviation, and its mechanical properties are sufficient for these applications. Thus, this work offers a promising

pathway for the use of renewable resources in the development of environmentally friendly composites, promoting a more sustainable future for the materials industry.

**Keywords:** hemp fiber, polyurethane, sustainability, carbon footprint, bio-composites

## ÖZET

Son yıllarda, geleneksel petrol esaslı kompozitlerin yarattığı zorlukların üstesinden gelmek için sürdürülebilir ve çevre dostu malzemeler geliştirmeye ilgi artmaktadır. Bu çalışma, mukavemet, dayanıklılık ve sürdürülebilirliği birleştiren alternatif bir malzeme geliştirmeyi amaçlayan sürekli kenevir elyaf takviyeli poliüretan kompozitlerin geliştirilmesine ve karakterizasyonuna odaklanmaktadır. Bu amaçla öncelikle sürekli kenevir lifinin hazırlanarak kalıba serilmesi daha sonra polyüretan bileşenleri olan diizosiyonat ve poliöl karışımının dökülmesi ile kompozitler elde edilmiştir. Sonrasında bu kompozitlerin çekme testleri ile kopma mukavemeti, kopma uzaması ve elastik modül değerleri olmak üzere mekanik özelliklerini incelenmiştir. Sonuçlardan poliüretan polimerin kopma dayanımı, kopma uzaması ve elastik modül değerlerinin sırasıyla 18,8 MPa, %3,3 ve 784 MPa olduğu görülmüştür. Bu değerler sürekli kenevir lif takviyeli kompozit için sırasıyla 8,97 MPa, %3,11 ve 340 MPa olarak belirlenmiştir. Kompozitin mekanik değerlerindeki bu azalışın gözenekli yapıda olmasından kaynaklandığı anlaşılmıştır. Kompozitin gözenekli yapısından dolayı otomotiv, inşaat ve havacılık gibi endüstrilerde ısı ve ses yalıtım malzemesi olarak kullanılabilmesi, mekanik özelliklerinin ise bu uygulamalar için yeterli düzeyde olduğu düşünülmektedir. Böylece bu çalışma çevre dostu kompozitlerin oluşturulmasında yenilenebilir kaynakların kullanımı için umut verici bir yol sunarak malzeme endüstrisi için daha sürdürülebilir bir geleceği teşvik etmektedir.

**Anahtar kelimeler:** kenevir lifi; poliüretan; sürdürülebilirlik; karbon ayak izi; biyokompozit



**EFFECT OF LIPID-BASED MULTIPLE MICRONUTRIENTS  
SUPPLEMENTATION IN UNDERWEIGHT PRIMIGRAVIDA PRE-ECLAMPTIC  
WOMEN ON MATERNAL AND PREGNANCY OUTCOMES: RANDOMIZED  
CLINICAL TRIAL**

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**ABSTRACT**

**Background and Objectives:** In pre-eclampsia, restricted blood supply due to the lack of trophoblastic cell invasion and spiral artery remodeling is responsible for adverse pregnancies and maternal outcomes, which is added to by maternal under nutrition. This study was designed to investigate the effects of lipid-based supplements (LNS-PLW) on pregnancy and maternal outcomes in underweight primigravida pre-eclamptic women.

**Materials and Methods:** A total of 60 pre-eclamptic, underweight primigravida women from the antenatal units of tertiary care hospitals in the Khyber Pakhtunkhwa Province, Pakistan, were randomly divided into two groups (Group 1 and Group 2). The participants of both groups were receiving routine treatment for pre-eclampsia: iron (60 mgs) and folic acid (400 ug) IFA daily. Group 2 was given an additional sachet of 75 gm LNS-PLW daily till delivery. The pregnancy outcomes of both groups were recorded. The clinical parameters, hemoglobin, platelet count, and proteinuria were measured at recruitment.

**Results:** The percentage of live births in Group 2 was 93% compared to 92% in Group 1. There were more normal vaginal deliveries (NVDs) in Group 2 compared to Group 1 (Group 2, 78% NVD; group 1, 69% NVD). In Group 1, 4% of the participants developed eclampsia. The frequency of cesarean sections was 8/26 (31%) in Group 1 and 6/28 (22%) in Group 2. The number of intrauterine deaths (IUDs) was only 1/28 (4%) in Group 2, while it was 2/26 (8%) in Group 1. The gestational age at delivery significantly improved with LNS-PLW supplementation (Group 2, 38.64 ± 0.78 weeks; Group 1, 36.88 ± 1.55 weeks, p-value 0.006). The Apgar score (Group 2, 9.3; Group 1, 8.4) and the birth weight of the babies improved with maternal supplementation with LNS-PLW (Group 2, 38.64 ± 0.78 weeks: Group 1, 36.88 ± 1.55; p-value 0.003). There was no significant difference in systolic blood pressure, while diastolic blood pressure (Group 2, 89.57 ± 2.08 mmHg; Group 1, 92.17 ± 5.18 mmHg, p-value

0.025) showed significant improvement with LNS-PLW supplementation. The hemoglobin concentration increased with the LNS-PLW supplement consumed in Group 2 (Group 2,  $12.15 \pm 0.78$  g/dL; Group 1,  $11.39 \pm 0.48$  g/dL, p-value < 0.001). However, no significant difference among the platelet counts of the two groups was observed.

**Conclusions:** The pregnancy and maternal outcomes of underweight pre-eclamptic women can be improved by the prenatal daily supplementation of LNS-PLW during pregnancy, along with IFA and regular antenatal care and follow-up.

**Keywords:** pre-eclampsia; lipid-based nutritional supplements; pregnancy outcome; maternal outcome; Khyber Pakhtunkhwa Province of Pakistan

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SPİN KAPLAMA TEKNİĞİ İLE ELDE EDİLEN KATKISIZ VE AL KATKILI ZNO  
İNCE FİLM OPTİK VE YAPISAL ÖZELLİKLERİN KARŞILAŞTIRILMASI

COMPARISON OF OPTICAL AND STRUCTURAL PROPERTIES OF  
UNDOPUTED AND AL-DOPPED ZNO THIN FILM OBTAINED BY SPIN COATING  
TECHNIQUE

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**ÖZET**

Ekonomik koşulların ve çevresel faktörlerin etkisiyle alternatif enerji kaynakları arayışları bilim dünyasında önemli bir yer edinmiştir. Enerji tüketimi kaçınılmaz olarak artmış olup, sentez tekniklerinin kalitesinin artması bilim ve teknolojiye gelişmelere bağlıdır. Güneş ışığı, güneş hücreleriyle birlikte termal veya elektrik enerjisine dönüştürülen en temiz ve en bol yenilenebilir enerji kaynağıdır. Şeffaf iletken oksit (TCO) ince filmler, uygun elektro-optik özellikleri nedeniyle güneş hücrelerinin ön tarafında yaygın olarak kullanılmaktadır. ZnO (saf ve katkılı) gibi toksik olmayan TCO'lar, uyarlanabilir elektronik uygulamalar için üstün ilgi görmüştür.

Saf ve farklı oranlarda Al katkılı ZnO ince film, uygun maliyetli ve basit bir yöntem olan sol-jel döndürerek kaplama tekniği kullanılarak düşük hacimli çözeltiyle soda kireç camı üzerinde üretilmiştir. Optimum tavlama sıcaklığı 700 °C' 1 saat süreyle kristal ince film katmanları elde edilmiştir. Optik geçirgenlik ve yapısal özellikler, saf ve farklı oranlarda Al katkılı ince filmler sistematik olarak karşılaştırılarak incelenmiştir. Al katkılı ZnO ince filmlerin (002) kırınım düzlemi boyunca tercihli bir yönelim sergilediği görülmüştür. Al katkılı atomların etkisi, ZnO kafes yapısının yeniden düzenlenmesine ve tane büyümesinin desteklenmesine yol açtı. Dolayısıyla taneler arasındaki tane sınırı azaldı ve kafesteki düzensizlikler ve kusurlar azaldı.

Görünür aralıkta % 85'in üzerinde geçirgenlik sergileyen optik şeffaflık ve kritik üretim parametreleri sol-jel döndürerek kaplama tekniği ile edilen ZnO ince filmin ticarileştirilmesiyle uygun yatırım olanağını göstermiştir. Artan Al konsantrasyonu nedeniyle, filmlerin UV soğurma kenarı maviye kayma gösterdi ve buda enerji bant aralığının genişlemesine neden

olmuştur. Yapısal ve mikroelettronik özellikler XRD analiz edilmiştir. XRD analizi sonucunda ZnO:Al altıgen wurtzite kristal yapısı sergilediği görülmüştür. Artan Al konsantrasyonuna bağlı olarak atomların çapları arasındaki fark nedeniyle filmin kristalliği bir miktar azaldı. Öte yandan tavlama sıcaklığının artmasıyla tanecikler arasındaki tane sınırı azalmıştır.

Bu çalışmada, ZnO ince filmlerin mikroelettronik cihazlarda ve güneş enerjisi sistemlerinde daha verimli kullanılmasının ve nispeten daha uygun maliyetli bir kaplama teknolojisinin araştırılması yapılmıştır.

**Anahtar kelimeler:** ZnO ince filmler, Sol-jel tekniği, Güneş hücresi, Döndürerek kaplama

## ABSTRACT

With the influence of economic conditions and environmental factors, the search for alternative energy sources has gained an important place in the scientific world. Energy consumption has inevitably increased, and the improvement in the quality of synthesis techniques depends on developments in science and technology. Sunlight is the cleanest and most abundant renewable energy source, converted into thermal or electrical energy by solar cells. Transparent conductive oxide (TCO) thin films are widely used on the front side of solar cells due to their favorable electro-optical properties. Nontoxic TCOs such as ZnO (pure and doped) have received outstanding attention for adaptive electronic applications.

Pure and Al-doped ZnO thin film at different ratios was produced on soda-lime glass with a low volume solution using the sol-gel spin coating technique, which is a cost-effective and simple method. Crystalline thin film layers were obtained at the optimum annealing temperature of 700 °C for 1 hour. Optical transmittance and structural properties were investigated by systematically comparing pure and Al-doped thin films at different ratios. It has been observed that Al-doped ZnO thin films exhibit a preferential orientation along the (002) diffraction plane. The influence of Al doped atoms led to the rearrangement of the ZnO lattice structure and promoted grain growth. Therefore, the grain boundary between the grains decreased and the irregularities and defects in the lattice decreased.

Optical transparency and critical production parameters, which exhibit a transmittance of over 85% in the visible range, have shown a suitable investment opportunity with the commercialization of ZnO thin film obtained by sol-gel spin coating technique. Due to increasing Al concentration, the UV absorption edge of the films showed a blue shift, which caused the energy band gap to widen. Structural and microelectronic properties were analyzed by XRD. As a result of XRD analysis, it was seen that ZnO:Al exhibited hexagonal wurtzite crystal structure. Due to the increasing Al concentration, the crystallinity of the film decreased slightly due to the difference between the diameters of the atoms. On the other hand, as the annealing temperature increased, the grain boundaries between the particles decreased.

In this study, a more efficient use of ZnO thin films in microelectronic devices and solar energy systems and a relatively more cost-effective coating technology were investigated.

**Keywords:** ZnO thin films, Sol-gel technique, Solar cell, Spin coating.

**GENERALIZED TOPOLOGIES, PERFORMANCE AND EFFICIENCY  
COMPARISON OF THE HIGH STEP-UP NON-ISOLATED STACKED COUPLED  
INDUCTOR DC-DC BOOST CONVERTERS**

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**ABSTRACT**

To increase the utility of renewable energy sources in electrical energy production, low-cost DC-DC converters with high voltage gain and efficiency are used as an interface. The desired output voltage cannot be obtained with the series-connected form of solar panels as a renewable energy source, due to the shadow effect and module incompatibility. In renewable energy systems with the low output voltage and the high output current, there is a need to use DC-DC converters with a high voltage gain to obtain the desired voltage of the grid system through inverters. Conventional boost converter has a low efficiency and performance in the high step-up applications due to its wide duty cycle range. Therefore, in order to obtain a high output voltage, a many DC-DC step-up converters with high voltage gain have been designed in the literature. There are many proposed topologies in the literature for non-isolated DC-DC converters with high voltage gain due to their high performance for use in renewable energy sources. In this study, high step-up non-isolated stacked coupled inductor DC-DC boost converters are discussed. The coupled inductor boost converters and their derived topologies have become more remarkable than the others due to their advantages such as; a high voltage conversion ratio is achieved with fewer components, some designed coupled inductor network structures, such as active switched coupled inductor network and reverse coupled inductor network can be included in the input section of the converter, by integrating a boost converter with a single switching component, a low input current ripple and a quadratic feature can be achieved. In this study, the generalized topologies of these converter were derived and categorized. For each category, generalized topologies were evaluated in terms of performance and efficiency. By taking care a photovoltaic (PV) system example, the efficiency comparison under the same standards was estimated using the simulation data and the values of the components data of the manufacturer.

**Keywords:** DC-DC converters, Boost converters, Renewable energy, Voltage gain cell.



**IT-BASED SKILLS TRAINING PROJECT FOR WOMEN IN PAKISTAN WITH  
EVALUATION HOW EUROPEAN COUNTRIES PROVIDE THE IT SKILL TO  
WOMEN AND GIRLS IN THEIR COUNTRIES**

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**ABSTRACT**

The idea has to be development of women empowerment in Pakistan so many departments has been opened but no any kind of practical work has been formulated in Pakistan. In first phase the Service of Common freedoms in Pakistan will be struggling an IT-based ability preparing project for Job working Women / Girls Students and household women. The second phase to prepared those women and girls will be comprised in to the other women which belongs to the rural areas of Pakistan. This drive means to engage women by outfitting them with fundamental data innovation abilities, empowering them to take part in the advanced economy and working on their financial status. The undertaking's key targets incorporate advancing orientation uniformity, crossing over the computerized separation, and cultivating ladies' financial strengthening. It's critical to take note of that the particulars of the task might shift in light of the Service of Basic liberties' needs, accessible assets, and organizations with important partners. The drive's definitive objective is to engage ladies with IT abilities, empowering them to get to better work open doors, increment their pay, and add to the advanced economy in Pakistan. as compare with the European countries European countries employ various strategies and initiatives to provide IT skills to women and girls, aiming to bridge the gender gap in the technology sector. These efforts can vary from country to country, Integration of computer science and IT education into the national curriculum. Promotion of Science, Technology, Engineering, and Mathematics subjects to girls from an early age. Encouraging girls to pursue IT-related courses and degrees in universities and technical schools. Support for coding clubs, workshops, and extracurricular activities for girls. Creation of girls-only tech clubs to foster interest in IT. Financial incentives in the form of scholarships or grants for women pursuing IT-related education and careers. Initiatives that connect women in IT with aspiring female technologists to provide guidance, support, and networking opportunities. Awareness campaigns targeting girls, parents, and educators to dispel stereotypes and promote IT as a career choice for women. Support for women in tech organizations and networks that facilitate mentorship, networking, and skill development. Programs to upskill and reskill women in IT, focusing on digital skills and tech-related certifications. Encouraging technology companies and organizations to implement diversity and inclusion policies that promote equal opportunities for women in IT. Collecting data on gender disparities in the tech sector to understand the specific challenges and barriers faced by women and girls. National policies and strategies promoting gender equality in the tech industry. Legislation and incentives to encourage companies to hire and promote women in IT. Partnerships between the government, educational institutions, and technology companies to create opportunities for women in IT.

Organizing hackathons and coding competitions with a focus on encouraging female participation.

**Keywords:** comprised, definitive, cultivating, extracurricular, reskill, hackathons.

**STRUCTURE, MECHANICAL AND RADIATION SHIELDING PROPERTIES OF  
Al-BASED TUNGSTEN REINFORCED, Al-Gd<sub>2</sub>O<sub>3</sub>-W NANOSTRUCTURED  
COMPOSITES**

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**ABSTRACT**

In this study, a novel Al-based tungsten-reinforced Al-Gd<sub>2</sub>O<sub>3</sub>/W metal composites were synthesized by the mechanical alloying method. The effect of the volume fraction of W-particles and thermal treatment on the microstructure and mechanical properties of metal matrix composite Al-Gd<sub>2</sub>O<sub>3</sub>-W were studied. The crystal structure was characterized using X-ray diffraction analysis while the microstructure and chemical composition of the metal composites were investigated using scanning and transmission electron microscopy (SEM and TEM). The peak shift of the X-ray peaks was observed from the X-ray diffraction pattern with the increase in the milling time of the samples. The findings from electron microscopy demonstrate that tungsten particles are evenly dispersed throughout the composites and have strong interface bonds to the metal matrix. The synthesized Al-based Gd<sub>2</sub>O<sub>3</sub>-W metal composites with different Gd content exhibit excellent mechanical properties. The Monte Carlo N-particle simulation code (MCNP 6.2) was used to theoretically explore the shielding performance against gamma and neutron radiation. Utilizing an aluminum (Al) matrix integrated with gadolinium oxide (Gd<sub>2</sub>O<sub>3</sub>) and further enhanced with tungsten (W), this work offers a composite that effectively addresses the dual requisites of mechanical robustness and radiation protection. Differential scanning calorimetry (DSC) revealed shifts in the thermal behavior of the composites which is ascribed to the presence of Gd content. Vickers microhardness measurements underscored the enhanced mechanical robustness of the synthesized composites, particularly with gadolinium and tungsten concentrations. This work highlights the possibilities of Gd and W-containing Al-Gd<sub>2</sub>O<sub>3</sub> composites as novel materials suitable for a wide range of cutting-edge industrial uses such as gamma and neutron radiation protection.

**ÖZET**

Bu çalışmada, mekanik alaşımlama yöntemi ile yeni bir Al-esaslı tungsten takviyeli Al-Gd<sub>2</sub>O<sub>3</sub>/W metal kompoziti sentezlenmiştir. W-parçacıklarının hacim oranının ve termal işlemin Al-Gd<sub>2</sub>O<sub>3</sub>-W metal matris kompozitinin mikroyapısı ve mekanik özellikleri üzerindeki etkisi incelendi. Kristal yapı, X-ışını difraksiyon analizi ile karakterize edilerek, kompozitlerin mikroyapısı ve kimyasal bileşimi tarama ve iletim elektron mikroskobu (SEM ve TEM)

kullanılarak araştırılmıştır. Örneklerin öğütme süresinin artmasıyla X-ışını piklerindeki kayma, X-ışını difraksiyon deseninden gözlemlendi. Elektron mikroskobu bulguları, tungsten parçacıklarının kompozitler boyunca eşit şekilde dağıldığını ve metal matrise güçlü arayüz bağlarına sahip olduğunu göstermektedir. Farklı Gd içeriğine sahip sentezlenen Al-esaslı  $Gd_2O_3$ -W kompozitleri mükemmel mekanik özelliklere sahiptir. Monte Carlo N-parçacık simülasyon kodu (MCNP 6.2), gama ve nötron radyasyonuna karşı koruma performansını teorik olarak incelemek için kullanılmıştır. Gadolinyum oksit ( $Gd_2O_3$ ) ile entegre edilmiş bir alüminyum (Al) matrisini tungsten (W) ile daha da güçlendirerek, bu çalışma mekanik dayanıklılık ve radyasyon zırhlama gibi iki temel gereksinimi etkili bir şekilde karşılayan bir kompozit sunmaktadır. Diferansiyel tarama kalorimetrisi (DSC), Gd içeriğinin varlığına atfedilen kompozitlerin termal davranışındaki değişiklikleri ortaya çıkardı. Vickers mikrosertlik ölçümleri, özellikle gadolinyum ve tungsten konsantrasyonları ile sentezlenen kompozitlerin artmış mekanik dayanıklılığını vurgulamaktadır. Bu çalışma, Gd ve W içeren Al- $Gd_2O_3$  kompozitlerinin gama ve nötron radyasyon zırhlama gibi keskin uçlu endüstriyel kullanımlar için uygun yeni malzemeler olarak olanaklarını vurgulamaktadır.

**Keywords:** Al-based composites, Enriched with tungsten, Radiation shielding, characterization

**SYNTHESIS OF NANOSTRUCTURED Al-Gd<sub>2</sub>O<sub>3</sub> COMPOSITE MATERIALS AND  
INVESTIGATION OF THEIR STRUCTURAL, MECHANICAL AND RADIATION  
SHIELDING PROPERTIES**

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**ABSTRACT**

Due to the rising global demand for high-strength, lightweight materials, research interest in composites based on aluminum has increased. Aluminum is used extensively in a variety of applications, including the aerospace and automotive industries, because of its excellent strength-to-weight ratio. In this study, nanostructured Al-Gd<sub>2</sub>O<sub>3</sub> composites (with Gd contents at 5%, 10%, and 15% wt) are synthesized from solid-state powder processed, mechanical alloying technique. This study aims to evaluate together the important properties such as mechanical, structural, and radiation shielding performance of nanostructured, Al-Gd<sub>2</sub>O<sub>3</sub> composites. X-ray diffraction analysis is used to study the crystal structure features of the composite materials while scanning and tunneling microscopy is used to study their surface morphology and chemical composition. From the X-ray diffraction pattern, it was observed that the peak shifts become more prominent as the milling time increases. Differential scanning calorimetry (DSC) revealed changes in temperature behavior that are influenced by the amount of Gd present. Vickers microhardness measurement showed that the synthesized composites exhibit improved mechanical strength as the concentration of gadolinium increased. Differential thermal analysis (DTA) reveals the thermal stability of Al-Gd<sub>2</sub>O<sub>3</sub> samples. From DTA analysis, the range of the temperature is determined beyond which samples undergo degradation. Because under exposure to ionizing radiation, the temperature of the samples under study may rise, leading to a decrease in radiation shielding performance. The gamma and neutron radiation shielding performance of the composite materials is investigated theoretically using the Monte Carlo N-particle simulation tool (MCNP 6.2). The radiation shielding performance of the composites was enhanced as the amount of Gd<sub>2</sub>O<sub>3</sub> increased. This study predicted that Al-Gd<sub>2</sub>O<sub>3</sub> composites are future materials for radiation protection applications.

**ÖZET**

Dünya genelinde yüksek dayanıklılığa sahip hafif malzemelere olan talebin artmasıyla alüminyum bazlı kompozitler üzerine yapılan araştırmalara olan ilgi artmıştır. Alüminyum, mükemmel ağırlık-güç oranı nedeniyle havacılık ve otomotiv endüstrileri başta olmak üzere birçok uygulamada yaygın olarak kullanılmaktadır. Bu çalışmada, katı hal toz işleme ve



mekanik alaşımlama tekniği ile sentezlenen nano yapıda Al-Gd<sub>2</sub>O<sub>3</sub> kompozitleri (Gd içeriği %5, %10 ve %15 ağırlık olarak) incelenmiştir. Bu çalışmanın amacı, nano yapıdaki Al-Gd<sub>2</sub>O<sub>3</sub> kompozitlerinin mekanik, yapısal ve radyasyon zırhlama özelliklerini bir arada değerlendirmektir. Kompozit malzemelerin kristal yapı özellikleri X-ışını difraksiyon analizi ile, yüzey morfolojisi ve kimyasal bileşimi ise tarama ve tünelleme mikroskobu ile incelenmiştir. X-ışını difraksiyon deseninden, öğütme süresi arttıkça pik kaymalarının daha belirgin hale geldiği gözlemlenmiştir. Diferansiyel tarama kalorimetrisi (DSC), Gd miktarının sıcaklık davranışındaki değişiklikleri ortaya koymuştur. Vickers mikrosertlik ölçümü, gadolinyum konsantrasyonunun artmasıyla sentezlenen kompozitlerin mekanik dayanımının arttığını göstermiştir. Diferansiyel termal analiz (DTA), Al-Gd<sub>2</sub>O<sub>3</sub> örneklerinin termal stabilitesini ortaya koymaktadır. DTA analizi, örneklerin bozulmaya başladığı sıcaklık aralığını belirlemektedir. İyonlaştırıcı radyasyona maruz kaldığında, incelenen örneklerin sıcaklığının yükselebileceği ve bu durumun radyasyon zırhlama performansını azaltabileceği göz önünde bulundurulmaktadır. Kompozit malzemelerin gama ve nötron radyasyonuna karşı koruma performansı, Monte Carlo N-parçacık simülasyon aracı (MNCP 6.2) kullanılarak teorik olarak incelenmiştir. Gd<sub>2</sub>O<sub>3</sub> miktarının artmasıyla kompozitlerin radyasyon koruma performansının arttığı belirlenmiştir. Bu çalışma, Al-Gd<sub>2</sub>O<sub>3</sub> kompozitlerinin gelecekte radyasyon koruma uygulamaları için uygun malzemeler olabileceğini öngörmektedir.

**Keywords:** Al-Based Composites, Radiation Shielding, Characterization

EVALUATING MANUFACTURING EFFICIENCY IN A TIRE MANUFACTURING  
COMPANY

BİR LASTİK ÜRETİM ŞİRKETİNDE ÜRETİM VERİMLİLİĞİNİN  
DEĞERLENDİRİLMESİ

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**ABSTRACT**

In current era of globalization, achieving manufacturing excellence is viewed as being crucial to a nation's survival and economic progress. Production companies constantly improve and optimize their production efficiency and effectiveness to be competitive due to the changing customer demand for high quality products at low prices and the prevalent, strong global rivalry. In this study, the production quantity/tonnage tracking form with the lowest cost, highest accuracy, and quickest efficiency was developed for a tire firm that is transitioning to digitalization but has not yet fully finished its digital transformation. Here, the goal is to make sure that the business can utilize its staff and time as effectively as possible throughout the ongoing digitization process. A form was made in which "Production efficiency," "Production effectiveness," "Quantity cut," and "Tonnage cut" were computed in accordance with the company's requirement after extensive research led to the selection of the most accurate approach. The fact that an engineer now has a tool to quickly process data and get the most accurate findings is the form's most significant benefit. This will make it easy to keep an eye on daily output and avoid unanticipated interruptions. In addition, it clarifies the company's choices for the planning and production side of the business thanks to the quantity and tonnage calculations that were added to the form.

**Keywords:** Efficiency, Effectiveness, Tire manufacturing, Quantity, Extruder

**ÖZET**

Küreselleşmenin mevcut çağında, üretimde mükemmelliğe ulaşmak, bir ülkenin hayatta kalması ve ekonomik ilerlemesi için çok önemli olarak görülüyor. Üretim şirketleri, düşük fiyatlarla yüksek kaliteli ürünlere yönelik değişen müşteri talebi ve yaygın, güçlü küresel rekabet nedeniyle rekabet edebilmek için üretim verimliliklerini ve etkinliklerini sürekli olarak

iyileştirir ve optimize eder. Bu çalışmada dijitalleşmeye geçen ancak dijital dönüşümünü henüz tam olarak tamamlamamış bir lastik firması için en düşük maliyet, en yüksek doğruluk ve en hızlı verime sahip üretim miktarı/tonaj takip formu geliştirildi. Burada amaç, devam eden dijitalleşme süreci boyunca işletmenin personelini ve zamanını mümkün olduğunca verimli kullanabilmesini sağlamaktır. Kapsamlı araştırmaların ardından şirketin ihtiyacına göre "Üretim verimliliği", "Üretim etkinliği", "Miktar kesintisi" ve "Tonaj kesintisi" hesaplanan bir form oluşturuldu ve en doğru yaklaşımın seçilmesi sağlandı. Bir mühendisin artık verileri hızlı bir şekilde işleyip en doğru bulguları elde edecek bir araca sahip olması, formun en önemli faydasıdır. Bu, günlük çıktıyı takip etmeyi ve beklenmedik kesintileri önlemeyi kolaylaştıracaktır. Ayrıca forma eklenen miktar ve tonaj hesaplamaları sayesinde firmanın işin planlama ve üretim kısmına yönelik tercihlerini netleştirir.

**Anahtar Kelimeler:** Verimlilik, Etkinlik, Lastik imalatı, Miktar, Ekstruder

CFD SIMULATION OF PEMWE FLOW-FIELD DESIGN BASED ON A BIO  
INSPIRED

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## ABSTRACT

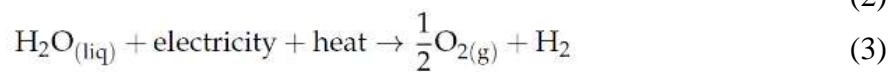
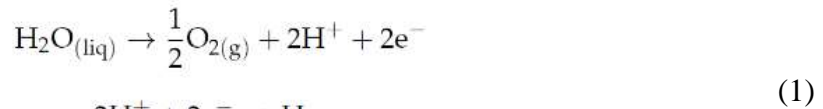
For the generation of green hydrogen, electrolysis in conjunction with renewable energy sources is the most viable approach. The capacity of the Polymer Electrolyte Membrane Water Electrolyzer (PEMWE) to generate compressed hydrogen with high purity at comparatively moderate working temperatures (70–90 C) has drawn attention. The bipolar plates (BPPs) are the PEMWE stack's major cost contributors. Flow distributor impact has a major effect on Polymer Electrolyte Membrane Water Electrolyzer (PEMWE) performance and durability. Several leaves were used as a very similar example inspired by the plant to study how to get the most out of bio-inspired design as a great convergence accelerator track for creating new bipolar plates (BPPs) geometries. The hydraulic pathway through a leaf can be thought of as analogous to an electrical circuit, which represents the channel geometry of BPPs. In order to assess the flow field performance of the proton exchange membrane water electrolysis (PEMWE) under the same operating conditions (operating temperature, anode pressure, current density) and design parameter (anode channel (ACH), porous gas diffusion layer (AGDL), and catalyst layer (ACL) thickness), a 3D numerical model based on COMSOL Multiphysics Software (version 6.1 COMSOL) is integrated with the Electrochemistry and Flow field distribution analysis. The primary design criteria in this study are centered on more even and consistent fluid pressure/velocity distributions, homogeneous water distribution, homogeneous species molar spreading along the flow channels, and efficient gas removal throughout the active area. which consequently enables the stack to operate at high pressure and high current density. Nature-inspired designs show their prominent characteristics such as low-pressure drops and effective fluid distribution. In turn homogeneous sufficient water sufficient removal.

**Keywords:** Flow field, PEMWE, bio-inspired, CFD, bipolar plates

## INTRODUCTION

The world's need for energy is quickly rising these days, and access to energy resources is becoming more and more important to maintain human well-being. The majority of the world's energy needs are met by fossil fuels, which will eventually cause the finite supply of fossil energy resources to gradually run out. [1]. In this situation, switching to hydrogen energy is typically an effective way to streamline the shift to a low-carbon community. PEMWE definition: A PEMWE consists of a membrane (PEM) positioned between two electrodes. The PEMWE is separated into the cathode and anode by the membrane; each section is made up of

a catalyst layer, a gas diffusion layer, and a gas channel. Figure 1 displays a schematic diagram of a typical PEMWE. Equation (1) illustrates how water enters the anode channel (ACH) on the anode side and travels via the porous gas diffusion layer (AGDL) and anode catalyst layer (ACL), where it undergoes semi-reactions of oxidation that split the water into protons, oxygen, and electrons. Protons of hydrogen travel through the membrane to reach the cathode catalyst layer (CCL), while electrons move there through an external circuit. Equation (2) describes how hydrogen protons and electrons combine on the cathode side to form hydrogen gas through semi-reactions of a reduction. Equation (3) presents the overall response [4-6].



## MODELING DEFINITION

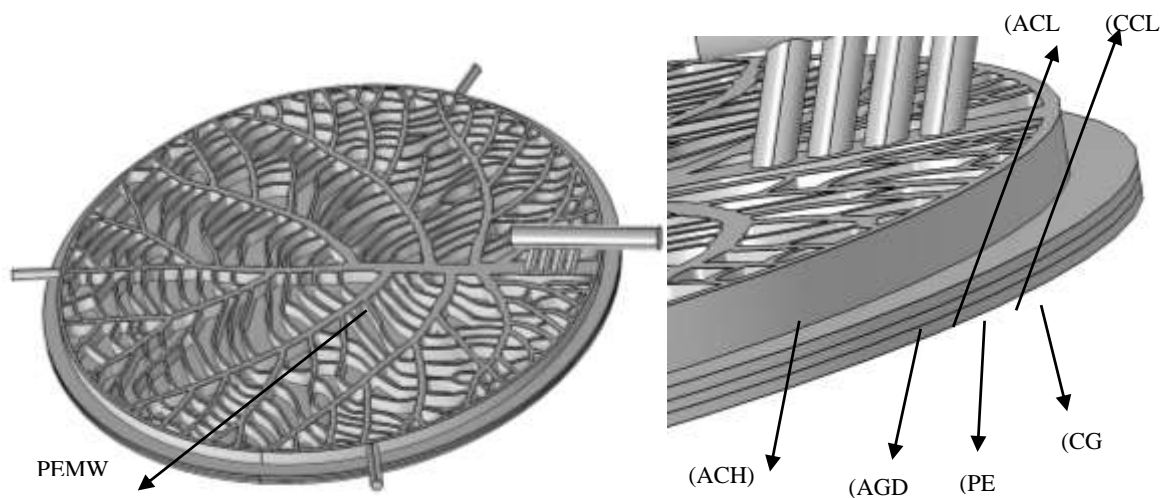


Figure 1 PEMWE

This work employs a single-phase-domain approach to implement the nonlinear differential equations for a three-dimensional single-half-cell PEMWE. The finite element method is used to model the conservation equations for electrochemical reactions that must be solved simultaneously across seven regions of the cell, including the anode and cathode catalyst layer, GDLs, anode channel, and membrane. Utilizing COMSOL Multiphysics 6.1, the numerical model is constructed. To solve the set of equations, an iterative procedure is used until the residual approaches  $10^{-6}$ . Because there are seven distinct geometries, the mesh count required to ensure the independence of the results is roughly between  $1\text{E}6$  and  $2\text{E}6$  cells. The mesh independence of the results is verified in order to certify that the results are independent of the mesh. The geometry parameters, physical parameters, and operating conditions for the PEMWE are shown in Table 1.



Name	Side	Material	Value	Unit	Source
PTL thickness	Anode	Ti mesh	2E-4	m	[7]
	Cathode	Ti mesh			[7]
CL thickness	Anode	Iridium dioxide (IrO2) platinum with carbon (Pt/C)	1E-5	m	[2]
	Cathode				[2]
Membrane thickness		Nafion® 117	1.78E-4	m	[7]
Channel thickness			0.001	m	[7] [3]

*Assumption:* The modeling studies focus on optimizing the anode channel patterns using the leaf-biomass-flow-field of five leaf vein patterns in order to improve PEMWE performance. A few presumptions are made in this model in order to avoid confusion and maintain consistency in a fruitful compromise. It is assumed that the model is operating in a steady state. Laminar flow has one or more inlets and one or more outlets, and it is incompressible. Isothermal Newtonian fluid that disregards gravity Potential and kinetic energy changes are ignored, One bar of anode pressure is present. The gas mixture is subjected to ideal gas behavior. There has been a disregard for the contact resistance between different layers. It is assumed that the GDL, catalyst layer, and membrane are homogeneous and isotropic.

### GOVERNING EQUATION AND NUMERICAL METHODS :

*Conservation of mass* - In the Flow fluid model part a free and porous media is applied to enable porous media domains and neglects the gravity effect. for zero velocity condition at the wall, mass exchange occurs at Porous Medium calculated by equation (4) :

$$\rho \nabla \cdot \mathbf{ua} = Q_m \quad (4)$$

where  $u$  is the mixture velocity vector (m/s),  $\rho$  is the mixture density ( kg/m<sup>3</sup> ),  $Q$  is the source term or mass source [ kg/(m<sup>3</sup> s) ].

*conservation of momentum* - the momentum conservation applied for the channel fluid and Porous Medium GDL as shown in equations (5-8) respectively :

$$\rho(\mathbf{ua} \cdot \nabla)\mathbf{ua} = \nabla \cdot [-p\mathbf{a} + \mathbf{K}] + \mathbf{F} \quad (5)$$

$$\mathbf{K} = \mu(\nabla\mathbf{ua} + (\nabla\mathbf{ua})^T) \quad (6)$$

$$\frac{1}{\epsilon_p} \rho(\mathbf{ua} \cdot \nabla)\mathbf{ua} \frac{1}{\epsilon_p} = \nabla \cdot [-p\mathbf{a} + \mathbf{K}] - \left( \mu \kappa^{-1} + \beta \rho |\mathbf{ua}| + \frac{Q_m}{\epsilon_p^2} \right) \mathbf{ua} + \mathbf{F} \quad (7)$$

$$\mathbf{K} = \mu \frac{1}{\epsilon_p} (\nabla\mathbf{ua} + (\nabla\mathbf{ua})^T) - \frac{2}{3} \mu \frac{1}{\epsilon_p} (\nabla \cdot \mathbf{ua}) \mathbf{I} \quad (8)$$

Where  $p$  is the pressure ( N/m<sup>2</sup> ),  $\mu$  is the dynamic viscosity of the mixture [ kg/(m s) ],  $\mathbf{K}$  is the viscous stress tensor (Pa),  $\mathbf{F}$  is the volume force vector (N/m<sup>3</sup>) and,  $T$  is the absolute temperature (K) ,  $\epsilon_p$  is the GDL porosity,  $\kappa$  the permeability of the GDL (m<sup>2</sup>), and  $\beta$  drag force coefficient which is assumed to be zero

*Mass Diffusion ( Maxwell–Stefan )* - In the electrochemical model part PEMWE selected including H<sub>2</sub>O species, gas phase diffusion, and H<sub>2</sub>O(L) in reaction stoichiometry. In order to solve the fluxes of each species in terms of mass fraction, The whole computational domain

multispecies mass transports are described by the Maxwell–Stefan equation (diffusion equation) (9-13) respectively:

$$\nabla \cdot \mathbf{j}_i + \rho(\mathbf{u} \cdot \nabla)\omega_i = R_{i,\text{total}} \quad (9)$$

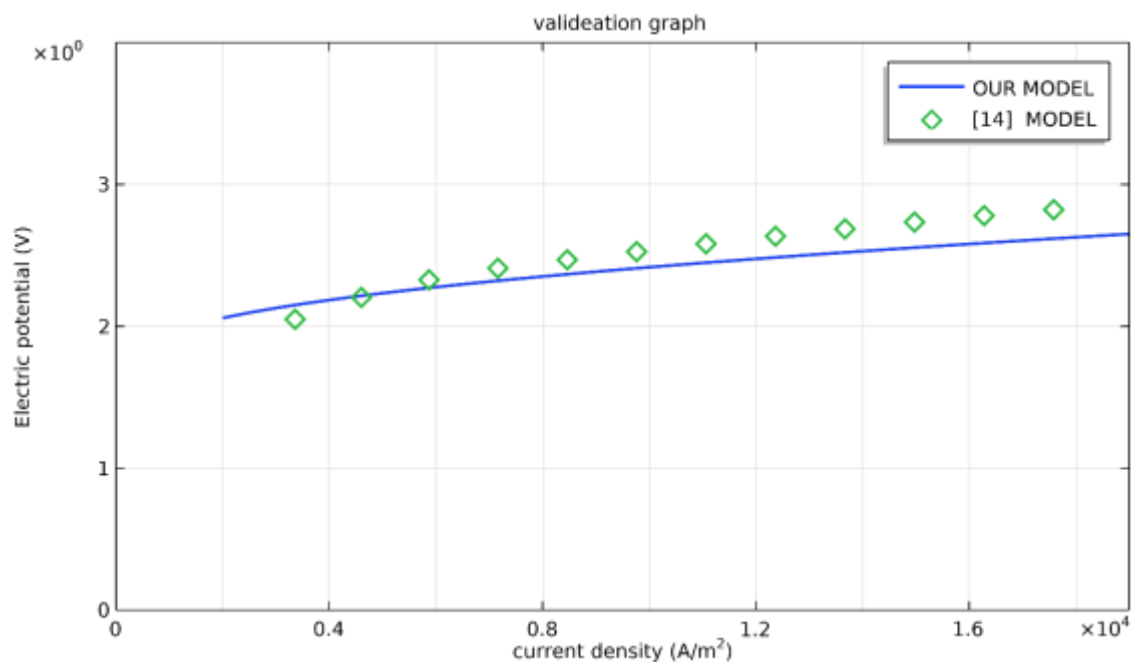
$$\mathbf{j}_i = -\rho\omega_i \sum_k \tilde{D}_{ik,\text{eff}} \mathbf{d}_k \quad (10)$$

$$\mathbf{d}_k = \nabla x_k + \frac{1}{\rho_A} [(x_k - \omega_k) \nabla p_A], \quad x_k = \frac{\omega_k M_n}{M_k} \quad (11)$$

$$p_i = x_i p_A \quad (12)$$

$$M_n = \left( \sum_i \frac{\omega_i}{M_i} \right)^{-1} \quad (13)$$

Where  $\mathbf{u}$  is the mass averaged velocity of the mixture (m/s),  $\mathbf{j}_i$  is the mass flux relative to the mass-averaged velocity ( $\text{kg}/(\text{m}^2 \cdot \text{s})$ ),  $\omega_i$  is the mass fraction (1),  $R_i$  is the rate expression describing its production or Consumption ( $\text{kg}/(\text{m}^3 \cdot \text{s})$ ). where,  $\mathbf{d}_k$  is the diffusional driving force ( $1/\text{m}$ ) acting on species  $k$ ,  $x_k$  mole fraction (1),  $p_A$  is the total anode pressure (Pa)  $M_n$  means molar mass ( $\text{kg}/\text{mol}$ ), and  $p_i$  partial pressures (Pa)



*Validation:* To verify the simulation model's findings, Upadhyay [2] presents the data from an experimental investigation, which is compared with the numerical results. As shown in Figure 2, the polarization curve of the experimental study created from [2] is compared to the polarization curve predicted by the current model at operating conditions of pressure at 1 bar and temperatures of 328.15. The experimental findings and the model predictions agree fairly well [2].

## RESULT AND DISCUSSION

**POLARIZATION CURVES** - The operating conditions are the basis for the simulation curves displayed in Figure 3 demonstrate how significantly bio-inspired designs can enhance PEMWE performance. The L4k bipolar plates (BPPs) geometry outperformed the other bioleaf designs, most likely because of the design's abundance of redundant channels, which raise the interface active area. And because of the longer channels than the multi-serpentine, record better performance. Water accumulation in bends reduces point flow and local current density.

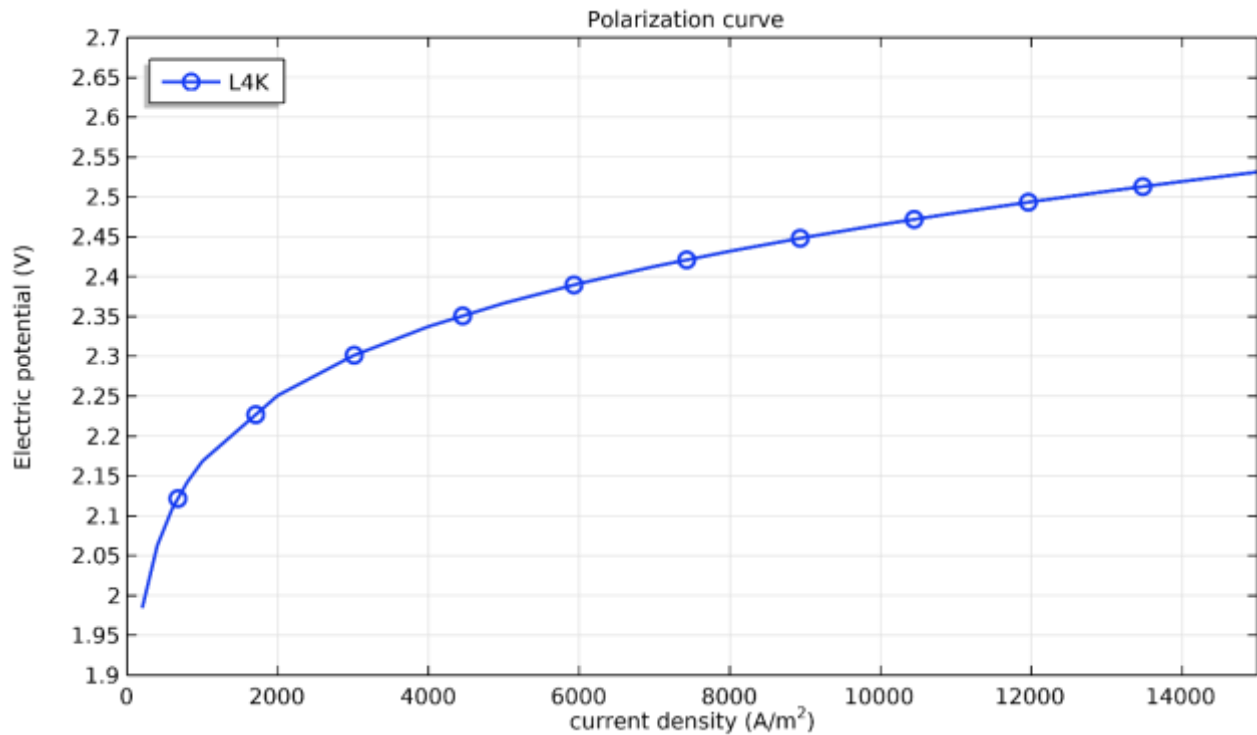


Figure 3 Polarization curve of the BPPs Kiwi leaf

## PRESSURE CONTOURS

The performance of PEMWE is significantly influenced by the pressure distribution. Reactant problems are brought on by the high-pressure drop across the electrolyzer. Thus, the ideal pressure distribution is the one that genuinely prevents water buildup in the cell. The static pressure of L4K flow field designs in the GDL is displayed in Figure 4. The designs with the largest pressure drop are the multi-serpentine. However by a wide margin, the bio-leaf design has the lowest pressure drop. Longer average path lengths increase pressure drop, which is illustrated in Figure 5.

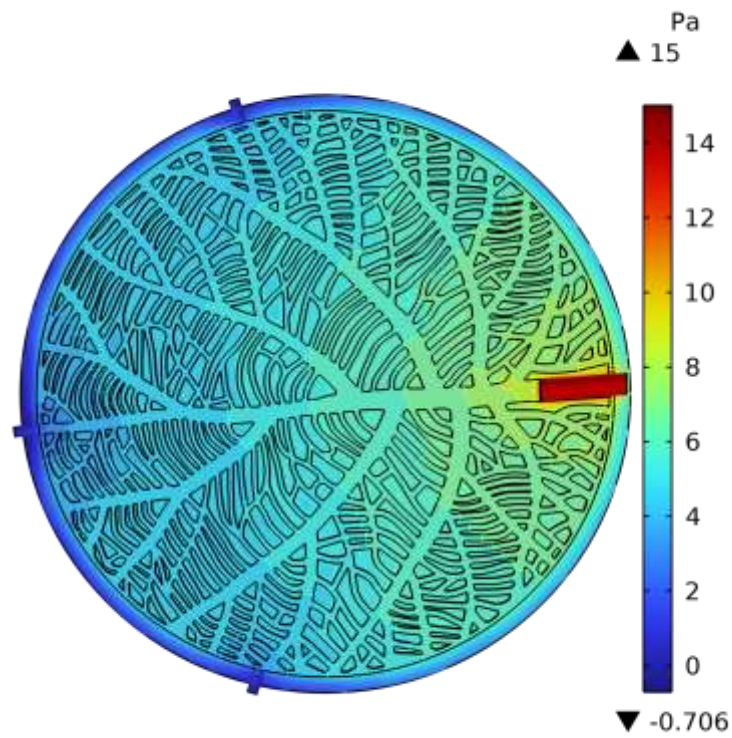


Figure 4 Pressure distributions for BPPs Kiwi leaf

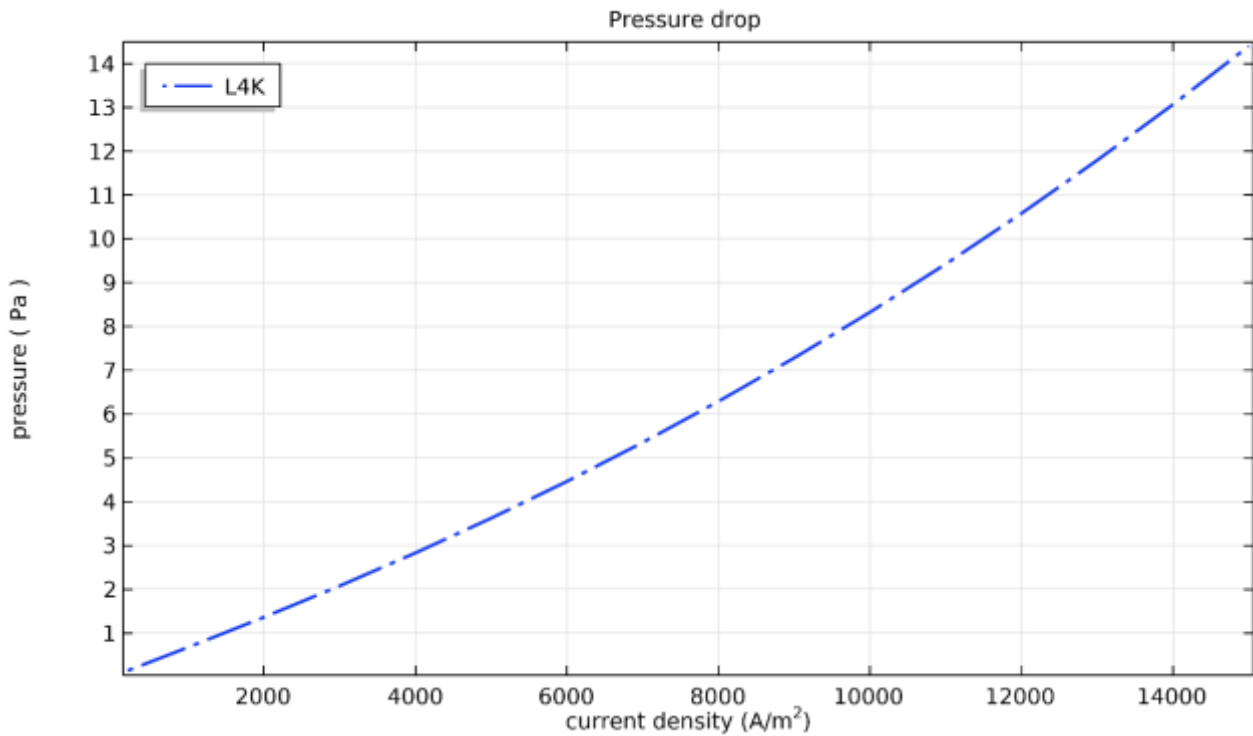


Figure 5 Pressure drop of BPPs Kiwi leaf

## VELOCITY CONTOURS

PEMWE benefits greatly from even and high velocity profiles. A cell's capacity to expel liquid water and the time it takes to extract the generated gases from the cell are both greatly enhanced by higher velocities. Reactant residence times are similar and the reactant distribution is more even when the velocity profiles

are uniform. This implies a more consistent distribution of hydrogen production. As a result, Figure 6 displays the L4K flow field design ' velocity distributions. the velocity profile of the bioleaf design is substantially more uniform.

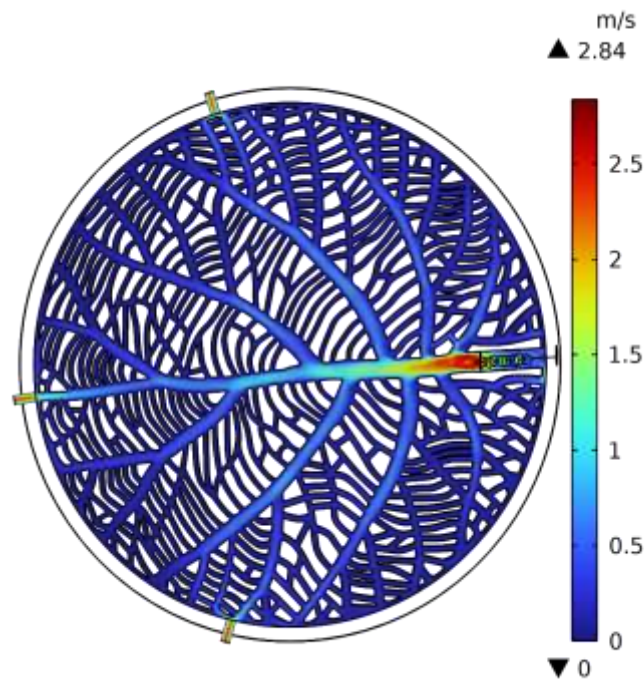


Figure 6 Velocity profiles of BPPs Kiwi leaf (m/s)

## OXYGEN DISTRIBUTION

The water distribution for the various flow field designs is displayed in Figure 7. Comparing the bio-leaf design to the multi-serpentine, the bio-leaf design has a more uniform water distribution. More high-performance cells result from a more uniformly distributed design.



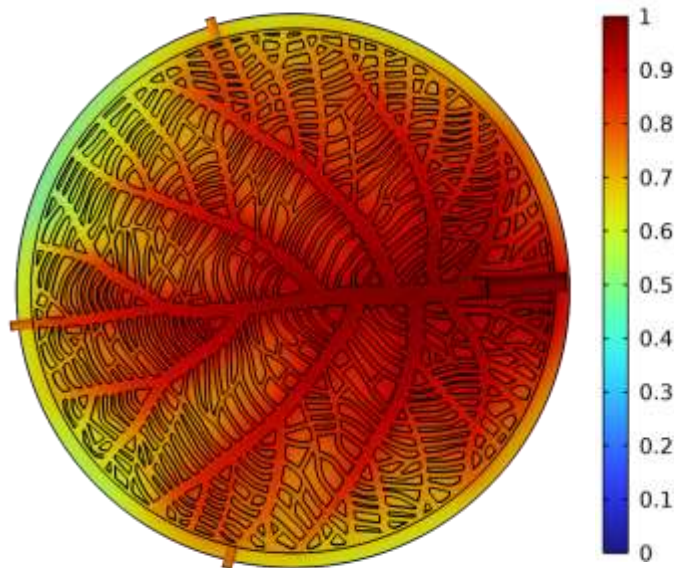


Figure 7 water mass density distributions for BPPs Kiwi leaf

## CONCLUSION

To sum up, this study looked into how bipolar plates (BPPs) in polymer electrolyte membrane water electrolyzers (PEMWE) might perform better by using a bio-inspired design, more especially a leaf-like geometry. The outcomes showed that the bio-leaf design has a number of benefits with regard to pressure distribution, velocity profiles, and water distribution—all of which have a significant impact on PEMWE's effectiveness and performance. The bio-leaf design had the lowest pressure drop, according to the pressure distribution analysis. This was primarily because of its redundant and connected flow channels, which facilitated quick pressure equalization. The bio-leaf design's uniform velocity profile resulted in more uniform reactant distribution and quicker water removal, even though the latter designs recorded higher maximum velocities.

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CASE MANAGEMENT

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**ABSTRACT**

Case management is a health care delivery system in which services provided by individual practitioners are professionally organized by a case manager. In the literature, instead of "case management", it can be used as "management of care", "joint management", "controlled care", "shared care", "targeted care". It is a system developed to provide quality patient care by using resources effectively. It includes strategies used by purchasers of healthcare services to reduce the cost and improve the quality of care services. The focus of case management is the patient and family. Case Manager; They are health professionals responsible for providing and monitoring the care of patient groups. The case management project planning and execution committee should review the literature to determine the most appropriate case management model for the institution, make job descriptions of the people who will take part, and prepare the joint care plans and care protocols to be used. The patient's physical health status, functional capacity, mental state, personal and social support systems, economic resources and environmental situation are evaluated. A standard assessment tool is used to collect this data. Once data is collected, the data is analyzed and synthesized to determine nursing diagnoses or common questions. Developing a plan with the participation of patients and their families. The basic elements of this phase are setting measurable goals, deciding on the steps necessary to achieve these goals, and determining resources and services together with the case manager, patient, family and other health disciplines. During the case application phase, necessary care is given to the individual. The case manager coordinates all services and ensures full participation of the patient and healthcare providers in care. The case manager should encourage and educate the patient and family about self-care. The final stage is observation and evaluation. The case manager evaluates the situation by meeting with the individual, his family and the service providers to understand whether the set goals are achieved. If the goal is achieved, the patient is discharged. Deviation from the targets specified in the maintenance plan is examined to create statistical data. The focus of case management is the comprehensive organization and coordination of services needed by individuals, families or groups. The effectiveness of case management programs is evaluated by examining the quality of patient care, cost of care, employee satisfaction, and use of resources.

**Keywords:** Case, Case Management, Case Manager, Quality of Patient Care

**ÖZET**

Vaka yönetimi ayrı ayrı uygulayıcılar tarafından verilen hizmetlerin bir vaka yöneticisi tarafından profesyonel olarak organize edildiği bir sağlık bakım hizmeti sunum sistemidir. Literatürde "vaka yönetimi" yerine "bakımın yönetimi", "ortak yönetim", "kontrollü bakım", "ortak bakım", "hedefe yönelik bakım" olarak kullanılabilir. Kaynakları etkin kullanılarak kaliteli hasta bakım sunmak için geliştirilen bir sistemdir. Bakım hizmetlerinin maliyetini düşürmek ve kalitesini arttırmak için sağlık hizmetini satın alanlar tarafından kullanılan

stratejileri içerir. Vaka yönetiminin ilgi odağı hasta ve ailedir. Vaka Yöneticisi; Hasta grupların bakımını sağlamak ve izlemekten sorumlu sağlık profesyonelleridir. Vaka yönetimi projesi planlama ve yürütme komitesi, kurum için en uygun vaka yönetimi modelini belirlemek, rol alacak kişilerin iş tanımlarını yapmak, kullanılacak ortak bakım planlarını ve bakım protokollerini hazırlamak için literatürü incelenmelidir. Hastanın fiziksel sağlık durumu, fonksiyonel kapasitesi, ruhsal durumu, kişisel ve toplumsal destek sistemleri, ekonomik kaynakları ve çevre durumu değerlendirilir. Bu verileri toplamada standart değerlendirme aracı kullanılır. Veriler toplandıktan sonra hemşirelik tanımlarını veya ortak soruları belirlemek üzere veriler analiz ve sentez edilir. Hasta ve ailelerinin katılımı ile plan geliştirilmesidir. Bu evrenin temel öğeleri ölçülebilir hedeflerin belirlenmesi, bu hedeflere ulaşmak için gerekli adımların kararlaştırılması, vaka yöneticisi, hasta, ailesi ve diğer sağlık disiplinleri ile birlikte kaynakların ve hizmetlerin belirlenmesidir. Vaka uygulama safhasında birey için gerekli bakım verilir. Vaka yöneticisi bütün hizmetleri koordine eder, hastanın ve sağlık hizmeti sunanların bakıma tam olarak katılımı sağlar. Vaka yöneticisi hasta ve aileyi kendi kendine bakım konusunda cesaretlendirmeli ve bu konuda eğitim vermelidir. Son aşama gözlem ve değerlendirmedir. Vaka yöneticisi belirlenen hedefler ulaşıp ulaşılmadığını anlamak için birey, ailesi ve hizmeti sunan kişilerle görüşüp durumu değerlendirir. Hedefe ulaşılmışsa hasta taburcu edilir. İstatistiksel veri oluşturmak için bakım planında belirtilen hedeflerden sapma durumu incelenir. Vaka yönetiminin odağı birey, aile veya grupların gereksinimi olan hizmetlerin kapsamlı olarak düzenlenmesi ve koordine edilmesidir. Vaka yönetimi programlarının etkinliği, hasta bakımının kalitesi, bakımın maliyeti, çalışanların doyumu, kaynakların kullanımı incelenerek değerlendirilmelidir.

**Anahtar Kelimeler:** Vaka, Vaka Yönetimi, Vaka Yöneticisi, Hasta Bakımının Kalitesi

## GİRİŞ

Sağlık hizmetlerindeki önemli gelişmeler sağlık bakım harcamalarının artmasına neden olmuş ve sağlık hizmetlerinde düşük maliyetli ve kaliteli bakım sunumu önem kazanmıştır. Vaka yönetimi bu gelişmeler ışığında ortaya çıkan bir hizmet modelidir (Çam vd., 2019; Daş, 1999). En basit biçimde aracı kurum olarak ifade edilen vaka yönetimi farklı disiplinlerdeki hizmetleri koordine etmek için güçlü bir araçtır (Marshall vd., 2000). Koordinasyon, entegrasyon ve sınırlı kaynakların bireyselleştirilmiş bakıma dahil edilmesiyle bir veya daha fazla personelle hizmet verilmesidir (Zigarus, 2000).

Kaynak kullanımının etkili hale getirilmesi ve standardize edilmesi, bütüncül ve sürekli bir bakım sağlanması, bireyin öz-bakım gücünün yükseltilmesi, ekip işbirliği, hastaların hastanede yatış süresinin kısaltılması ve sağlık hizmetlerini sunanlar ile alanların memnuniyetinin artırılması vaka yönetiminde önemli olan noktalardır (Bower, 1997; Türkmen, 1997).

Vaka yönetimi hizmet sunumu yapmaya çalışan bir yaklaşımdır. Temelde birleştirici, müracaatçı odaklı, koordine edici, amaç odaklı, hesap verilebilir, esnek, düzenli, uygun maliyetli, sürdürülebilir ve kapsamlı olma gibi özelliklere sahiptir (UCLA, 1989). Literatürde vaka yönetimi kavramının yerine, "hedeflere göre yönetim, kontrollü bakım, bakım yönetimi, ortak yönetim ve ortak bakım" gibi terimlerin kullanıldığı da görülmektedir (Ignatavicus ve Hausman, 1995).

Vaka yönetiminin ana amacı, düşük maliyetle kaliteli bir sağlık bakım hizmeti sunmaktır. Bu nedenle, yöntemin hem bireylerin hem de kurumun ihtiyaçlarında odaklanan bazı bileşenleri kapsaması gerekmektedir. Bunlar; bakım planları, kaliteyi değerlendirme ve iyileştirme, mali analiz, araştırma ve bakım protokolüdür (Girard, 1994).

Vaka yönetimi; bireylerin çeşitli ihtiyaçlarını (tedavi, sosyal, konaklama, finansal, istihdam, dinlenme, kültürel ihtiyaçlar) karşılamak amacıyla tüm hizmetlerin bir arada ve eşgüdümlü olarak verildiği bir süreçtir (Killaspy ve Rosen, 2011). Hasta ve hizmet verenlerin memnuniyetini ve maliyeti dikkate alan, bireylerin bütüncül sağlık endişelerinin yönetimini sağlayan bir bakım verme modelidir (Girard, 1994). Sağlık bakım sisteminde hastanın gereksinimlerini karşılamak için, parçalara ayrılmış olan sağlık hizmetlerinin koordinasyonudur (Townsend, 2009).

## **VAKA YÖNETİMİ**

Vaka yönetimi ile ilgili olarak pek çok tanımlama yapılmıştır. Yapılan tanımlamalar hem konuya farklı açılardan bakmamızı sağlayabilmekte, hem de vaka yönetimi kavramını anlamayı kolaylaştırmaktadır. Tanımların kendi analitik duruşu ile tutarlı olması ve tanımsal açıdan belirli uygulamaların açıklamalarını içermesi gereklidir. Vaka yönetimi ile ilgili herkes tarafından kabul edilecek ortak bir tanımın yapılması zor olsa da tanımlara bakıldığında iki tür tanım olduğu görülmektedir. İlk tür tanımlar, genelleyici ve kapsamlı tanımlardır. Bu tanımların içinde kişiye özel hizmetler, koordinasyon, bağ kurma, hizmet ağları, verimlilik ve etkin maliyet gibi kavramlar bulunmaktadır. İkinci tür tanımlamalar ise klinik veya gelişmiş uygulamaların odağında tasarlanmaktadır. Bu tanımlar genellikle vaka yöneticisinin ayrıntılı koordinasyon sorumluluklarını ve klinik görevlerini içermektedir (Gursansky vd., 2003). Genel bir tanım olarak vaka yönetimi; bireylerin sağlık bakım gereksinimlerini karşılamak için sağlığın değerlendirildiği, gereken aktivitelerin planlandığı, uygulandığı ve izlendiği multidisipliner bir sistemdir (Cohen, 1991; Goodwin, 1992; Phillips, 1996).

Vaka yönetimi ve bakım protokolü bu amaca yönelik ortaya çıkan en güncel yöntemlerdendir. (Bailey vd., 1998, Bower, 1997, Olds, 1997, Pearson vd., 1995). Vaka yönetimiyle bireyin, problem çözme, iş ve sosyal becerilerinin gelişmesi, boş zaman aktivitelerinin artması ve bireyin bağımsızlaşmasıyla işlevselliğinin gelişmesi amaçlanır ve bu yönüyle vaka yönetiminin kronik ruhsal hastalığı olan bireyler için etkili bir yöntem olduğu belirtilmektedir. (Townsend, 2009). Vaka yönetimi sağlık ve insani hizmet çalışanları tarafından kullanılmaktadır. Bu kavram bireyle çalışmanın önceki kavramsallaştırmaları ile birçok açıdan benzerdir. Birçok alanda kullanılan bu yaklaşımı sosyal hizmet uzmanları müracaatçıya destek olma amacıyla kullanırlar. Bu yaklaşım müracaatçıların içinde buldukları şartlar ve durumlara uygun, uzun süreli, etkili, onların sosyal fonksiyon göstermelerini sağlayabilen ve genel sağlık durumlarını olumlu yönde geliştirmeye yönelik bir yaklaşımdır. Vaka yönetimi toplumdaki çocuklar, yetişkinler, aileler, kronik fiziksel hastalığı olanlar ve yaşlılar ile sağlık hizmetleri ve sosyal hizmetlere ihtiyaç duyulan her grupta kullanılır (Bogo, 2006). Vaka yönetiminden, düşükün yaşlılar, gelişimsel, zihinsel ve fiziksel engeli olan bireyler, çok yönlü ve yüksek maliyetli bakım gerektiren problemleri olan bireyler ve hastalığın akut bir nöbeti veya akut alevlenmeden ciddi ölçüde etkilenen bireyler faydalanabilmektedir (Townsend, 2009).

Standart bakıma kıyasla, vaka yönetiminin hastanın psikiyatrik belirti, yaşam kalitesi, sosyal ve mesleki işlevselliği açısından olumlu sonuçları olduğu belirtilmektedir (Björkman ve Hansson, 2007). Klinik ve sosyal sonuçları iyileştirmeye mümkün olduğunca hastaneye yatışların azalması beklenir (Lieberman, 2008).

## **VAKA YÖNETİMİNİN AŞAMALARI**

Vaka yönetimi hem planlama hem de uygulama ayağı olan bir yaklaşımdır. Yaklaşımın nerde, ne zaman, kimin için ve ne şekilde kullanılacağı önemlidir. Planlama odağında bakıldığında Tahan (1996) vaka yönetimi programı geliştirmek için 10 basamak sıralamıştır.

1. Formatı tasarlama,



2. Hedef nüfusu seçme,
3. Disiplinlerarası takımı düzenleme,
4. Takımı eğitme,
5. Var olan süreci inceleme,
6. Alanyazını tarama,
7. Planın süresinin belirleme,
8. İçeriği geliştirme,
9. Bir pilot çalışma yürütme,
10. Planı standartlaştırma (Tahan, 1996).

### **VAKA YÖNETİCİSİ**

Vaka yönetimi geleneksel olarak hastaların toplumla bütünleşmelerine hız veren bir hizmettir ancak hastalar için damgalayıcı anlamlar da çağrıştırmaktadır. Hastalar kendilerinin yönetilecek vakalar olarak görülmelerini istemez, klinisyenlerle ortaklaşa seçilen hizmetleri almayı tercih etmektedirler. Bu sebeple ciddi ruhsal hastalığı olan bireylerin saygınlığı ve güçlenmeleri ile daha uyumlu olan terim “kişisel destek hizmetleri”dir. Bu hizmeti sunanlar ise kişisel destek uzmanı olarak isimlendirilir (Lieberman, 2008).

Hekim, hemşire, sosyal hizmet uzmanı ya da sağlık ekibinin herhangi bir üyesi vaka yöneticisi olabilir. Ancak vaka yöneticisinin klinik bakım, kurumsal dinamikler, finans sistemleri ve toplum kaynakları gibi konularda bilgili ve eğitilmiş olması önerilmektedir. Vaka yöneticisinin kim olması gerektiğine dair tartışmalar sürmesine rağmen, bu görevi sıklıkla hemşireler yerine getirmektedir. Amerikan Hemşireler Birliği vaka yöneticisi olacak hemşirelerin en az lisans derecesine ve alanında en az üç yıllık deneyime sahip olması gerektiğini belirtmektedir (Girard, 1994, Pearson vd., 1995; Türkmen, 1997).

### **VAKA YÖNETİCİSİNİN ROL VE FONKSİYONLARI**

Günümüzde vaka yönetiminde çok farklı meslek elemanları yer almaktadır. Vaka yöneticisi olarak çalışan meslek elemanlarının arasında psikiyatrlar, hemşireler, sosyal hizmet uzmanları, psikologlar ve bakaloryal düzeyinde eğitim almış idari personel yer alabilmektedir. Vaka yöneticileri bireysel olarak veya disiplinler arası grubun bir parçası olarak çalışabilirler. Vaka yöneticilerinin müracaatçıları ile görüşme aralıkları her gün, her altı ayda bir görüşme veya hiç görüşmeme şeklinde olabilir. Bazı vaka yöneticileri müracaatçılarıyla telefon aracılığı ile iletişim kurmayı da tercih edebilir. Bu yöntemlerin hiçbirinde esas hedef değişmemelidir (Dill, 2001).

**Amerika Vaka Yöneticileri Topluluğu (CMSA) daha kapsamlı bir bakış açısıyla bakmış, vaka yöneticisinin rol ve fonksiyonlarını 9 başlık altında sıralamıştır:**

1. Müracaatçının sağlık okuryazarlık durumu ve diğer yetersizlikleri de içeren kapsamda sağlığı ve psikososyal ihtiyaçları ile ilgili kapsamlı bir değerlendirme yapma ve müracaatçı, aile ve bakıcı ile birlikte vaka yönetim planı geliştirme.
2. Müracaatçı, aile ya da bakıcı, birinci basamak hekimi/personeli, diğer sağlık personeli ve toplum ile sağlık bakımının sonuçları, kalitesi ve etkin mali çıktılarını en üst seviyeye getirebilmek için plan yapma.
3. Hizmet alımlarında parçalanmaları en aza indirmek için karar verme sürecine müracaatçıyı da dâhil ederek sağlık bakım ekibi üyeleri arasında İletişimi ve koordinasyonu kolaylaştırma.



4. Zamanında ve bilinçli kararlar verebilmek için müracaatçı, aile ya da bakıcı ve sağlık bakım ekibi üyelerine; tedavi seçenekleri, toplum kaynakları, sigorta yardımları, psikososyal ilgiler ve vaka yönetimi gibi konular hakkında eğitim verme.

5. Kullanılabilir ve alternatif planlar olduğunda ve gerektiğinde istenilen sonuçlara ulaşmak için müracaatçıyı bakım seçeneklerini keşfederek problem çözme amacıyla güçlendirme.

6. Sağlık bakımı hizmetlerinin elverişli kullanımına cesaretlendirme, bakımın kalitesini artırmak için çabalama ve vaka başına yeterli ücret sağlama.

7. Müracaatçının bakımının bir sonraki en uygun düzeye güvenli biçimde dönüşmesine yardımcı olma

8. Müracaatçının kendi savunuculuğunu yapabilmesini ve kendi kaderini tayin hakkını artırmak için çabalama

9. Hem müracaatçıyı hem de ödemelerden sorumlu kişiyi, müracaatçının, sağlık bakımı ekibinin ve ödemelerden sorumlu kişinin giderlerine ilişkin kolaylık sağlamak için savunma. Ancak, eğer bir çatışma ortaya çıkarsa, müracaatçının gereksinimlerini öncelikli tutma (CMSA, 2010).

**Vaka Yöneticisinin Yapması gerekenler Los Angeles HIV Komisyonu tarafından 10 başlık altında sıralanmıştır.**

1. Müracaatçının durumunda meydana gelen değişimleri izleme

2. Müracaatçı için hazırlanan planda güncelleme veya değişiklik yapma

3. Bakım koordinasyonunu sağlama

4. Tavsiyelere uyma ve hizmetlerden yararlanma durumunu onaylamak için takip etme ve davranışları izleme

5. Müracaatçıyı diğer hizmet sağlayıcılarına karşı savunma/koruma,

6. Bağımsız yaşama stratejilerini kullanabilmesi için müracaatçıyı güçlendirme

7. Engelleri aşma noktasında müracaatçıya destek olma

8. Müracaatçı için hazırlanan plandaki hedefleri izleme

9. Müracaatçı ile ayda en az bir kez iletişim kurmayı sürdürmek (en az üç ayda bir kez de yüz yüze iletişim kurmak)

10. Bir sonraki iş günü sonuna kadar kaçırılmış olan randevuları izlemek (Los Angeles County Commission on HIV, 2019).

## **SONUÇ**

Vaka yönetimi yaklaşımının birçok alanda kullanılan ve yapılan müdahalelere olumlu anlamda ciddi düzeyde katkı sunan bir yaklaşımdır. Sağlık bakım kalitesinin yükseltilmesinde, maliyetlerin azaltılmasında, bireylerin bilinç düzeylerinin yükseltilmesinde, kısıtlı kaynakların en verimli şekilde kullanılmasında vaka yönetimi etkin bir yöntem olarak kullanılabilir.

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PROGRAM MANAGEMENT

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**ABSTRACT**

Factors such as the development of health technology and the increase in people's education levels are gradually increasing people's expectations from health. Over the last 60 years, little emphasis has been placed on planning and evaluation in health. Health institutions that have made programs also determine their goals and effective health services. Health institutions that have made a program will be able to access existing problems more easily, evaluate these problems, and have the ability to solve them more quickly and with higher quality. The control mechanism of organizations that have a specific program will also be easier. The program development process includes program preparation, implementation and evaluation studies. An implemented program is developed and evaluated through research and development activities. Program development is a dynamic and ongoing process. The elements of the program are examined in their entirety. Quality control is carried out in the program being implemented. It is a continuous process. Whatever decision is made for the optimal solution must be effective. The focus is on the action plan. It should be clearly stated how planning, assignment and coordination will be done. Objectives related to planned activities and criteria for outputs are determined. It is determined how, on what basis and to whom monitoring and control will be carried out, and who will report to whom, when or how often. The new situation in which the implementation of the decision is revealed is monitored for a certain period of time. The previous situation and the new situation are compared in line with the planned goals. It is checked whether the problem has been resolved and whether the new situation creates new problems. In this case, the problems may need to be examined and some decisions must be made again. Records, healthcare workers' notes and various reports can be used to monitor results. The program should be evaluated by determining how adequate and effective a new or developed program will be according to various needs. There are three types of program evaluation: Diagnostic evaluation, Formative evaluation, Level-determining evaluation. The goals-based evaluation model developed by Tyler is still valid today. Evaluation model with the differences approach developed by Provus; It is an evaluation approach based on system management theory. The standards and performance of the program are determined and compared. The program is evaluated by evaluating the differences between them.

**Keywords:** Program Management, Program Evaluation, Action Plan, Process.

**ÖZET**

Sağlık teknolojisinin gelişmesi, insanların eğitim seviyelerinin yükselmesi gibi faktörler insanların sağlıktan beklenti seviyelerini de gittikçe yükseltmektedir. Son 60 yıl boyunca sağlıkta planlama yapma ve değerlendirmenin üzerinde azla durulmaktadır. Program yapmış olan sağlık kuruluşları aynı zamanda amaçlarını, etkili sağlık hizmetlerini de belirlemiş olmaktadır. Program yapmış olan sağlık kuruluşları var olan problemlere daha kolay ulaşip bu problemleri değerlendirip, daha çabuk ve kaliteli çözümleme yeteneğine de sahip olan kuruluşlar olacaktır. Belirli bir programa sahip olan kuruluşların kontrol mekanizması da daha kolay olacaktır. Program geliştirme süreci, program hazırlama, uygulama ve değerlendirme çalışmalarını içine alır. Uygulanmakta olan bir program araştırma geliştirme faaliyetleriyle değerlendirilerek geliştirilir. Program geliştirme dinamik ve devamlılığı olan bir süreçtir. Programın öğeleri bütünlük içinde incelenir. Uygulanmakta olan programda kalite kontrolü yapılır. Sürekli bir süreçtir. En uygun çözüm için verilen karar ne olursa olsun etkili olmalıdır. Eylem planı üzerinde yoğunlaşılır. Planlama, görevlendirme ve koordinasyonunun nasıl olacağı açık seçik

belirtilmelidir. Planlanan etkinliklerle ilgili hedefler ve çıktılara ilişkin ölçütler saptanır. İzleme ve kontrolün nasıl, neye göre ve kimlere yapılacağı, kimin, kime, ne zaman ya da ne sıklıkla rapor vereceği belirlenir. Kararın uygulanmasının ortaya çıkarıldığı yeni durum belli bir süre izlenir. Önceki durum ile yeni durum planlanan hedefler yönünde karşılaştırılır. Sorunun çözümlenmiş olup olmadığına ve yeni durumun yeni sorun yaratıp yaratmadığına bakılır. Bu durumda sorunların irdelenip yeniden bazı kararların alınması gerekebilir. Sonuçlar izlemek için kayıtlar, sağlık çalışanlarının notları ve çeşitli raporlardan yararlanılabilir. Çeşitli ihtiyaçlara göre yeni yapılan ya da geliştirilen bir programın ne kadar yeterli ve etkili olacağını belirlenerek program değerlendirilmelidir. Program değerlendirmesi 3 çeşittir: Tanılayıcı değerlendirme, Biçimlendirici değerlendirme, Düzey belirleyici değerlendirme. Tyler tarafından geliştirilen hedeflere dayalı değerlendirme modeli günümüzde halen geçerliliğini korumaktadır. Provus tarafından geliştirilen farklar yaklaşımı ile değerlendirme modeli; sistem yönetimi kuramına dayanan bir değerlendirme yaklaşımıdır. Programın standartları ve performansı belirlenerek karşılaştırma yapılır. Arasındaki farklar değerlendirilerek program değerlendirilir.

**Anahtar Kelimeler:** Program Yönetimi, Program Değerlendirme, Eylem Planı, Süreç.

## **GİRİŞ**

Program yönetimi yaklaşımını kullanarak organizasyonu stratejik hedeflerine ulaştırmak için gerekli sonuçları elde etmek için, geçici ve esnek bir organizasyon yapısının tasarlanması gerekmektedir. Bu sayede, systematic, hesap verilebilir ve daha reaktif bir yaklaşım geliştirilmesi mümkün olabilecektir. Çok sayıda projeyi bir program çatısı altında yönetmenin, organizasyonun karşılaşılabileceği riskleri azaltacağı düşünülmektedir. Çünkü, bir projede oluşabilecek başarısızlık, diğer projenin tamamlanamamasına yol açabilir ve bu durum, proje seviyesi bakış açısı ile öngörülemez (Eren ve Erenel, 2018).

Doğru tanımlanmış bir organizasyon program yapısında, program yöneticisi, bağımlılıklara odaklanmak, iş stratejileri ile beklenen faydayı eşleştirebilecek yöntemler önererek projeler ile stratejileri birbirine uyumlamaya çalışmalıdır. Özellikle, çok sayıda aktörün paydaş olarak konumlandığı ve girdi yaptığı organizasyonlarda, program yönetim ofisleri, programların kontrol altında yürütülmesine olanak tanımakta ve tercih edilmektedir. (Project Management Institute, 2013).

Program yönetimi disiplininin uygulanması, organizasyonel değişikliklerin yanı sıra, ilgili paydaşlar tarafından kültürel değişimi de gerektirmektedir. Proje yönetim standartlarının dayandığı zaman, maliyet ve kalite beklentilerinden risk, fayda ve performans odaklı bir standardın oluşturulmasına geçişin zahmetli olacağı öngörülebilir. Bu çerçevede, program yönetim ofislerinin, yalnızca proje yönetimlerinin üzerinde bir hiyerarşik kademe olarak konumlandırılmaları ve toplam faydaya odaklı bir anlayış ile çalışmamaları, program yönetimi felsefesinin uygulanmasını zorlaştıracaktır (Eren ve Erenel, 2018).

Uygulanmakta olan bir program araştırma geliştirme faaliyetleriyle değerlendirilerek geliştirilir. Program geliştirme dinamik ve devamlılığı olan bir süreçtir. Programın öğeleri bütünlük içinde incelenir. Uygulanmakta olan programda kalite kontrolü yapılır. Sürekli bir süreçtir.

## **PROGRAM TASARIMI VE MODELLERİ**

Program tasarımı, bir programın hangi öğelerden oluşacağını ortaya çıkarılması sürecidir. Program tasarımları bir programını oluşturan temel öğelerden oluşmaktadır. Bu temel öğeler hedef, içerik, uygulama, sonuç ve değerlendirmedir. Tasarımlarda bu öğelere farklı ağırlıklar verilerek oluşur. Böylece tasarımcı kendine özgü tasarımını ortaya koyar.

## **PROGRAM TASARIMI YAKLAŞIMLARI**

Program yönetimi, projelerin bağımlılıklarına odaklanarak kullanıcıların projeleri yönetmesi için en uygun yaklaşımı geliştirmesine yardım eder. Bu bağımlılıklar 3 şekilde ortaya çıkabilir:

1. Bir projenin sonucu diğer projeyi etkiler.
2. Projeler aynı sınırlı kaynağı kullanır.

3. Bir proje, diğer projelerde kullanılacak/kullanılan sistemleri içerir. (Project Management Institute, 2013).

3 çeşit program tasarımı yaklaşımı vardır:

1. Konu merkezli program tasarımı
2. Öğrenme merkezli program tasarımı
3. Sorun merkezli program tasarımı

### **PROGRAM GELİŞTİRME**

Program geliştirme, eğitim programının hedef, içerik, öğrenme-öğretme süreci ve değerlendirme öğeleri arasındaki dinamik ilişkiler bütünü olarak tanımlanmaktadır (Demirel, 1996). Uzun soluklu ve karmaşık projelerin yönetiminde belirli bir uzmanlığa ve uygulama pratiğine erişilmiş olmasına karşın, yapılan araştırmalar, proje sayılarının artması ile birlikte organizasyon yapılarında bazı değişiklikler yapılmasına ihtiyaç duyulduğunu göstermektedir. Yetenek ve senaryo temelli savunma konsepti, ulusal savunma stratejilerini gerçekleştirmek amacıyla ihtiyaç duyulan yeteneklerin yürütülen projelerle ne ölçüde karşılanabileceğini öngörebilecek projeler üstü bir yönetim yapısının uygulamaya geçirilmesini gerektirmektedir (Eren ve Erenel, 2018).

### **PROGRAM GELİŞTİRME MODELLERİ**

Program modelleri genellikle modeli öneren kişi ya da kişilerin adıyla anılmaktadır. Tyler, Taba, Saylor ve Alexander, Goodland, Hunkins, Miller ve Seller, Olivia, Davis, Wulf ve Schave, Popham-Schrang ve Blochus, Kerr, Butler, Tanner ve Tanner modelleri bunlardan bazılarıdır (Posner, 1995; Demirel, 1996; Olivia, 1988; Ornstein, 1988; Urevbu, 1991; White, 1988; Erişen, 1998).

### **ABD'DE YAYGIN OLAN PROGRAM MODELLERİ**

- Taba modeli
- Programla ilgili herkes program geliştirme faaliyetine katılmalıdır.
- Programda görüşlere yer verilmelidir.
- Tümevarım yönetimini benimser
- İhtiyaçların belirlenmesi
- Amaçların belirlenmesi
- İçeriğin seçimi
- İçeriğin düzenlenmesi
- Öğrenme yaşantılarının seçimi
- Neyi nasıl değerlendireceğinin saptanması
- Program öğelerinin sırası ve ilişkilerin kontrolü
- Tyler modeli
- Okul merkezli bir modeldir
- İlerlemecilik temel felsefesini benimser.
- Tüme varım yönetiminden faydalanılmıştır

### **AVRUPA DA YAYGIN OLAN PROGRAM MODELLERİ**

#### **A. Rasyonel Planlama Modeli**

- Teknokratik modelde denmektedir.
- Yeniden kurmacılık felsefe görüşün etkisindedir.



- Modelin aşamaları: genel amaçlar-amaçlar-öğrenme durumları-değerlendirme

#### **Yenilikçi yaklaşım**

- Skilbeck tarafından geliştirilmiştir
- Hümanistik yaklaşımdan etkilenmiştir.
- Okul merkezli program geliştirme anlayışına ağırlık vermiştir.
- Modelin aşamaları: durum çözümlemesi-amaçlar-öğrenme\öğretme etkinlikleri-düzenleme-uygulama-değerlendirme

#### **Süreç Yaklaşım**

- Stenhouse temsilcisidir.
- Okul merkezli modeldir
- Tayler ve ilerlemecilik felsefi görüşü etkisi altındadır.
- Öğretmenlerin yaptığı ders planlama sürecinden etkilenmiştir.
- Modelin aşamaları: içerik-öğrenme durumları-genel amaçlar-değerlendirme.

#### **Wulf Ve Scave Modeli**

- Sistem yaklaşımını esas alarak geliştirilen bu model 3 aşamada oluşturulur.
- Birinci aşama: problemin tanımı
- İkinci aşama: program geliştirme süreci
- Üçüncü aşama: değerlendirme

#### **Aşama işlemi**

- Problemin tanım amacının belirlenmesi
- Komisyon üyelerinin secimi
- İçeriğin secimi
- Amaçların yazılması
- Amaçların uygulamaya dönüştürülmesi
- Planların yazılması
- Araç gereçlerin temini
- Ortamın değerlendirilmesi
- Değerlendirme sonuçlarının değerlendirilmesi
- Sürekli geri bildirim sağlanması

#### **PROGRAM GELİŞTİRMENİN PLANLANMASI**

Program geliştirme çalışma grupları ve program geliştirme karar ve koordinasyon grubu oluşturulur.

#### **Program Geliştirme Çalışma Grubu**

- Programın hazırlanması uygulanması değerlendirilmesi ve geliştirilmesi aşamalarında sürekli görev yapan bir komisyondur.
- Grupta bulunanlar
- Program geliştirme uzmanları
- Ölçme ve değerlendirme uzmanları

- İlgili konu alanı uzmanı
- İlgili konu alanı uygulayıcıları

#### **Program Geliştirme Karar Ve Koordinasyon Grubu**

- Temek işlev, hangi alanlarda program geliştirme çalışmaları yapılacağına karar vermek
- Ülkede geçerli olan eğitim felsefesinin bu programlara yansıtılmasını sağlamak
- Hazırlanan programları kabul yada değiştirmede karar organı olarak görev yapmak
- Tüm program geliştirme çalışmalarında koordinasyon sağlamak

#### **PROGRAMIN DEĞERLENDİRİLMESİ**

Program yöneticileri, organizasyon yapısı ve denetleme sürecinin projelerle uyumlu olarak planlanmasından, proje seviyesinin program üst kurulu ile arasında köprü oluşturulmasından sorumlu olmalıdır (U.S. Department of Defense, 2003) Bundan dolayı, program yöneticilerinin yeterli yönetim yetkisi ile donatılmış olması gerekmektedir. Program yöneticileri, ilgili organizasyonlarda eş seviyede oluşturulacak olan program yönetim ofisleri tarafından desteklenmeli ve kontrol edilmelidir (Eren ve Erenel, 2018).

Program değerlendirmesi 3 aşamada yapılır. Programa girişte yapılan **Tanılayıcı değerlendirme**, süreç içinde güçlüklerini ortaya çıkarmak ve gerekli düzeltmeleri yapmak için yapılan **Biçimlendirici değerlendirme** ve program sonunda belirlene hedeflere ulaşma düzeyini belirleyen **Düzyer belirleyici değerlendirme**.

#### **Programların Uygulanmasında Aşağıdaki Sıra İzlenir:**

- **Uygulamanın planlanması:** uygulamanın her aşaması ayrıntılı olarak planlanmalıdır.
- **Deneme yapılacak hastane, saha ve servislerin seçilmesi:** ülke düzeyinde uygulanacak bir program denemesi için uygun bir örnekleme tekniği ile kurumlar seçilmelidir.
- **Kurumlarda işbirliği yapılacak yöneticilerin seçilmesi:** işbirliği yapmak programın getirdiği yeniliklerin başarılı olması için gereklidir.
- **Yöneticilere veya sorumlulara denenecek programın tanıtılması:** programın uygulanmasında etkin rol alacak yöneticileri ile sorumlu elemanlara uygulamadaki rolleri ve sorumlulukları konusunda bilgiler verilmelidir. Hizmet içi eğitim uygulanabilir.
- **Hazırlanan program uygulanması ve değerlendirilmesi:** belirlenen öğretim materyalleri yöneticilere sağlanarak program uygulanır. Uygulanan programların istenilen değişimleri meydana getirici nitelikte olup olmadığını kontrol etmek için değerlendirme çalışmaları yapılabilir.

#### **SONUÇ**

Sonuç olarak, ülkelere özgü program yönetimi yaklaşımının, akademik ve üst seviye politika belirleyicilerin desteği ile planlama, programlama ve bütçeleme sürecinin tamamı boyunca projelerin koordinasyonundan, risk ve performansından sorumlu olarak konumlandırılacak program yönetim ofisleri ve program yöneticilerinin yetiştirilmesi ve organizasyon yapısının bu anlayışa uygun olarak düzenlenmesi ile mümkün olabileceği değerlendirilmektedir

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CİNSEL SIKINTILARIN PLISSIT MODEL İLE DEĞERLENDİRİLMESİ  
EVALUATION OF SEXUAL PROBLEMS USING THE PLISSIT MODEL

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**ÖZET**

Cinsellik; beden imajı, benlik saygısı ve cinsel benlik gibi kavramlarla ilişkilidir. Fiziksel değişiklikler, bireysel ve sosyal faktörler cinselliği etkileyebilir. Öyle ki cinselliği etkileyen bu faktörler cinsel sıkıntılarının ortaya çıkmasına neden olabilmektedir. Aynı zamanda cinsel sağlık ve üreme sağlığının ihmal edilmesi, dünya çapında sağlıkla ilgili birçok sorunun temelini oluşturmaktadır. Dünya Sağlık Örgütü, cinsel sağlığın temel sağlık hizmetlerine entegre edilmesi, insanların ve sağlık çalışanlarının cinsellik konusunda eğitilmesi ve cinsel sağlığın teşvik edilmesi konularına dikkat çekerek önemini vurgulamaktadır. PLISSIT model, yüz yüze bireysel danışmanlık ile cinsel sorunları olan kişilere yardım etmede kullanılan iyi bilinen bir yaklaşımdır. Sağlık profesyonelleri cinsel sıkıntılara yönelik tanılama yaparak bakım planı oluşturmak için cinsel sorunları ele alma yöntemlerinden biri olan PLISSIT modelden faydalanabilirler. PLISSIT, modelin dört aşamasının kısaltmasıdır: İzin verme ( Permission – P ), Sınırlı Bilgi ( Limited Information – LI ), Özel Öneriler ( Specific Suggestions – SS ), Yoğun Terapi ( Intensive Therapy – IT ). PLISSIT model yüz yüze bireysel danışmanlıkta kullanılan, cinsel sorunları olan kişilere yardım etmede iyi bilinen bir yaklaşımdır. PLISSIT modeli cinsel sorunlara yönelik kapsamlı bakımın planlanması için özel bir çerçeve oluşturmaktadır. Modelin kullanımı bakım sağlayıcının yetkinliğine göre ayarlanmıştır ve her adımda hastaları daha ileri bir tedaviye yönlendirmelerine izin verilmektedir. Bu model, sağlık hizmeti sağlayıcılarının bireylerle cinsel konular hakkında tartışma başlatmasına ve modelin sonraki adımlarında faydalı bilgi ve önerilerin bakıma dahil edilmesine olanak sağlayarak hasta ile sağlık profesyoneli arasında cinsel konular hakkında güvenli ve rahat konuşma imkanı sunar. Ayrıca bu model etkili, basit, kullanışlı ve uygun maliyetli bir danışmanlık yöntemidir. Danışmanlardan her adımda geri bildirim alınamaması ve bir adımdan diğerine doğrusal bir şekilde ilerlemesi PLISSIT'in sınırlamasıdır.

**Anahtar Kelimeler:** Cinsel Sıkıntı, Danışmanlık, PLISSIT

**ABSTRACT**

Sexuality; It is related to concepts such as body image, self-esteem and sexual self. Physical changes, individual and social factors can affect sexuality. So much so that these factors affecting sexuality can cause sexual problems to occur. At the same time, neglect of sexual and reproductive health underlies many health-related problems worldwide. The World Health Organization emphasizes the importance of integrating sexual health into primary health care, educating people and healthcare professionals about sexuality, and promoting sexual health.

The PLISSIT model is a well-known approach to helping people with sexual problems through face-to-face individual counseling. Health professionals can benefit from the PLISSIT model, one of the methods of addressing sexual problems, to diagnose sexual problems and create a care plan. PLISSIT is an acronym for the four stages of the model: Permission (P), Limited Information (LI), Specific Suggestions (SS), Intensive Therapy (IT). The PLISSIT model is a well-known approach to helping people with sexual problems, used in face-to-face individual counseling. The PLISSIT model creates a specific framework for planning comprehensive care for sexual problems. The use of the model is tailored to the competency of the care provider, allowing them to refer patients to further treatment at each step. This model allows healthcare providers to initiate discussions about sexual issues with individuals and incorporate useful information and suggestions into care in subsequent steps of the model, providing a safe and comfortable conversation between the patient and the healthcare professional about sexual issues. In addition, this model is an effective, simple, convenient and cost-effective consultancy method. The limitation of PLISSIT is that it cannot receive feedback from clients at every step and progresses linearly from one step to the next.

**Keywords:** Counseling, PLISSIT, Sexual Distress

## GİRİŞ

İnsan yaşamının önemli bir parçası olan cinsellik, iyilik halinin ve sağlığın sürdürülmesinde yaşamsal rol oynamaktadır (Uslu ve ark., 2016). Beden imajı, benlik saygısı ve cinsel benlik gibi kavramlar cinsellikle yakından ilişkilidir. Cinsellik, fiziksel, bireysel ve sosyal faktörlerden etkilenebilmektedir (Ziaei ve ark., 2022).

Oldukça karmaşık bir durum olan cinsellikle ilgili kadın ve erkeklerde cinsel istek bozukluğu, orgazm, erektil bozukluk, erken boşalma, uyarılma ve disparoni gibi önemli birçok sorun yaygın olarak görülebilmektedir (Bal ve ark., 2022; Uslu ve ark., 2016). Ege ve ark. (2010) çalışmasında kadınların %45,6'sının cinsel fonksiyon bozukluğu yaşadığını, Bal ve ark. (2022) kadınların %40,5'inin cinsel sıkıntı yaşadıklarını, Moreira ve ark. (2008) çalışmalarında erkeklerde en yaygın görülen cinsel sorunların erken boşalma (%20) ve erektil disfonksiyon (%18), kadınlarda ise cinsel istek bozukluğu (%34) ve cinsellikten zevk alamama (%25) olduğunu belirtmişlerdir (Bal ve ark., 2022; Ege ve ark., 2010; Moreira ve ark., 2008). Ayrıca Moreira ve ark. (2008) çalışmasında araştırmaya katılan erkeklerin sadece %26'sının, kadınların ise %17'sinin cinsel problemlerini bir doktorla görüştüğünü tespit etmiştir (Moreira ve ark., 2008). Konuyla (cinsellik) ilişkili problemler kadınlar tarafından çok sık ifade edilmeyen, yasaklı olarak kabul edilip değerlendirilen ve çoğu kez sağlık profesyonellerince de üzerinde durulmayan bir durumdur (Ege ve ark., 2010). Cinselliğin değerlendirilmesi ve danışmanlık verilmesi sağlık profesyonellerinin rolleri arasında yer almaktadır. Fakat az sayıda kişi bunun farkında olarak yerine getirmektedir ve bu konuda daha çok bilinçlendirilmeye ihtiyaç vardır (Sabancı Baransel, 2021).

Cinsel sağlığın değerlendirilmesi ve danışmanlık süreçlerinde model kullanımı hem sağlık profesyonellerine rehberlik ederek cinsel öykü alma sürecini kolaylaştırmakta hem de cinsel sorunların belirlenerek çözümüne yönelik imkan sağlamaktadır (Denizhan Kırcan, 2022). Kadınlarda cinsel sıkıntılarının çözümüne yönelik danışmanlık verilirken pek çok model kullanılmakla birlikte, cinsel danışmanlık için en yaygın kullanılan modellerden birisi PLISSIT modelidir (Yörük ve Karaçam, 2016). Bu model etkili, basit, kullanışlı ve uygun maliyetli bir danışmanlık yöntemidir (Tuncer ve Oskay, 2021). Modelle cinsel sıkıntı yaşayan bireylerin sıkıntılarının çözümü için onlarla iş birliği yaparak cinsel danışmanlıkla problemlerin çözülmesi planlanmaktadır (Denizhan Kırcan, 2022).

Bu derlemede cinsel sıkıntılarının PLISSIT model ile değerlendirilmesine yönelik farkındalık oluşturmak amaçlanmıştır.

## PLISSIT MODEL

PLISSIT modeli, 1976 yılında Jack S. Annon tarafından sağlık profesyonellerine, bireylerin cinsel sorunlarının düzenlenmesi ve tedavisinde yardımcı olması için geliştirilmiş, girişimsel yaklaşımları teorik olarak destekleyen etkili bir iletişim modelidir (Almeida ve ark., 2019; Emam ve ark., 2018; Rutte ve ark., 2015). Model, 2006 yılında Taylor ve Davis tarafından tekrardan gözden geçirilmiştir (Taylor ve Davis, 2006). Bu model, cinselliğin tartışılmasına, pozisyon değişikliği ve kayganlaştırıcı kullanımı gibi özel öneriler sunulmasına, terapideki bireysel hastaların ihtiyaçlarına göre farklı önerilerin yanı sıra, daha karmaşık vakalarda uzman profesyonellerle yoğun terapiye yönlendirmeye olanak sağlamaktadır (Almeida ve ark., 2019). PLISSIT, modelin dört aşamasının kısaltmasıdır (Rutte ve ark., 2015). Sırasıyla; izin verme (P), sınırlı bilgi (LI), özel öneriler (SS) ve yoğun terapi (IT) aşamalarından oluşmaktadır (Ziaei ve ark., 2022; Almeida ve ark., 2019; Emam ve ark., 2018).

**1- İzin Verme (P-Permission):** İzin verme basamağı, kadına ve eşine endişe duydukları konuları ve cinsel işlevlerini olumsuz yönde etkileyen sorunları tartışmalarına izin vermeyi gerektirmektedir (Denizhan Kırcan, 2022; Emam ve ark., 2018). Hastaya sorulacak sorular özenle seçilmelidir. Hastalığınız cinsel yaşantınızı nasıl etkiledi? Hastalığınız sonrasında cinsel ilişkiniz nasıl etkilendi? Bu konuda konuşmak ister misiniz? gibi açık uçlu sorular sorulmalıdır (Tuğut ve Gölbaşı, 2013). Sağlık profesyoneli mahremiyete saygılı, önyargısız ve sorgulayıcı olmadan bireyin duygu ve davranışlarının farkına varmasını sağlamalıdır (Denizhan Kırcan, 2022; Tuğut ve Gölbaşı, 2013). Cinsel sıkıntılarının çoğunluğunun çözümlendiği en etkili basamaktır (Denizhan Kırcan, 2022).

**2- Sınırlı Bilgi (LI-Limited Information):** Sınırlı bilgi basamağı, bireylerin cinselliğe ilişkin yanlış bilgi, inanç ve mitlerini ortaya çıkararak danışmanlık planlamak veya konuya ilişkin eğitim materyalleri (broşür, kitapçık) önermek, anatomi ve cinsel fizyoloji hakkında doğru bilgilendirmeler yapmak gibi uygulamalar ile hastanın bilgisini arttırmayı, endişelerini ortadan kaldırmayı amaçlamaktadır (Denizhan Kırcan, 2022; Tuğut ve Gölbaşı, 2013). Eğer sınırlı bilgi cinsel sorunları çözmek için yeterli değilse, profesyonellerin iki seçeneği vardır: bireyleri yoğun terapi veren bir yere yönlendirmek ya da uygun bilgi, beceri ve deneyimli profesyoneller varsa tedavinin üçüncü aşamasına geçmektir (Almeida ve ark., 2019).

**3- Özel Öneriler (SS-Specific Suggestion):** Özel öneriler basamağında, kişinin belirli bir sorunu üzerinde problem çözme yöntemi kullanılır. Ayrıca bu kısımda sadece cinsel davranışlar değil cinsel sağlığın tüm yönleri, uyarılma, orgazm, ağırlı ilişki ve doyum gibi sorunlar ele alınarak çözüm önerileri geliştirilmektedir (Tuğut ve Gölbaşı, 2013). Bu basamakla çözülemeyen bazı problemlerde (kişisel çatışmalar veya psikolojik sorunlar gibi) yoğun terapiye ihtiyaç duyulacaktır (Emam ve ark., 2018).

**4- Yoğun Terapi (IT-Intensive Therapy):** Yoğun terapi basamağı ise yalnızca ilk üç aşamada tedavi edilemeyen hastaların cinsel sorunlarının derinlemesine ele alınması için uzmana yönlendirilmesidir (Almeida ve ark., 2019).

Çalışmaları incelediğimizde; Nho (2013) çalışmasında PLISSIT temelli danışmanlığın jinekolojik kanserli kadınlar ve eşlerinde cinsel işlevi iyileştirmede, cinsel sıkıntıyı azaltmada, evlilik yakınlığını ve öznel mutluluğu artırmada etkili olduğunu belirlemiştir (Nho, 2013). Banaei ve ark. (2018) PLISSIT temelli danışmanlık modelinin kadınların doğumdan sonraki ilk altı aydaki cinsel işlevleri üzerindeki etkinliğini değerlendirmek amacıyla yaptıkları çalışmada PLISSIT modelinin emziren kadınların cinsel sorunlarını azalttığını tespit etmişlerdir (Banaei ve ark., 2018). Rostamkhani ve ark. (2015) çalışmasında PLISSIT modelinin birinci basamak



sağlık hizmetlerinde danışanların cinsel sağlık ihtiyaçlarını karşılayabildiğini ve sağlık çalışanları tarafından cinsel şikayet ve işlev bozukluklarının giderilmesinde kolaylıkla kullanılabileceğini belirtmişlerdir (Rostamkhani ve ark., 2015). Çalışmalar, PLISSIT modeli doğrultusunda verilen danışmanlığın etkili olduğunu, cinsel sıkıntıların çözümünde başarı ile kullanılabileceğini göstermektedir (Denizhan Kırcan, 2022).

## SONUÇ

İnsan olmanın ve yaşamının bir parçası cinsellik ve cinsellikle ilgili duygulara sahip olmaktır. Cinsel gereksinimler bireylerin yaşamını sürdürebilmesi için gerekli olan temel insan gereksinimlerindedir. Fizyolojik, psikososyal sorunların yanı sıra cinsel sorunların belirlenerek çözümlenmesi bireylerin yaşam kalitesini artırabilmek için oldukça önemlidir. Bu noktada bireylerin cinsel sıkıntılarının çözümlenmesinde yol gösterici olan modellere ihtiyaç duyulmaktadır. PLISSIT modeli, sağlık profesyonellerinin cinsellikle ilişkili sıkıntıları değerlendirebilmesinde etkin bir rehber olarak kullanılabilir. Bu model sağlık profesyonellerine kendilerini daha rahat hissedebilecekleri bir ortam sunarak, ayrıntılı bir biçimde danışanın cinselliğini değerlendirerek uygun bakım ve girişimleri uygulayabilecekleri bir çerçeveye sağlamaktadır.

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**ZEYTİN İŞLETMESİ YAN ÜRÜNLERİNDEN ZEYTİN ACI SUYU VE KARA  
SUYUNUN ANTİMİKROBİYAL ÖZELLİKLERİ**

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**ÖZET**

Zeytin ağacı yetiştiriciliği Akdeniz ülkelerinde oldukça yaygındır ve Türkiye, zeytin üretiminde dünyanın önde gelen ülkelerinden biridir. Üretilen zeytinin büyük bir kısmı zeytinyağı üretiminde kullanılmaktadır. Her endüstriyel proseste olduğu gibi, zeytin ve zeytinyağı işleme sırasında da bazı kalıntı atıklar oluşur ve bunların kirletici gücü, yağın özel olarak çıkarılma şekline bağlıdır. Zeytin ve zeytinyağı üretimi sırasında açığa çıkan yan ürünlerin başında prina, acı su ve karasu gelmektedir. Zeytin ve zeytinyağı işleme yan ürünlerinden zeytin acı suyu ve zeytin kara suyu başta antimikrobiyal ve antioksidan olmak üzere çok yönlü biyolojik etkilere sahip fenolik bileşiklerce zengindir. Özellikle yeşil zeytin, kabuk, meyvenin etli kısımlarında ve bitki yapraklarında bulunan oleuropein birçok araştırmaya konu olmuştur. Zeytin acı suyu ve zeytin karasuyunun doğal antioksidan ve antimikrobiyal ajanlar olarak farklı alanlarda (ilaç, gıda, kozmetik, hayvan besleme gibi...) değerlendirilmesi çevresel, sosyal, ekonomik ve sağlık açısından oldukça önem taşımaktadır. Bu çalışmamızda zeytin prosesinden elde edilen acı su ve zeytinyağı üretimi sonucu oluşan zeytin kara suyunda ki antimikrobiyal aktiviteler araştırılmıştır. Disk difüzyon yöntemi ve pozitif kontrol olarak da Cefadroksil antibiyotik disklerinin kullanıldığı çalışmamızda kağıt disklere emdirilen acı su ve karasu, duyarlılığı araştırılan mikroorganizmaların inoküle edildiği besiyerine difüze olması temeline dayanmaktadır. Çalışmada; *Bacillus spizizenii*, *Enterococcus faecalis*, *Klebsiella aerogenes*, *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus pyogenes* ve *Candida albicans* gibi seçilmiş mikroorganizmalar kullanılmıştır. İnokülasyon sonrası inhibisyon zonlarını karşılaştırdığımızda; *Pseudomonas aeruginosa* ve *Klebsiella pneumoniae* türlerinde aktivite gözlenmezken diğer bütün türlerde antimikrobiyal aktivite tespit edilmiştir. En iyi aktivite acı su örneklerinde ve *Bacillus spizizenii*, *Enterococcus faecalis*, *Klebsiella aerogenes*, *Streptococcus pyogenes* ve *Candida albicans* ' da 0,3 cm olarak ölçülmüştür.

**Anahtar Kelimeler:** Zeytin Acı Suyu, Zeytin Karasuyu, Antimikrobiyal Aktivite

**ABSTRACT**

Olive tree cultivation is widespread in Mediterranean countries and Turkey is one of the world's leading olive producing countries. Most of the olives produced are used in olive oil production. As with any industrial process, some residual wastes are generated during olive and olive oil processing and their pollutant strength depends on the specific way the oil is extracted. The main by-products released during olive and olive oil production are pomace, olive brackish water and olive mill wastewater. Among the by-products of olive and olive oil processing, olive brackish water and olive mill wastewater are rich in phenolic compounds with multifaceted biological effects, especially antimicrobial and antioxidant. Especially oleuropein found in

green olives, peel, fleshy parts of the fruit and plant leaves has been the subject of many studies. The utilization of olive brackish water and olive mill wastewater as natural antioxidants and antimicrobial agents in different fields (pharmaceuticals, food, cosmetics, animal nutrition, etc.) is very important in terms of environmental, social, economic and health. In this study, the antimicrobial activities of brackish water obtained from the olive process and olive mill wastewater resulting from olive oil production were investigated. The use of brackish water as natural antioxidants and antimicrobial agents in different fields (such as medicine, food, cosmetics, animal nutrition...) is of great importance in terms of environmental, social, economic and health. In this study, the antimicrobial activities of brackish water obtained from the olive process and olive mill wastewater resulting from olive oil production were investigated. The disc diffusion method and Cefadroksil antibiotic discs as positive control were used in our study, which was based on the diffusion of brackish water and mill wastewater impregnated on paper discs into the medium in which the microorganisms whose susceptibility was investigated were inoculated. Selected microorganisms such as *Bacillus spizizenii*, *Enterococcus faecalis*, *Klebsiella aerogenes*, *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus pyogenes* and *Candida albicans* were used in the study. When we compared the inhibition zones after inoculation; no activity was observed in *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* species, while antimicrobial activity was detected in all other species. The best activity was measured as 0.3 cm in brackish water samples and in *Bacillus spizizenii*, *Enterococcus faecalis*, *Klebsiella aerogenes*, *Streptococcus pyogenes* and *Candida albicans*.

**Key Words:** Olive Brackish Water, Olive Mill Wastewater, Antimicrobial Activity

## GİRİŞ

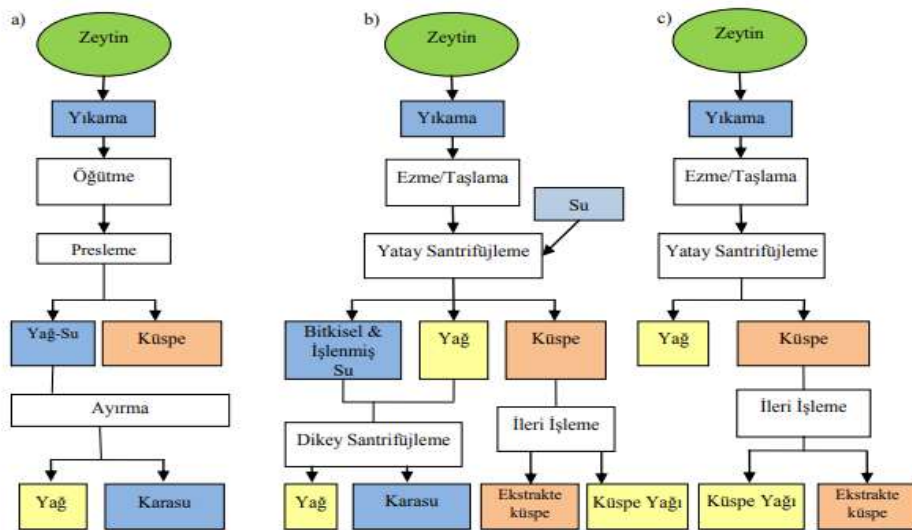
Zeytin ağacı yetiştiriciliği Akdeniz ülkelerinde oldukça yaygındır ve Türkiye, zeytin üretiminde dünyanın önde gelen ülkelerinden biridir. Üretilen zeytinin büyük bir kısmı zeytinyağı üretiminde kullanılmaktadır. Her tarımsal ürünün endüstriyel olarak işlenmesi sonucunda önemli miktarda yan ürünler elde edilir. Zeytin ve zeytinyağı üretimi sırasında açığa çıkan yan ürünlerin başında prina, acı su ve karasu gelmektedir. Zeytin ve zeytinyağı işleme yan ürünlerinden zeytin acı suyu ve zeytin kara suyu başta antimikrobiyal ve antioksidan olmak üzere çok yönlü biyolojik etkilere sahip fenolik bileşiklerce zengindir. Zeytin ağacı önemli biyolojik özelliklere sahip fenolik maddelerce zengin olup, bu fenolik bileşenlerin başlıcası oleuropeindir (Malik ve Bradford, 2006; Japon-Lujan ve ark., 2006; Bouaziz ve ark., 2008). Özellikle yeşil zeytin, kabuk, meyvenin etli kısımlarında ve bitki yapraklarında bulunan oleuropein birçok araştırmaya konu olmuştur. Elenolik asit ve hidroksitriosolün heterozidik esteri olan oleuropein, insan sağlığı üzerinde birçok faydalı etkiye sahiptir. Birçok araştırmacı tarafından antimikrobiyel bozulmaya sahip olduğu kanıtlanmış olan bu organik alternatif gıda katkıları olarak da mevcuttur. Zeytinin acı tadı onun doğal tadıdır. Oleuropein zeytin meyvelerinin özellikle acı tadından sorumludur. Zeytin bazı işlemlerden geçirilerek yenecek kıvama getirilir. Zeytinin tadındaki acılık gider ve tüketilebilecek besin haline getirilir. Zeytinin acılığı suda bekletilerek ve bazı farklı yöntemler ile giderilir. Zeytin acı suyu; hasat işlemi biten kurum ve salamura işlemine geçilen zeytinlerin su eklenerek çevirme, yuvarlama gibi farklı yöntemler yardımıyla belirli bir süre bekledikten sonra ortaya çıkan su dur. Bu süreç ortalama 2-3 ay kadar sürmektedir. Acı suyu çıkan zeytinler tatlandırılmak üzere su değişimine gider ve tüketilebilecek hale hazır olurlar. Zeytinin hasattan hemen sonra tüketilebilir nitelikte olamamasından sorumlu olan bu glikozit suda çözünbilme özelliğine sahiptir. Klasik salamura yöntemi, alkali uygulaması, enzimatik yöntem ya da mikroorganizmalarla hidrolize edilerek zeytinden uzaklaştırılabilmektedir (Fleming ve ark., 1973; Brenes ve ark., 1995; Marsillo ve

Lanza, 1998; Brenes ve DeCastro, 1998). Zeytin ağacının tamamında bulunan oleuropein zeytinde, dolayısıyla posasında, yağında ve zeytinyağı üretimi sırasında ortaya çıkan atıklarda da bulunmaktadır. (Soler-Rivas ve ark., 2000; Gikas ve ark., 2007).

Karasu, zeytinyağı işleme sırasında oluşan; tamamı organik, koyu kahverenkli ve mineral maddeler bakımından zengin, asidik nitelikte, sıvı atıktır. Karasu, organik madde, katı madde, kimyasal oksijen ihtiyacı, fenolik madde içeriği çok yüksek bir atıktır ve asidik pH'ya sahiptir. Bunun yanında yüksek antimikrobiyal etki göstermektedir. Bu nedenle karasuyun verimli bir biçimde değerlendirilerek çevreye en az zarar verebilecek hale getirilmesi oldukça önemlidir.



Zeytinyağı karasularının yapılarında bulunan tanninler, polifenoller ve polialkoller, antimikrobiyal aktiviteye ve bu nedenle de yüksek toksisiteye sahiptirler. Zeytin karasuyunun içerdiği fenolik bileşikleri doğal antioksidan veya antimikrobiyal madde kaynağı olarak farklı alanlarda değerlendirmek çevresel, sosyal, ekonomik ve sağlık açısından oldukça önemlidir. Bazı fiziksel ve kimyasal işlemlerle zeytin karasuyundaki antioksidan özellik gösteren maddeler izole edilip gıda, hayvancılık, ilaç vb. alanlarda kullanılabilir. Herhangi bir piyasa değeri olmayan ve çevre için tehdit oluşturan zeytin karasuyundan antioksidan üretimi ülkemiz ekonomisi açısından faydalı olacaktır. Zeytinin klasik pres ve üç fazlı sürekli proseslerle yağa işlenmesi sırasında elde edilen zeytin karasuyu zeytinin bünyesindeki özsu, zeytin yıkama suları, proses sırasında katılan su ve pirinadan sızan suların toplamıdır (Ben Sassi ve ark., 2006). Ülkemizde zeytin yağı üretimi klasik pres ve üç fazlı sürekli proseslerle elde edilir. Ancak zeytinyağı üretiminin iki fazlı sürekli olarak gerçekleştirildiği Avustralya, İspanya gibi ülkelerde tek başına karasu çok az veya hiç elde edilmez. Bu ülkelerde elde edilen ürün zeytin küspesi+karasuyu şeklindedir. Üç farklı işleme prosesi Şekil 1'de verilmiştir.



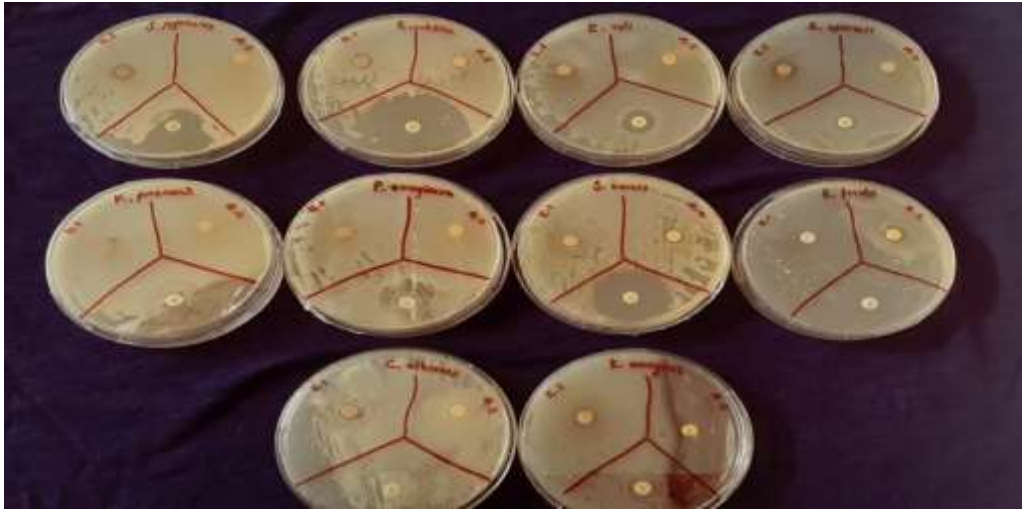
Şekil 1. Klasik (a), üç fazlı sürekli (b), iki fazlı sürekli (c) zeytin işleme prosesleri (Anonim, 2008)



## ARAŞTIRMA VE BULGULAR

Denemede kullanılan karasu ve acı su örnekleri Mersinin Tarsus ilçesinde bulunan zeytinyağı işletmelerinden temin edilmiştir. Sıkımdan sonra elde edilen karasu ve zeytin kurum işleminden elde edilen acı su Malatya Turgut Özal Üniversitesi Biyoloji Fakültesine getirilmiş ve denemelerde kullanılıncaya kadar +4°C’de bekletilmiştir.

Çalışmamızda zeytin prosesinden elde edilen acı su ve zeytinyağı üretimi sonucu oluşan zeytin kara suyunda ki antimikrobiyal aktiviteler araştırılmıştır. Disk difüzyon yöntemi ve pozitif kontrol olarak da Cefadroxil antibiyotik disklerinin kullanıldığı çalışmamızda kağıt disklere emdirilen acı su ve karasu, duyarlılığı araştırılan mikroorganizmaların inoküle edildiği besiyerine difüze olması temeline dayanmaktadır. Çalışmada; *Bacillus spizizenii*, *Enterococcus faecalis*, *Klebsiella aerogenes*, *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus pyogenes* ve *Candida albicans* gibi seçilmiş mikroorganizmalar kullanılmıştır. İnokülasyon sonrası inhibisyon zonlarını karşılaştırdığımızda; *Pseudomonas aeruginosa* ve *Klebsiella pneumoniae* türlerinde aktivite gözlenmezken diğer bütün türlerde antimikrobiyal aktivite tespit edilmiştir. En iyi aktivite acı su örneklerinde ve *Bacillus spizizenii*, *Enterococcus faecalis*, *Klebsiella aerogenes*, *Streptococcus pyogenes* ve *Candida albicans*’ da 0,3 cm olarak ölçülmüştür.



	KARASU	ACI SU	CFR
Bacillus Spizizenii	0,2 cm	0,3 cm	0,5 cm
Enterococcus Faecalis	0,2 cm	0,3 cm	1 cm
Klebsiella Aerogenes	0,2 cm	0,3 cm	0,5 cm
Staphylococcus Aureus	0,1 cm	0,2 cm	1,2 cm
Escherichia Coli	0,1 cm	-	0,5 cm
Pseudomonas Aeruginosa	-	-	1 cm
Bacillus Subtilis	0,2 cm	0,1 cm	2 cm
Klebsiella Pneumoniae	-	-	0,7 cm
Streptococcus Pyogenes	0,2 cm	0,3 cm	1 cm
Candida Albicans	0,1 cm	0,3 cm	-

Tablo:1 Karasu ve acı su antimikrobiyal sonuçları



Doğal antimikrobiyel maddeler arasında gösterilen oleuropeinin, mikroorganizmaların gelişme hızını geciktirdiği ve inhibe ettiği bildirilmektedir (Sousa ve ark., 2006; Sanchez ve ark., 2007; Sudjana ve ark., 2009; Lee ve Lee, 2010). Bu konuda yapılan birçok çalışmada fenolik glikozit oleuropein ve parçalanma ürünlerinin *Bacillus cereus*, *Enterococcus faecalis*, *Escherichia coli*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Lactobacillus plantarum*, *Moraxella catarrhalis*, *Pseudomonas fragi*, *Salmonella enteritidis*, *Salmonella typhi*, *Staphylococcus aureus*, *Staphylococcus carnosus*, *Vibrio parahaemolyticus*, *Vibrio cholerae*, *Vibrio alginolyticus* ve küfler üzerinde inhibe edici etkisinin olduğu ifade edilmektedir (Juven ve Heniz, 1970; Tassou ve Nychas, 1995; Aziz ve ark. 1998; Bisignano ve ark., 1999; Furneri ve ark., 2002).

Oleuropeinin *Staphylococcus aureus* ve *Escherichia coli* üzerine etkisinin incelendiği çalışmalarda, toksik etkinin Gr (+) bakteriler üzerinde Gr (-) bakterilere göre daha fazla olduğu bildirilmiştir. Bu etkinin bakterilerin hücre yapılarındaki farklılıklardan kaynaklandığı belirtilmektedir (Furneri ve ark., 2002; Pereira ve ark., 2006; Sanchez ve ark., 2007).

### **SONUÇ**

Mikrobiyel gelişmeyi kontrol altına almak amacıyla kullanılan katkı maddeleri antimikrobiyel olarak adlandırılmaktadır. Ancak son yıllarda, bu amaçla kullanılan sentetik kökenli maddelerin insan vücudunda istenmeyen ve beklenmedik yan etkiler oluşturmasının yanı sıra mikroorganizmaların bunlara karşı direnç kazanması alternatif olarak doğal antimikrobiyel maddelerin arayışına neden olmuştur (Sanchez ve ark., 2007).

Zeytin acı suyu ve zeytin karasuyunun içerdikleri fenolik bileşikler ile doğal antioksidan ve antimikrobiyel kaynağı olarak farklı alanlarda değerlendirmeleri çevresel, sosyal, ekonomik ve sağlık açısından oldukça önemlidir. Zeytin karasuyunun antioksidan ve antimikrobiyel etkileri üzerine yeterli sayıda in vitro çalışma yapılmış olmasına rağmen, özellikle zeytin acı suyu ile yapılan denemeler, sınırlı sayıdadır. Söz konusu ürünlerin ilaç, gıda, kozmetik, hayvan besleme gibi değerlendirilmesi çevresel, sosyal, ekonomik ve sağlık açısından oldukça önem taşımaktadır.

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**HEMŞİRELİK HİZMETLERİNDE İŞ YERİ NEZAKETSİZLİĞİ**  
**WORKPLACE INCIVILITY IN NURSING SERVICES**

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**ÖZET**

İşyeri nezaketsizliği, başka bir kişi üzerinde gücü olan bir kişi veya grup tarafından tekrarlanan veya ısrarla sergilenen, alıcının kendisini aşağılanmış, üzgün ve tehdit altında hissetmesine neden olan, özgüvenini azaltan ve kişilerarası çatışmalara neden olan olumsuz davranışlardır. Bu davranışlar, sözlü hakaretler, sözlü olmayan imalar, arkadan konuşma, bilgi saklama, sabotaj, mahremiyetin ihlali ve günah keçisi ilan etme şeklinde olabilir. Hemşirelikte yaygın ve acil bir sorun olarak uluslararası düzeyde kabul gören işyeri nezaketsizliği, sağlıklı çalışma ortamı için bir risk oluşturarak hemşirelerin mesleğine yönelik davranışını, düşünce sürecini ve bakış açısını değiştirmektedir. Yapılan çalışmalarda işyeri nezaketsizliğinin hemşirelerde iş stresine, dikkat dağınıklığına, psikolojik sıkıntıya, iş tatmininin, iş performansının ve yaratıcılığın azalmasına ve işten ayrılma niyetine yol açtığı belirtilmiştir. Bununla birlikte işyeri nezaketsizliği, bakım kalitesini düşürerek hasta güvenliğini de tehlikeye atmaktadır. Bu kapsamda hemşirelikte işyeri nezaketsizliğini kontrol altına almak/azaltmak için gerekli stratejilerin belirlenmesi önemlidir. Bu nedenle bu derleme, hemşirelikte işyeri nezaketsizliği, sonuçları ve işyeri nezaketsizliğinin yönetimine ilişkin farkındalık oluşturmak amacıyla yapılmıştır.

**Anahtar kelimeler:** Hemşirelik, yönetici hemşire, işyeri nezaketsizliği

**ABSTRACT**

Workplace incivility is negative behavior that is repeated or persistently displayed by a person or group of people who have power over another person, causing the recipient to feel humiliated, upset, or threatened, reducing self-esteem, and causing interpersonal conflict. These behaviors may include verbal insults, non-verbal insinuations, back-talking, withholding information, sabotage, invasion of privacy, and scapegoating. Workplace incivility, which is internationally recognized as a common and urgent problem in nursing, poses a risk to a healthy working environment and changes nurses' behavior, thought process and perspective towards their profession. Studies have shown that workplace incivility causes job stress, distraction, psychological distress, decreased job satisfaction, job performance and creativity, and intention to quit in nurses. However, workplace incivility also jeopardizes patient safety by reducing the quality of care. In this context, it is important to determine the necessary strategies to control/reduce workplace incivility in nursing. Therefore, this review was conducted to raise awareness about workplace incivility, its consequences and management of workplace incivility in nursing.

**Keywords:** Nursing, nurse manager, workplace incivility.

## **GİRİŞ**

Dünyada meydana gelen hızlı teknolojik gelişmelerle birlikte rekabet ve iş yoğunluğunun artması, zaman baskısı gibi faktörler çalışanları olumsuz yönde etkileyerek bireylerin iş ortamıyla daha az etkileşime girmesine, etkisiz iletişime ve işyeri nezaketsizliğine yol açmaktadır (Taşkaya & Aksoy, 2021). İşyeri nezaketsizliği işyerindeki saygı normlarını ve diğer kişileri göz ardı ederek hareket etmeyi içeren davranışlardır (Andersson & Pearson, 1999). Genel olarak, işyerinde belirli bir süre boyunca düşük yoğunlukta tekrarlanan, kolayca gözden kaçabilen ve birey, grup ve organizasyon düzeyinde zarar verici etkileri olan her türlü kaba davranış işyeri nezaketsizliği olarak kabul edilmektedir (Namin et al., 2021). İş arkadaşları hakkında söylentiler yaymak ve onların itibarına zarar vermek, öfke patlamaları, bağırarak, sözlü saldırılarda bulunmak, küçümseyici konuşmak, iş arkadaşlarına kaba e-postalar göndermek, astlarını tanımayı ihmal etmek, önemli iş faaliyetlerine katılmamak, başkalarının sözünü kesmek, toplantıları aksatmak, işbirliği içinde çalışmayı reddetmek, başkalarından gelen girdileri kabul etmemek, önemli bilgileri saklamak gibi davranışlar işyerindeki nezaketsiz davranışlara örnek gösterilebilir (Vasconcelos, 2020). Bir davranışın işyeri nezaketsizliği olarak değerlendirilebilmesi için işyerinde meydana gelmesi, en az iki kişi arasında gerçekleşmesi, karşılıklı saygı normlarını ihlal etmesi, fiziksel ya da elektronik ortamda, bireysel ya da toplum içinde sözlü yada sözsüz şekilde gerçekleşmesi gerekmektedir (Işııkay, 2019). Önemsiz gibi görünebilen, dışarıdan herhangi bir kötülük içermeyen ve basitçe kaba, kötü huylu veya nezaketsiz olarak göz ardı edilebilecek bu düşük türdeki sapkın işyeri davranışları, genellikle başkalarına zarar verme yönünde açık bir niyetle bağlantılıdır ve kuruluş ve çalışanları üzerinde uzun vadede ciddi zarar verici etkiler yaratabilir (Andersson & Pearson, 1999 ; Collins & Rogers, 2017; Cortina et al., 2017). Ayrıca nezaketsizlik, daha fazla nezaketsizliğin önünü açarak, daha saldırgan davranışların ortaya çıkmasına yol açabilmektedir (Fouk ve ark., 2016).

Hemşireler, diğer sağlık profesyonelleri gibi, hasta ihtiyaçlarını öngörmek, hasta güvenliğini sağlamak, etkili hemşirelik girişimlerini uygulamak ve hasta bakımının sürekliliğini sağlamak da dahil olmak üzere bütünsel bakım (örneğin, fiziksel, zihinsel, sosyal, ruhsal ve duygusal) sağlama konusunda birincil sorumluluğa sahiptir. (Amerikan Hemşireler Birliği [ANA], 2019). Ancak hemşireler oldukça yaygın bir şekilde işyerinde nezaketsizliğine maruz kalmaktadır. İran'da yapılan bir çalışmada, hemşireler arasında yüksek nezaketsizlik yaygınlığı rapor edilmiştir (Abdollahzadeh ve diğerleri, 2017). Alshehry ve ark.'nın Suudi Arabistan'da gerçekleştirdikleri bir çalışmada hemşirelerin, orta düzeyde işyeri nezaketsizliği algıladıkları belirlenmiştir (Alshehry et al. 2019a). Lewis ve Malecha (2011) Amerika Birleşik Devletleri'nde çalışan 659 hemşire ile yürüttükleri bir çalışmada, hemşirelerin yaklaşık %85'inin son 12 ayda işyeri nezaketsizliği yaşadığını tespit etmiştir. Türkiye'de yürütülen bir çalışmaya göre hemşireler, meslektaşları tarafından maruz kaldıkları kaba davranışları yaygın bir deneyim olarak açıklamıştır (İleri ve ark. 2023) .

Dünya çapında sağlık hizmeti ortamında ciddi bir endişe olarak tanımlanan işyeri nezaketsizliğinin hemşireler, hastalar ve yöneticiler açısından önemli olumsuz sonuçları bulunmaktadır (Spiri et al. 2016). Hemşireler sağlık ekibinin temel üyeleridir ve nezaketsiz davranışlara maruz kalmak iletişim süreçlerine zarar verebilir ve hastalara bütünsel yaklaşımı engelleyebilir (Ricciotti, 2016). Bununla birlikte işyeri nezaketsizliğine maruz kalmak bir hemşirenin davranışını, düşünce sürecini ve hemşirelik mesleğine yönelik bakış açısını değiştirebilir (Abdollahzadeh et al. 2017). Diğer istenmeyen davranışlara göre daha az zararlı ve daha az yoğun olarak algılanmasına rağmen işyeri nezaketsizliği, motivasyon ve performansın azalmasına, izolasyon ve tükenme duygularına ve işten ayrılma niyetinin artmasına neden olabilir (Armstrong, 2018). Shi ve ark.'larının 696 hemşire ile

gerçekleştirdikleri bir çalışmada işyeri nezaketsizliğinin hemşirelerin kaygı ve tükenmişlik düzeylerini arttırdığını ve dayanıklılıklarını azalttığını tespit etmiştir (Shi ve ark., 2018). Bir çalışmada, işyerindeki nezaketsizlik deneyimi ile stres arasında pozitif bir ilişki olduğu rapor edilmiştir (Kanitha ve Naik, 2021). Zia-ud-Din Arif ve ark. işyerindeki nezaketsizlik ile çalışan devamsızlığı ve örgütsel bağlılık arasında anlamlı negatif bir ilişki olduğunu bulmuştur (Zia-ud-Din et al., 2017). Üç özel hastanede çalışan 250 hemşire ile yapılan bir çalışmada, işyerinde nezaketsizliğe daha az maruz kalan hemşirelerin işten ayrılma niyetinin daha düşük olduğu görülmüştür (Kavaklı & Yildirim, 2022). Kulmral'ın çalışmasında hemşirelerin yaşadıkları nezaketsizliğin örgütsel sessizliğe neden olduğu bulunmuştur (Kumral, 2017). Alquwez, 261 klinik hemşire ile gerçekleştirdiği bir çalışmada işyeri nezaketsizliğinin hasta güvenliğini olumsuz yönde etkilediğini belirlemiştir (Alquwez, 2020). Birkaç çalışma, hemşirelerin nezaketsizlik deneyiminin hemşirelerin performanslarını veya yeterliliklerini azaltan ana faktör olduğunu bildirmiştir (Rhee et al., 2017; Westbrook et al., 2021). Bununla birlikte bir çalışmaya göre işyeri nezaketsizliğinden kaynaklanan verimlilik kaybı bir hemşire için yıllık ortalama 11.581 dolar olarak hesaplanmıştır (Lewis ve Malecha 2011). Genel nezaketsizlik ve hemşire nezaketsizliğinin hemşirelik bakımının kalitesini olumsuz yönde etkilediği bir diğer çalışma bulgusudur (Alshehry et al., 2019b). Nezaketsizliğe maruz kalmak hemşirelerin klinik performansı üzerinde olumsuz bir etki yaratarak hemşirelerin hata yapma riskini arttırabilir (Johnson et al., 2020).

Bu kapsamda hemşirelik hizmetlerinde işyeri nezaketsizliğinin etkin yönetilmesini sağlamak için çeşitli stratejilerden yararlanılabilir. Yapılan çalışmalarda etkili iletişim teknikleri ve yeni öğrenilen iletişim tekniklerini uygulamaya yönelik aktif öğrenme stratejilerini içeren eğitimler işyeri nezaketsizliğini önlemede kullanılmıştır (Armstrong, 2017 ; Warrner et al., 2016). Bununla birlikte ekip oluşturma egzersizleri de kullanılan diğer bir yöntemdir (Armstrong, 2017; Laschinger et al., 2012). Ota ve ark. yürüttükleri bir kapsam belirleme çalışmasına göre çalışanlar arasında örgüt kültürüne ilişkin ortak bir vizyon geliştirmek, sorumluluğun teşvik edilmesi, çalışanlara destek sağlanması da sağlık hizmeti ortamlarında nezaketi teşvik etme ve desteklemede kullanılan stratejilerdir (Ota et al. 2022).

## **SONUÇ**

Hemşirelik işyeri nezaketsizliği sağlık bakım ortamında süregelen bir sorundur. Çalışma sonuçlarına göre işyeri nezaketsizliği, hemşirelerin motivasyon, dayanıklılık, verimlilik ve performansını azaltır; kaygı, stres, tükenme, işe devamsızlık ve işten ayrılma niyetini artırır; hasta güvenliğini ve bakım kalitesini olumsuz yönde etkiler. hemşirelik hizmet sunumunda aksamaya neden olan işyeri nezaketsizliğini azaltmak/önlemek için etkili iletişimin geliştirilmesi, kurumiçi eğitimlerin planlanması, çalışanlara geribildirimde bulunulması ve çalışanları desteklemek için ödüllendirme sisteminin kullanılması önemlidir.

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HEMŞİRELİK ÖĞRENCİLERİNDE KLİNİK MUHAKEMEYİ GELİŞTİRMEK  
IMPROVING CLINICAL REASONING IN NURSING STUDENTS

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**ÖZET**

Klinik muhakeme, hasta bilgilerini toplamak, analiz etmek, bu bilgilerin önemini değerlendirmek ve alternatif hemşirelik girişimlerini belirlemek için düşünme yöntemlerini kullanan bilişsel bir süreçtir. Yetkin hemşirelik uygulamasının önemli bir bileşeni olan klinik muhakeme, belirsiz, riskli ve karmaşık koşullar altında karar vermeyi kolaylaştırır. Bu nedenle hemşirelik öğrencilerinin sağlık hizmeti ortamındaki mevcut değişikliklere etkili bir şekilde yanıt verebilmelerini sağlamak için klinik muhakeme becerisinin kazandırılması önemlidir. Hemşirelik öğrencilerinde klinik muhakeme yeterliliğinin geliştirilmesi, kaliteli, güvenli ve etkili hasta bakımının sağlanmasına ve sürdürülmesine yardımcı olmaktadır. Bu kapsamda hemşirelik öğrencilerinde klinik muhakemeyi geliştirmek veya değerlendirmek için kullanılan birçok eğitim yöntemleri mevcuttur. Bu eğitim programları; simülasyon tabanlı, vaka çalışmaları, probleme dayalı öğrenme, mobil cihaz tabanlı öğrenme (oyunlar, sanal hasta vb.) gibi çeşitli stratejilerdir. Bu derlemenin amacı, hemşirelik öğrencilerinde klinik muhakemeyi geliştirmek için yaygın olarak kullanılan öğretim stratejilerini araştırmak ve farkındalık oluşturmak amacıyla yapılmıştır.

**Anahtar Kelimeler:** Hemşirelik, hemşirelik öğrencileri, klinik muhakeme.

**ABSTRACT**

Clinical reasoning is a cognitive process that uses thinking methods to collect and analyze patient information, evaluate the importance of this information, and determine alternative nursing interventions. Clinical judgment, an important component of competent nursing practice, facilitates decision-making under uncertain, risky and complex conditions. Therefore, it is important to provide nursing students with clinical reasoning skills to enable them to respond effectively to current changes in the health care environment. The development of clinical reasoning competence in nursing students helps to provide and maintain quality, safe and effective patient care. In this context, there are many educational methods used to develop or evaluate clinical reasoning in nursing students. These training programs; simulation-based, case studies, problem-based learning, mobile device-based learning (games, virtual patient, etc.). The aim of this review was to investigate and raise awareness of commonly used teaching strategies to improve clinical reasoning in nursing students.

**Keywords:** Nursing, nursing students, clinical reasoning.

## GİRİŞ

Muhakeme kelimesinin kökleri hesaplama, değerlendirme ve aklın kullanımı anlamlarına gelen Latince ‘raciocinium’ sözcüğünden üretilmişken, klinik kelimesi önleyici, iyileştirici ve palyatif bakımın verildiği yer veya hastalık durumunda ortaya çıkan semptomların analizi anlamlarına gelen Yunanca ‘klinikos’ sözcüğünden üretilmiştir (Houaiss, 1986). Klinik muhakeme kavramı, 1960’lardan günümüze kadar hemşirelik literatüründe önemli bir özellik olarak nitelendirilmiş ve daha kapsamlı tanımlanmaya, eleştirel olarak analiz edilmeye çalışılmıştır (Cerullo & Cruz, 2010). Bu kapsamda klinik muhakeme, bir çözüm geliştirmek için bilgi ve deneyimi klinik bir duruma uygulama sürecidir (Carr, 2004). Başka bir tanıma göre klinik muhakeme, bir kararın ve eylemin öncüsüdür (Simmons, 2010).

Klinik muhakeme, hemşirelerin hasta sorunlarını tanımladığı, analiz ettiği, müdahaleleri planlayıp uyguladığı, sonuçları değerlendirdiği ve üzerinde derinlemesine düşündüğü bilişsel bir süreç olarak tanımlanmaktadır (Hoffman, 2007). Ayrıca klinik muhakeme, yalnızca bilişsel bir işlev değil; sosyal, psikolojik ve kültürel etkileri içermektedir (Sedgwick et al., 2014). Bu bağlamda hemşireler için temel bir yeterlilik olan klinik muhakeme, hemşirelerin giderek daha karmaşık hale gelen sağlık bakım ortamını ve genişleyen profesyonel rollerini yönetmesi için gerekli bir beceridir (Tyo & McCurry, 2019). Klinik muhakeme becerisine sahip bir hemşire, hasta merkezli, zamanında ve etkili kararlar alırken (Koharchik et al., 2015), zayıf klinik muhakeme becerisine sahip hemşire, etik, yasal ve mesleki kriterlere dikkate almaması verilerin doğru tanımlanmamasına, hemşirelik girişimlerinin zamanında uygulanmamasına ve risk altında olan hastaların belirlenip önceliklendirilememesine neden olmaktadır ve bu durum hasta ve çalışan güvenliğini olumsuz yönde etkilemektedir (Mohammadi-Shahboulaghi et al., 2021). Dolayısıyla güvenli ve kaliteli hasta bakımı için klinik muhakeme önemli bir kriterdir (Hunter & Arthur, 2016) ve bu nedenle öğrencilerde klinik muhakeme becerisinin hemşirelik eğitimi boyunca temel bir bilişsel düşünme süreci olarak ele alınması gerekmektedir (Menezes et al., 2015).

Hemşirelik eğitiminde öğrencilerin uygulamalardaki farkındalığını ve yeterliliğini artıran klinik muhakeme, mesleki gelişimin temelini oluşturan bir bilişsel süreç olarak kabul edilmekte (Mohammadi-Shahboulaghi et al., 2021) ve akreditasyon kuruluşları tarafından gerekliliği ve önemi vurgulanmaktadır (AACN, 2021). Ancak çalışmalarda hemşirelik öğrencilerinin klinik muhakeme becerilerinde eksiklikler olduğu bildirilmiştir (Killam et al., 2011; Kavanagh & Szweda, 2017; Jarvelainen et al., 2018). Bu kapsamda hemşirelik öğrencilerine klinik muhakeme becerisini kazandırmaya yönelik öğretim yöntemlerinin kullanımının teşvik edilmesi önemlidir (Kavanagh & Szweda, 2017).

## HEMŞİRELİK EĞİTİMİ

Hemşirelik eğitiminde, öğrencilerin klinik muhakeme becerisini geliştirmek için kavram haritası (Alfayoumi, 2019), probleme dayalı (de Sá Tinôco et al., 2021), simülasyona (Blanié et al., 2020; Theobald et al., 2021) dayalı öğretim yöntemlerinin kullanıldığı belirlenmiştir.

### Kavram haritası

Kavram haritası, öğrenmeyi teşvik etmek için müfredat boyunca işlenen temel fikirlerin veya kavramların öğretilmesine dayanır. Kavram haritası, kavramların daireler/kutucuklar içine alarak kavramlar ve alt kavramlar arasındaki ilişkiyi ortaya koyan etkili bir klinik öğretim yaklaşımıdır (Heims & Boyd, 1990). Yapılan çalışmalarda kavram haritasının hemşirelik öğrencilerinin klinik muhakeme becerilerinin geliştirilmesine katkıda bulunduğu gösterilmiştir (Gerdeman et al., 2013; Alfayoumi, 2019). Bununla birlikte kavram haritası yönteminin akademik performansın yanı sıra üst düzey bilişsel yeteneklerin gelişiminde de olumlu etkisi vardır (Prinz et al., 2020).

### Probleme dayalı öğrenme yöntemi

Probleme dayalı öğrenme, hemşirelik eğitiminde klinik muhakemeyi geliştirmek için en yaygın kullanılan öğretim yöntemlerinden birisidir (Merisier et al., 2018). Probleme dayalı öğrenme, hemşirelik öğrencilerinin klinik becerilerini ve bilişsel kapasitelerini geliştirmek amacıyla küçük gruplar halinde iş birliği yapmalarına olanak tanıyan öğrenci merkezli bir öğrenme yöntemidir (Jamshidi et al., 2021). Bununla birlikte öğrencilerin aktif olarak katılmasına, öğrenme hedeflerini tanımlamak için küçük gruplar halinde akranlarıyla etkileşime girmesine, kendi kendine çalışmasına, yeni bilgileri tartışmasına ve uygulamasına ve sonunda çeşitli materyalleri öğrenme sürecine entegre etmesine olanak tanımaktadır (Savin-Baden, 2016). Ayrıca hemşirelik öğrencilerinin özgüveni, klinik muhakeme, eleştirel düşünme, öz değerlendirme, akran değerlendirme ve kişilerarası iletişim becerilerini geliştirmelerine olanak tanıyan bu yöntem, hemşirelik eğitimcileri için etkili ve eğlenceli bir öğretim yöntemidir (Sharma et al., 2023).

### Simülasyona dayalı öğretim yöntemi

Klinik muhakemeyi geliştirmek ve değerlendirmek için hemşirelik eğitiminde giderek daha fazla kullanılan simülasyon, hemşirelik öğrencilerinin gerçek bir durum içerisindeymiş gibi klinik bir durumu deneyimlemesi olarak tanımlanmaktadır (Gaba, 2007). Simülasyon, öğrencilerin hata yapmaları durumunda hastaya zarar verme korkusu olmadan karar verebilecekleri ve harekete geçebilecekleri güvenli bir ortam sağlamaktadır (Martin et al., 2020). Bununla birlikte hemşirelik eğitiminde klinik muhakeme becerilerinin öğretilmesinde simülasyonun etkinliğini inceleyen sistematik derlemelerde, simülasyonun klinik muhakemenin geliştirilmesinde önemli bir rolü olduğu tespit edilmiştir (Lapkin et al., 2010; Theobald et al., 2021). Ayrıca simülasyona dayalı öğretim yöntemi hemşirelik öğrencilerinde eleştirel düşünme, klinik beceri performansın, kendine güven duygusunun ve memnuniyet düzeyinin artması ile ilişkilendirilmiştir (Lapkin et al., 2010).

### SONUÇ

Sonuç olarak klinik muhakeme, hemşirelik öğrencilerinin giderek karmaşık hale gelen sağlık bakım ortamlarını yönetebilmesi ve 'risk altındaki' hastaları tanımlayabilmesi için gerekli bir beceridir ve hemşirelik öğrencilerinde bu becerinin kazandırılması için kullanılan birçok eğitim yöntemleri mevcuttur. Bunlar; simülasyona, probleme ve kavram haritasına dayalı yöntemlerdir. Bununla birlikte hemşirelik eğitimi veren kurumların müfredatlarını klinik muhakeme becerisine sahip öğrenciler yetiştirecek şekilde öğretme ve öğrenme yöntemlerini kullanmalıdır.

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**THE EFFECT OF MULTIDRUG RESISTANCE PROTEIN 1 IN ALLERGIC  
ASTHMA**

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**ABSTRACT**

Multidrug resistance protein 1 (MRP1), which can protect cells from toxic insults, mediates the transportation of the cysteinyl leukotriene C4 (LTC4) that has been correlated with the pathophysiology of asthma. MRP1 activity in allergic asthma patients and the effect of MRP1 inhibition were investigated. 32 asthma patients [mild persistent (n=13) and mild intermittent (n=19)] and healthy controls (n=22) were evaluated. MRP1 gene expressions were detected in leukocytes by using quantitative PCR. MRP1 efflux function was assessed by incubating

leukocytes with Calcein-AM and comparing calcein fluorescence with and without the modulator probenecid. LTC<sub>4</sub> release in vitro from cells was assessed by ELISA. Effects of MRP1 inhibition was evaluated by flow cytometer after probenecid induction in the leucocytes. LTC<sub>4</sub> levels detected by ELISA and ATP levels by chemiluminescence technic. MRP1 gene expression were found to be increased compared to the controls ( $p=0.003$  by unpaired t-test). Significantly low LTC<sub>4</sub> levels were detected in the leucocytes supernatants of asthmatic patients ( $p=0.004$ ) and MRP1 regulated transport of LTC<sub>4</sub> was found faster than control group. ATP levels were also significantly reduced ( $p=0.03$ ). In the mild persistent asthma group. In addition, the activity of MRP1 transport proteins was found to be increased in asthma ( $p=0.031$ ). Based on our results, we can suggest that MRP1 plays a role in the compensation mechanism in asthma pathogenesis by ensuring LT transport in allergic asthma. Inhibition of MRP1 may attract the attention of clinicians by providing a new perspective on treatment protocols aiming to prevent and reduce cell activation in asthma.

**Key words:** asthma, allergy, flow cytometry, inflammation, lymphocytes, MRP1

## INTRODUCTION

Asthma is inflammatory lung disease characterized by systemic and chronic localized inflammation. Inflammatory and immune cells such as lymphocytes, neutrophils and eosinophils and a number of cytokines including leukotrienes (LTs) released from these cells, contribute to the late asthmatic reaction. The cysteinyl leukotriene C<sub>4</sub> (LTC<sub>4</sub>), the conjugation product of glutathione and leukotriene A<sub>4</sub>, is a mediator of inflammation, increases postcapillary permeability, causes vasoconstriction, and induces oxidative stress (Mehrotra & Henderson, 2009). LTC<sub>4</sub> and its metabolites, LTD<sub>4</sub> and LTE<sub>4</sub>, are powerful inflammatory agents involved in particular bronchial asthma (Taylor & Folco, 1994). Biologic activities of cysteinyl leukotrienes in the airways strongly support the hypothesis that they are involved in airway remodeling in bronchial asthma. Increased cysteinyl leukotriene (CysLT) levels have been detected in the sputum of patients with asthma and have been shown to correlate with symptom severity (Pavord et al., 1999). There are several studies indicating that peripheral leukocytes of asthmatics produce significantly more LTC<sub>4</sub> than those of controls (Kristjánsson et al., 1995; Mitsunobu et al., 2000).

Although overexpression of the multidrug resistance-associated protein (MRP) family members seems closely associated with the clinical outcome of various malignancies, their physiological functions are still poorly defined. Abrogation of MRP expression in mice, however, led not only to hypersensitivity to anticancer drugs but also to an impairment in the inflammatory response. This defect was attributed to a decreased secretion of LTC<sub>4</sub> (Wijnholds et al., 1997). MRP1 is an ATP-binding cassette (ABC) transporter protein that expels chemicals and conjugates, in order to protect the cells from the detrimental effects of oxidative stress (Renes et al., 2000). GSH conjugates and LTC<sub>4</sub> are specific conjugates of MRP1. In addition, conjugated steroids, E<sub>2</sub> 17  $\beta$ G, Ostroron-3-sulfate, Dehydroepiandrosterone 3-sulfate are endogenous substrates of MRP1. It is known that high LTC<sub>4</sub> levels trigger an asthma attack, but the effect and mRNA levels of MRP1, which transports LTC<sub>4</sub> from inside the cell to the outside of the cell, in asthma pathology are still unknown. Accordingly, LTC<sub>4</sub> receptor antagonists have been used as a drug in the treatment of asthma, and it has been observed that this treatment has similar results to the use of steroids.

MRP1 protein has been assessed in leukocytes, platelets and lung epithelial cells. However, the role of MRP1 in leukocyte membranes and asthma still remains unclear. Considering the oxidative stress mechanism and the role of MRP1 related to this mechanism in asthma, it can

be expected that MRP1 protein is effective in its interaction with leukocytes, which are inflammatory cells.

## MATERIALS AND METHODS

### Study Group

32 adult patients (mild intermittent (MI)(n=19), and mild persistent (MP)(n=13) who had been suffering from asthma since two years or more, and those who attended to outpatient clinic of Istanbul University Cerrahpasa Medical Faculty Pulmonology Department were included in this study. Characteristics of the asthma patients and control group are shown in Table 1. Median age of the patients (29 females and 3 males) was 39 (min:17-max:68) years. Asthma patients had normal cyprometric values, peripheric eosinophilia and high serum eosinophilic cationic protein levels (ECP) and daily peak expiratory flow (PEF) variation were between 20-30%. Asthma patients were asked to stop using inhaled steroids or leukotriene antagonists at least two months prior to the study. Patients with negative prick tests, severe cardiac insufficiency, immune suppressive diseases, interstitial fibrosis, disseminated bronchiectasis, active infections, severe liver or kidney insufficiency and those who had severe asthma attacks within last three months, and were taking multivitamin preparations were not included in this study. The control group consisted of 22 healthy donors (13 females and 9 males). Median age was 33 (min:23-max:46) years for controls. Informed consent was obtained from healthy volunteers and patients participating in the study. This study was approved by Cerrahpasa Faculty of Medicine Local Ethics Committee.

Table 1. Characteristics of Control and Asthma Patients

	<b>Controls (n=22)</b>	<b>Asthma Patients (n=32)</b>
Gender (n)		
Female	13	29
Male	9	3
Median age (min-max)	33 (23-46)	39 (17-68)
Family story	No	13
Asthma degree		
MI	0	19
MP	0	13
FVCex Predicted (Mean ± SD)	105.02 ± 14.77	104.18 ± 6.82
FEV1 Predicted (Mean ± SD)	96.27 ± 15.33	95.15 ± 16.03
FEV1/FVC% Predicted (Mean ± SD)	94.55 ± 6.42	95.82 ± 7.80
MEF25-75 Predicted (Mean ± SD)	77.63 ± 19.45	66.09 ± 24.49

MI; Mild Intermitant Asthma, MP; Mild Persistant Asthma, SD;Standart Deviation, FEV1; forced expiratory volume in 1 second, FVC; forced vital capacity, MEF; maximum expiratory flow 25/50/75 % of the FVC remain to be exhaled.

### **Isolation of peripheral blood mononuclear cells**

Peripheral blood mononuclear cells (PBMC) were obtained from heparinized blood by density gradient centrifugation over Ficoll(Sigma Chem. Co., St. Louis, MO).

### **Detection of MRP1 gene expression by qRT-PCR**

Total RNA was isolated by Qiagen RNeasy Kit (Qiagen, GmbH, Germany) from PBMC and one microgram of total RNA was used for cDNA synthesis by using random hexamers and MMLV reverse transcriptase (MBI Fermentase, Lithuania) according to the manufacturer's instructions. qRT-PCR was carried out in the Light Cycler 480 Instrument (Roche Applied Sciences, Germany). Fast Start SYBR Green I Master Kit (Roche Diagnostics, Mannheim, Germany) and five picomoles of each primer were used and all samples were run in duplicates. The specificity of the amplification products was confirmed by the melting curve analyses. The PCR protocol was as follows: initial denaturation at 95 °C for 7 min, amplification segment at 95°C for 5 sec, at 58°C for 10 sec, at 72°C for 10 sec, a total of 45 cycles, melting curve segment was at 60°C for 15 sec for one cycle and cooling. Cyclophilin A (CYPA), MRPL28 and ABL genes were used for normalization. The underlying principles were described by Vandesompele et al. ([Vandesompele et al., 2002](#)). Relative expressions were calculated according to the delta Ct method, based on the mathematical model described by Livak et al. ([Livak & Schmittgen, 2001](#)).

### **Assessment of MRP1 transporter expression**

To detect the MRP1 protein expression, isolated leucocytes were labeled with FITC-conjugated mouse anti-human MRP1 monoclonal antibody (BD PharMingen, San Diego, CA, USA) according to the manufacturer's instructions [5]. The fluorescence intensities of the gated cell populations were measured using FACSCalibur (Becton Dickinson, USA) and were analyzed by CELL Quest software program (Becton Dickinson, San Diego, CA, USA).

### **Functional analysis of MRP1**

Leukocytes ( $1 \times 10^6$ ) were incubated with 1  $\mu$ M of calcein-AM for 60 minutes at 37 °C in phosphate-buffered saline (PBS) with and without modulator (probenecid 200  $\mu$ mol/L). Control cells were incubated only with PBS [8, 9]. Probenecid (Invitrogen USA) (200 mM, incubated with for one hour at 37°C) was used for inhibition of MRP1 in the platelet and leukocytes [10]. MRP1 activity (calcein efflux blocking factor) was calculated by the ratio of the mfi value of leukocytes inhibited by probenecid for 60 minutes to the uninhibited mfi value (probenecid-Ca-AM/Ca-AM) ([Broxterman et al., 1996](#); [Feller et al., 1995](#); [Lowry et al., 1951](#)).

### **Leukocyte stimulation and measurement of LTC4 levels**

Leukocytes( $3 \times 10^6$ ) were incubated with 200  $\mu$ mol/L of probenecid for 60 minutes at 37 °C in PBS. L-serine(50 mM, pH 7.4) and 1  $\mu$ g/ml phorbol myristate acetate(PMA) were added in the 45th and 50th minutes, respectively ([Rao et al., 1999](#)). Incubations were terminated by quenching on ice and supernatants were collected by centrifugation at 8.000 X g for 1 min. LTC4 was measured in the supernatants by using LTC4 ELISA kit(Cayman Chemicals, Ann Arbor, MI). Each experiment was performed in duplicate or triplicate.

### **Measurement of ATP levels**

Cells were rinsed twice with PBS and break into pieces in 200 ml of 5% (w/v) meta phosphoric acid on ice. After centrifugation (10.000 g, 3 min at room temperature) cellular ATP levels were determined using the ATP Bioluminescence Assay Kit (ATP Bioluminescence Assay Kit CLC II) (ROCHE, Germany) according to the manufacturer's instructions.

### Detection of oxidative stress

Serum 4-HNE levels were studied using the Enzyme Linked Immunosorbent Assay (ELISA) kit (96 Test) (0.1-10µg/ml. sensitivity range) (Cell Biolabs, Inc. San Diego, CA, USA) and GSH levels were measured by the spectrophotometric method (Reid et al., 2003).

### Statistical analysis

Statistical analyses were performed by using Package for Social Sciences Statistical Software release 16 (SPSS, Inc., Chicago, Illinois, USA) and GraphPad Prism v.9.0 (GraphPad Software). P value of < 0.05 was considered statistically significant and data presented as mean ± SEM on box plot with line at mean. Unpaired t-test with Welch's correction was used to compare the relative mRNA levels of the samples between the groups.

Statistical analysis was performed with Student's t test Wilcoxon, paired and unpaired t-test, Mann-Whitney, Pillai's Trace (post-hoc), multiple comparisons (LSD), Bonferroni, Dunnett-t. The results were evaluated in terms of mean values and standard deviation.

## RESULTS

### MRP1 gene and protein expression in asthma patients

We determined the relative MRP1 mRNA levels in the allergic asthma patients and the control group by qRT-PCR (Figure 1). Increased MRP1 mRNA levels were observed in the allergic asthma patients compared to the controls (Figure 1A, p=0.003 by t test). Patients were also analyzed according to the grade of the disease as "mild intermittent asthma" and "mild persistent asthma" patients and no difference was observed between the patients and the control group in terms of grading (MI vs control p=0.07 and MP vs control p=0.16)(Figure 1B).

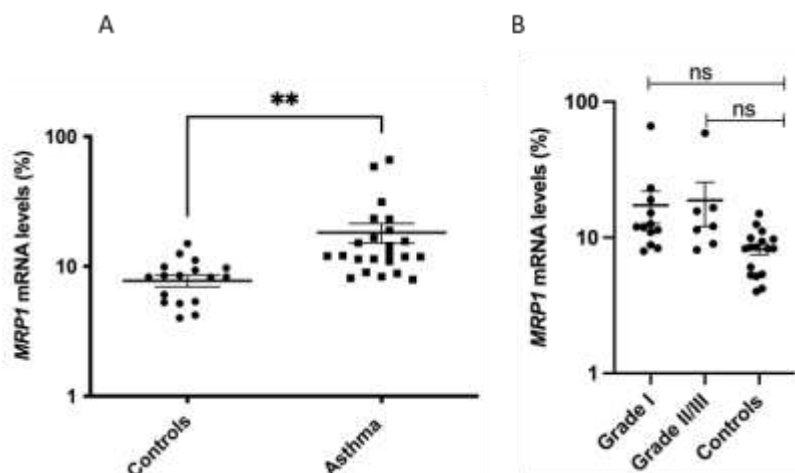


Figure 1: A) MRP1 expression in asthma patients and controls (\*\*p=0.003 by t-test) B) MRP1 expression in asthma subgroups (Grade I MI (Mild Intermittant), Grade II / III MP (Mild Persistent) and controls. MI vs control p=0.07 and MP vs control p=0.16 by t-test)

MRP1 protein expression levels were examined by flow cytometry in asthmatic and healthy individuals. MRP-1 percentage and MFI % values of the leukocytes showed no statistical difference between the asthma patients (mean 3.00 ± 2.31) and control group (mean 2.01 ± 0.49) (p>0.05 by paired t- test p=0.083)

### LTC4 levels in asthma patients and control group

LTC4 levels in the asthma group were found to be statistically lower in the presence of probenecid, a modulator of MRP1, compared to the experiment without probenecid (p=0.02).



LTC<sub>4</sub> levels in the presence and the absence of probenecid were not found to be significantly different in the control group (p=0.60) (Figure 2).

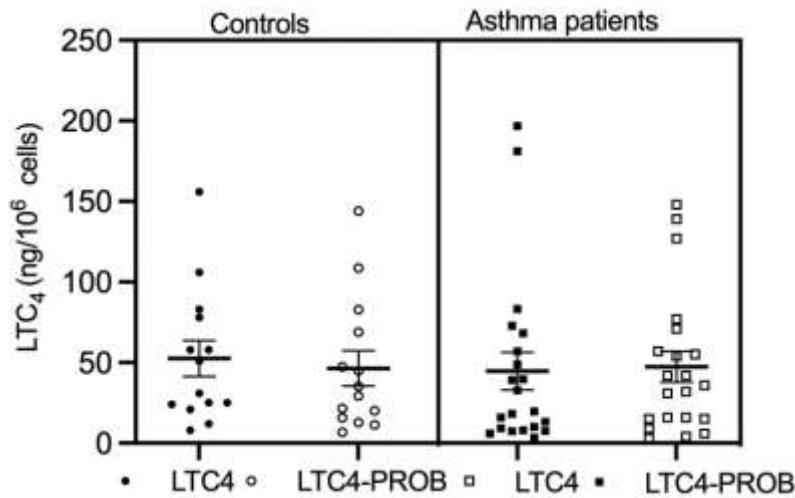


Figure 2: LTC<sub>4</sub> levels in asthma patients and controls. Paired t-test used for comparison (for controls p=0.60 and for asthma patients p=0.02) LTC<sub>4</sub> (Leukotriene C<sub>4</sub>); LCT<sub>4</sub> level that secreted out of the cells by the ELISA method. LTC<sub>4</sub>-PROB (Leukotriene C<sub>4</sub> and Probenecid) level; probenecid, which is the MRP1 modulator, LTC<sub>4</sub> levels in the supernatant were measured by ELISA method.

### Intracellular Calcein-AM accumulation in leucocytes

Intracellular accumulations of Calcein-AM were examined after probenecid inhibition (Figure 3). As a result of MRP1 inhibition by probenecid in leucocytes in the asthma group, intracellular Calcein-AM accumulation increased (p=0.03), but this increase was not observed in the control group (p=0.36). Intracellular Calcein-AM accumulations in lymphocytes (p=0.24) and granulocytes (p=0.65) were not found significant different next to probenecid inhibition.

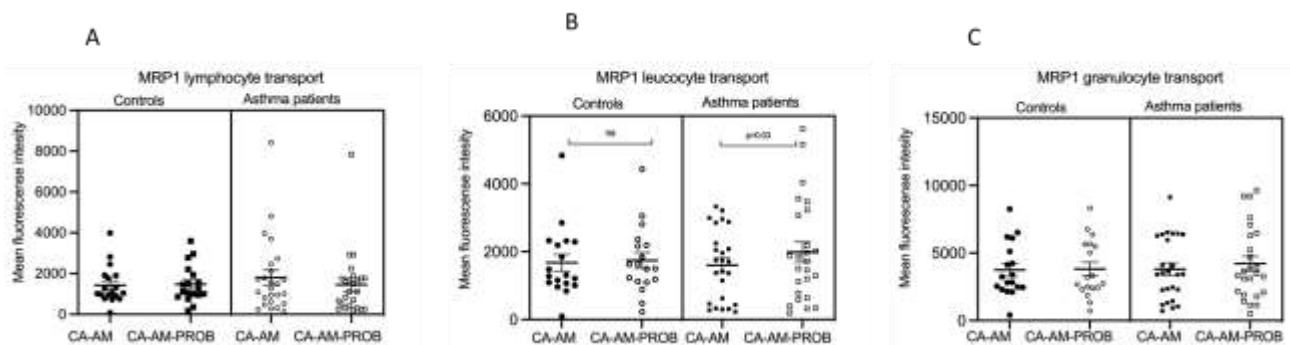


Figure 3: Comparison of intracellular Calcein-AM accumulation in (A) lymphocytes (p=0.24), (B) leucocytes (p=0.03) and (C) granulocytes (p=0.65) after probenecid inhibition in controls and asthma patients. CA-AM; Calcein AM, CA-AM-PROB; Calcein AM and Probenecid.

### Intracellular ATP and glutathione levels in asthmatic patients and control group

ATP levels were also examined in the leukocytes of asthma patients and control group (Figure 4) and were found to be reduced in the asthma patients compared to the control group (t-test Welch's correction, p=0.03) (Figure 4B). We also showed a negative correlation between MRP1 gene expression and ATP levels (Pearson correlation Test, r = -0.42) (Figure 4A). Additionally, although glutathione levels detected higher in asthma patients than control group, difference was not significant (p=0.29, Figure 4C).



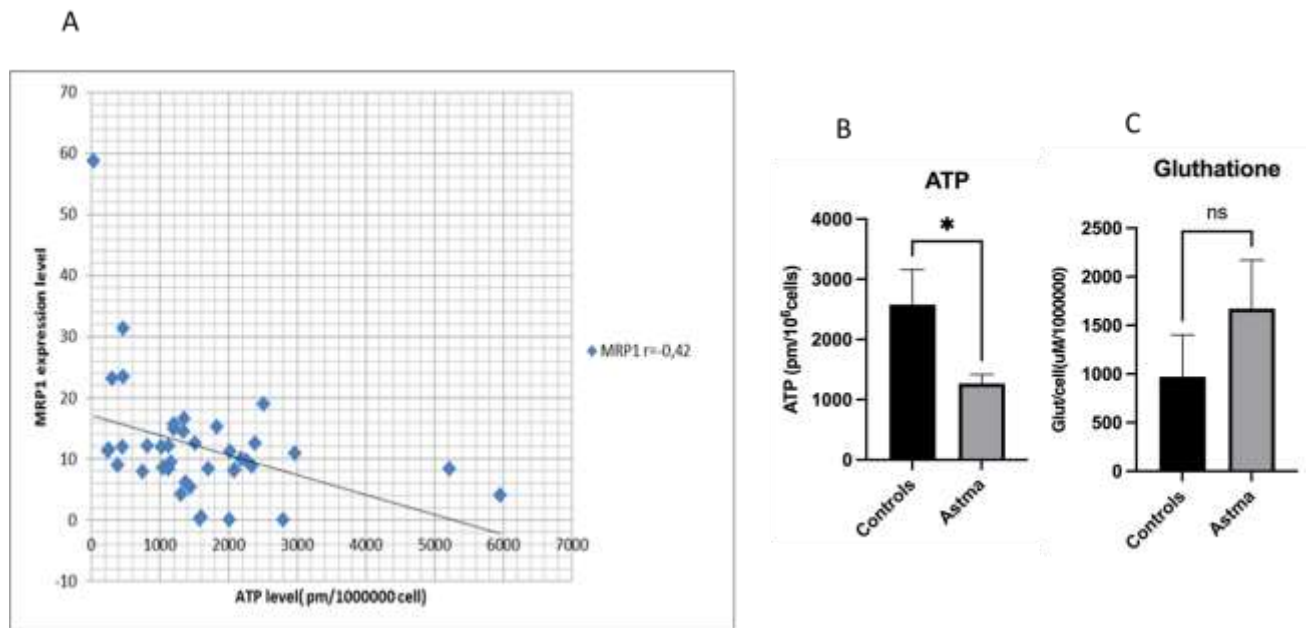


Figure 4: Intracellular ATP and glutathione levels in asthma patients and controls. A) Correlation analysis between MRP1 expression and ATP levels in leukocytes (Pearson correlation Test,  $r = -0.42$ ). B) ATP levels in leucocytes (by t-test Welch's correction  $p=0.03$ ) and C) Glutathione levels (by t-test Welch's correction  $p=0.29$ ) in leucocytes.

Blood cells were classified as granulocytes, monocytes and lymphocytes on SSC/FSC scales according to their size and granularity by FCM (Legrand et al., 1998; Zaman et al., 1993). No significant differences were detected in 4-HNE levels, GSH levels among the groups.

## DISCUSSION

In recent years, it has been shown that MRP1 is not only involved in exporting xenobiotics, but also in transporting the lipid mediators like leukotrienes (LT) or prostaglandins (Burger et al., 1994; Yoshioka et al., 2009). Therefore, it is considered a good target gene of potential interest for studying the inflammatory response. Animal models have shown that MRP1 plays an important role in the allergic airway inflammatory response. Furthermore, a decrease of CysLt levels in the BAL fluid occurs in lack of MRP1 (Yoshioka et al., 2009). Hence, we evaluated that MRP1 might have an anti-inflammatory effect not only on the lung but also on blood cells in allergic asthma patients. Thus, MRP1 expression in peripheral blood leukocytes obtained from asthma patients and the transport of MRP1 as a transmembrane protein in LTC4 and Calcein AM in asthma were investigated.

Increased MRP1 gene expression levels in peripheral blood leukocytes of asthmatic subjects and a positive correlation was observed between asthma grades. MRP1 gene expression levels were similar in mild persistent and intermittent subjects. Asthma is a disease with high oxidative stress and increased inflammation. It has been found that its function has increased in several inflammatory diseases such as rheumatoid arthritis (Wolf et al., 2005), atherosclerosis (Kotlyarov & Kotlyarova, 2021), Crohn's disease and ulcerative colitis (Blokzijl et al., 2008). In order to show the MRP1 function in asthma, we detected substrate transport activities and our findings proved that both MRP1 expression and MRP1 Calcein-AM transport were increased in asthmatic patients compared to control group. Lu et al. have reported increased MRP1 transport in patients with systemic lupus erythematosus (Lu et al., 2008), but there is no previous data about the asthma patients and MRP1 function. In this study, we also focused on the rate of MRP1 transport of LTC4 from leukocytes in asthma patients. In the extracellular

area, no difference was shown in LTC<sub>4</sub> levels, whereas after probenecid inhibition, LTC<sub>4</sub> levels were increased in the asthmatic leukocytes. So, it is possible to conclude that MRP1 expression and transport may increase LTC<sub>4</sub> and work as a compensatory mechanism against inflammation in asthma by regulating LTC<sub>4</sub> transport. ATP and glutathione levels support this finding. LTC<sub>4</sub> is important mediator of asthma, and inhibition of its effects may represent a potential breakthrough in the therapy of asthma (Chung, 1995).

Activated platelets and leukocytes cause inflammation by activating cells in the circulation and respiratory tract, especially with their secretions (cytokine, LTC<sub>4</sub>, PAF, interleukin, histamine etc.) (Pitchford & Page, 2006; Tutluoglu et al., 2005). It has been reported that the cells that play an important role in inflammation in asthma are eosinophils, mast cells, and platelets, and their numbers and effects in the circulation increase due to late apoptosis of eosinophil (Lommatzsch et al., 2020). On the other hand, it has been stated that MRP1 located in platelet and leukocyte membranes plays a protective role against apoptosis by removing oxidative stress products, glutathione (GSSG) and LTC<sub>4</sub> from the cell (Sjölander et al., 1999). In an in vitro study on endothelial cells, it has been shown that MRP1 can be subject to an up-regulation against cytokine-induced apoptosis, and plays a cell protective role (Blokzijl et al., 2008). Considering our findings of increased MRP1 activity in the light of these information, the question of whether MRP1 has a mechanism in the apoptosis resistance of eosinophil, whose numbers are frequently increased in asthmatic patients, may come to mind.

To conclude, our data shows that MRP1 efflux function and MRP1 expression increased in peripheral leukocytes of allergic asthma patients. We may suggest that MRP1 is involved in the compensation mechanism of asthma pathogenesis by providing LT transport in asthma. MRP1 inhibition may introduce a new perspective to the treatment protocols that aim preventing and reducing cell activation in asthma. There is no previous data evaluating the MRP1 function in asthma, and future studies are needed to understand the MRP1 function in detail in asthma patients. When the mechanisms are resolved, modulation of leucocyte function can be used for new treatments in asthma and might draw clinicians' attention to the potential efficacy of existing anti asthmatic drugs.

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**EKOLOJİ VE BİLGİSAYAR TEKNOLOJİLERİ**  
**ECOLOGY AND COMPUTER TECHNOLOGIES**

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**ÖZET**

Ekoloji ve evrimsel biyoloji, karmaşık kalıpları ve süreçleri araştırır. Bu nedenle kalıtım, doğal seçim, adaptasyon, popülasyon dinamikleri ve besin ağları gibi organik evrimin ve ekolojik etkileşimlerin temel bileşenlerini tanımlamak ve açıklamak için matematiksel bir araç seti gerekli olmuştur. Bilgisayar teknolojileri, ekoloji alanı da dahil olmak üzere çok sayıda çeşitli bilginin işlenmesi ve analiz edilmesi sorununu çözmek için güçlü bir araçtır. Modern bilgisayar teknoloji yöntemleri ve araçlarına hakim olmak, bilgiyi algıyı geliştiren, analizini, sentezini, değerlendirmesini ve tahminini önemli ölçüde basitleştiren ve hızlandıran formlarda sunmanıza olanak tanımaktadır; bu çevre yönetimi ve çevre koruma alanında becerileri modern bilimsel araştırma ve uzmanların pratik faaliyetleri için ayrılmaz bir araç haline getirmektedir. Bu çalışmada, bilgisayar teknolojileri: bilgisayar modelleme ve derin öğrenme yöntemleri ekolojide rolü tartışacağız.

**Anahtar kelimeler:** Ekoloji, Bilgisayar Teknolojileri, Bilgisayar görselleştirmesi, Makine öğrenimi.

**ABSTRACT**

Ecology and evolutionary biology investigate complex patterns and processes. Therefore, a mathematical toolset has become necessary to describe and explain fundamental components of organic evolution and ecological interactions, such as heredity, natural selection, adaptation, population dynamics, and food webs. Computer technologies are a powerful tool for solving the problem of processing and analyzing a large number of diverse information, including in the field of ecology. Mastering modern computer technology methods and tools allows you to present information in forms that improve perception, significantly simplifying and accelerating its analysis, synthesis, evaluation and prediction; This makes skills in the field of environmental management and environmental protection an integral tool for modern scientific research and



practical activities of experts. In this study, we will discuss the role of computer technologies: computer modeling and deep learning methods in ecology.

**Key words:** Ecology, Computer Technologies, Computer visualization, Machine learning.

## **GİRİŞ**

Ekoloji ve evrimsel biyoloji, karmaşık kalıpları ve süreçleri araştırmaktadır. Bu nedenle kalıtım, doğal seçim, adaptasyon, popülasyon dinamikleri ve besin ağları gibi organik evrimin ve ekolojik etkileşimlerin temel bileşenlerini tanımlamak ve açıklamak için matematiksel bir araç seti gerekli olmuştur [1]. Modern biyologlar, genetik dizilerin yanı sıra örnekler, örnekler ve türler hakkında dijitalleştirilmiş bilgiler de içeren verilerle dolup taşmaktadır.

Bu veri zenginliği, yeni anlayış, daha fazla verimlilik ve kullanım kolaylığı sağlayabilecek analitik araçların geliştirilmesini teşvik etmektedir. Artan veri miktarı benzeri görülmemiş bir görüşe olanak sağlarken, aynı zamanda ekolojik ve evrimsel çıkarımların pratik yönlerini de zorlaştırmaktadır. Karmaşık modeller genellikle karmaşık modellerle daha iyi tanımlanmaktadır ve her yeni modelin araştırmacılar tarafından geliştirilmesi gerekmektedir. Üstelik, birçok değişkeni dikkate almak üzere tasarlanan mekanik yaklaşımlar, hesaplama açısından o kadar pahalı olabilir ki, artık modern çalışmalarda rutin olarak oluşturulan verilere uygulanamayabilir.

Bu derlemede bilgisayar modellemenin ve sinir ağlarının ne olduğunu ve nasıl çalıştığını açıklayacağız, uygulandıkları ekolojik ve evrimsel biyoloji sorunlarını özetleyeceğiz ve vaatleri ve sınırlamaları hakkında genel bir bakış sunacağız.

## **BİLGİSAYAR MODELLEME TEKNOLOJİLERİ**

Günümüzde bilgisayar modelleme teknolojileri yaygın olarak kullanılmaktadır. Gelecekte bilgisayar modellemenin rolü ve önemi kesinlikle önemli ölçüde artacaktır. Bilgisayar modelleme, karmaşık sistemleri incelemek için etkili yöntemlerden biridir. Bilgisayar modelleri, gerçek bir deneyle karşılaştırıldığında finansal ve fiziksel engeller nedeniyle zor olan veya öngörülemez sonuçlar verebilen hesaplamalı deneyler yapabilme yetenekleri nedeniyle çalışmak daha kolay ve kullanışlıdır. Bilgisayar modellerinin mantığı ve resmileştirilmesi, incelenen orijinal nesnenin (veya tüm nesne sınıfının) özelliklerini belirleyen ana faktörleri tanımlamayı, özellikle simüle edilmiş fiziksel sistemin sistemindeki değişikliklere tepkisini incelemeyi mümkün kılar. Parametreler ve başlangıç koşulları. Bir model matematik ve mantık yoluyla temsil edildiğinde gerçek bir nesnenin soyut görüntüsü ortaya çıkmaktadır; gerçek bir nesnenin örneği model olarak incelendiğinde somut bir çalışma gerçekleşmektedir [2].

Modelleme, model oluşturma, çalışma ve uygulama sürecini ifade eder. Modellemenin ana özelliği, proxy nesnelere kullanan dolaylı bir biliş yöntemi olmasıdır. Soyutlamaları, analogileri, hipotezleri ve diğer kategorileri ve biliş yöntemlerini kullanmanın belirli biçimlerini belirleyen, modelleme yönteminin bu özelliğidir. Modelleme, ana biliş yöntemlerinden biridir, gerçekliğin bir yansıması biçimidir ve gerçek nesnelere, nesnelere ve olayların belirli özelliklerini diğer nesnelere, süreçlere, olayların yardımıyla veya soyut bir açıklama kullanarak bulmayı veya yeniden üretmeyi içerir. bir görüntü, plan, harita, bir dizi denklem, algoritma ve program biçimindedir [4].

Bilimsel araştırmalarda modelleme eski zamanlarda kullanılmaya başlandı ve yavaş yavaş bilimsel bilginin yeni alanlarını ele geçirdi: teknik tasarım, inşaat ve mimarlık, astronomi, fizik, kimya, biyoloji ve son olarak sosyal bilimler. 20. yüzyıl modern bilimin hemen hemen tüm dallarında modelleme yöntemine büyük başarı ve tanınırlık kazandı. Modelleme



metodolojisi uzun zamandır bireysel bilimlerden birbirinden bağımsız olarak geliştirilmiştir. Birleşik bir kavram sistemi, birleşik bir terminoloji yoktu. Modellemenin evrensel bir bilimsel bilgi yöntemi olarak rolü ancak yavaş yavaş anlaşılmasına başlandı. Ancak bilgisayar modellemesi ampirik ve teorik, tümevarım ve tümdengelimle birlikte bilimsel bilgi edinmenin üçüncü yolu ve akıl yürütme yolu olarak düşünülemez. Bu tekniğin önemli metodolojik önemi, her şeyden önce, bilimin karmaşık metodolojik problemlerini modern dile "çevirmenize" olanak sağlaması, böylece yalnızca bunların değerlendirilmesi için yeni bir perspektif açmakla kalmayıp, aynı zamanda şunları yapmanızı da sağlamasında yatmaktadır: Çözümlerine giden yolda en zor noktaları belirleyin. Modelleme yönteminin kullanılması ihtiyacı, birçok nesnenin (veya bu nesnelere ilgili problemlerin) doğrudan çalışılmasının imkansız olması veya bu araştırmanın çok fazla zaman ve kaynak gerektirmesi nedeniyle belirlenmektedir [3].

### **MODEL OLUŞTURMA AŞAMALARI**

Model oluşturma aşaması, orijinal nesne hakkında bazı bilgilerin varlığını varsayar. Modelin bilişsel yetenekleri, modelin orijinal nesnenin temel özelliklerini yansıtması gerçeğiyle belirlenir. Orijinal ile model arasındaki benzerliğin gerekliliği ve yeterli derecede olup olmadığı sorusu özel bir analiz gerektirir. Modelin hem orijinalle özdeş olması (o zaman orijinal haline gelmesi) hem de orijinalden tüm önemli açılardan aşırı farklılık göstermesi durumunda anlamını yitirdiği açıktır. Böylece, modellenen nesnenin bazı taraflarının incelenmesi, diğer tarafların yansıtılmasının reddedilmesi pahasına gerçekleştirilir. Bu nedenle, herhangi bir model orijinalin yerini yalnızca kesin olarak sınırlı bir anlamda alır. Bundan, bir nesne için, dikkati incelenen nesnenin belirli yönlerine yoğunlaştırarak veya nesneyi değişen ayrıntı dereceleriyle karakterize ederek birkaç "özelleştirilmiş" modelin oluşturulabileceği sonucu çıkar. Aşağıda doğal ve teknik bilimlerde kullanılan bir dizi modelleme yöntemi bulunmaktadır [2].

Bilgi teknolojisinin gelişmesi, bilgisayarların sistem işleyişi süreçlerini modellemek için kullanılmaya başlamasına ve bu durumda bir algoritma ve programın ortaya çıkmasına ve klasik formundaki matematiksel modelin pratikte bulunmamasına ya da matematiksel modelin analitik gösterimlerden biri olduğunu varsaydı. Bu yöne simülasyon modelleme denir. Bu modeller, gerçek bir sistemde meydana gelen olayları adım adım yeniden üreten bilgisayar programlarıdır. Simülasyon modellerinin avantajı, incelenen sistemdeki olay değiştirme sürecini gerçek zamanlı olarak programın hızında hızlandırılmış olay değiştirme süreciyle değiştirme yeteneğidir [4].

Kantitatif yöntemler kullanılarak incelenen ilk ekosistemler avcı-av sistemleriydi. 1925'te Amerikalı A. Lotka ve 1926'da İtalyan V. Volterra, bireysel bir popülasyonun büyümesine ve rekabet ve yırtıcılık ilişkileriyle ilişkili popülasyon dinamiklerine ilişkin matematiksel modeller yarattı. Yırtıcı-av sistemleri üzerine yapılan bir çalışma, bir av popülasyonu için tipik bir evrimin doğum oranındaki bir artış olduğunu ve bir yırtıcı hayvan popülasyonu için bunun, av yakalama yöntemlerinde bir gelişme olduğunu göstermiştir [6].

Daha sonra matematiksel modelleme yöntemi, büyük potansiyeli nedeniyle ekolojide giderek daha yaygın olarak kullanıldı. Modelleme, doğal çevreye yönelik teorik araştırma düzeyinin yeterince yüksek olmadığı durumlarda ekosistemlerin davranışına ilişkin bir ön açıklama ve tahmin sağlar. Bu açıdan, doğa üzerindeki pratik etki ile bu etkinin sonuçlarının teorik olarak anlaşılması arasındaki boşluk devam ettiğinden ve biyosferin yeniden yapılandırılması için niteliksel olarak tüm yeni seçeneklerin mutlaka modellenmesi gerektiğinden, modelleme her zaman teorik yapıları tamamlayacaktır [5].

Doğayı dönüştürme yollarının bilinçli seçimi, çeşitli modelleme türlerinin ve model türlerinin kullanılmasını gerektirir. Biyosferin dönüştürülmesinde doğayı anlamaya yönelik her türlü modelleme kullanılıyor. Çeşitli model ve modelleme türlerinin kullanılması, bir yandan bilimin teorik statüsünün artmasına ve bilginin sentezine katkıda bulunurken, diğer yandan insanın dönüştürücü ve bilişsel yönlerinin çok ihtiyaç duyulan koordinasyonunu sağlamaktadır. [7].

Arzu edilen geleceğin ideal modelleri her zaman insan beyninde oluşmaktadır. Dönüşüm planları ne kadar büyük olursa bu modeller de o kadar çok yönlü olur. İnsanın doğanın gelişiminin nesnel yasalarına bağımlılığı, maddi davranış modelleri ve gerekli gelecek oluşturma ihtiyacını doğurmaktadır.

Bilgisayar modellemenin gerçek bir deneyle karşılaştırıldığında avantajları arasında nispeten düşük maliyeti ve modeli minimum çabayla değiştirebilme yeteneği yer almaktadır. Bilgisayar, bir süreci zaman içinde simüle etmenize ve sistem geçmişine ilişkin öğeleri modele dahil etmenize olanak tanır; bu, özellikle geri dönüşü olmayan süreçlerin modellenmesi için önemlidir. Bilgisayar modellemesine çok erken aşamalarda geçilebilmektedir ve çalışma süreci sırasında makinenin “çıktısındaki” resim, hangi deneylerin yapılması gerektiğini ve modelin daha iyi hale gelmesi için tam olarak nasıl değiştirilmesi gerektiğini önermektedir [2].

Bir çevre sorununun çözümünde bilgisayar modellemenin genel öneminden bahsederken, en uygun çözüm arayışının hız kazandığını da belirtmek gerekmektedir. İnsanlık doğaya uyumunu hızlandırma fırsatı bulmaktadır. Faaliyetlerinde esas olarak tek deneme yanılma yöntemiyle (geniş anlamda anlarsak) yönlendirilen insanlık, gerçek bir test yapmadan önce birçok model üzerinde birçok test yapmak zorundadır, çünkü teknik yeteneklerin artmasıyla birlikte, bir hata artmaktadır [3].

Makine, birkaç yıl boyunca işletilen çok amaçlı bir su kaynağı sisteminin ekonomik verimlilik göstergesi tarafından temsil edilen işlevi en üst düzeye çıkaran sistemdeki süreçlerin böyle bir sırasını ve kombinasyonunu seçerek birçok değişkenin davranışını modellemektedir [4].

Son yıllarda, bilgisayar modellemeyi kullanarak, toplum ve doğal çevre arasındaki ilişkiler sisteminin küresel gelişimindeki durumu ve eğilimleri dikkate almak için girişimlerde bulunulmuştur [5].

## **MAKİNE ÖĞRENİMİ**

Makine öğreniminin amacı verilerden tahmin yapma konusunda iyi performans gösteren bir model bulmaktır. Bu durum, veriyi oluşturan modelin bilindiğini varsayan veri modelleme yaklaşımlarıyla çelişmektedir [8]. Geniş anlamda makine öğrenimi, veri dönüşümleri ve kümeleme (örneğin temel bileşen ve ayırt edici fonksiyon analizi, K-araçları) ve ekoloji ve evrimdeki model tabanlı çıkarımların çoğunda optimizasyon (örneğin; Markov zincirleri, genetik algoritmalar; [9-12]). Son zamanlarda makine öğrenimi, bir dizi yeni algoritma ve uygulamayla birlikte popülerlikte dramatik bir artış gördü.

Hızla popülerlik kazanan yaklaşımlardan biri de derin öğrenmedir. Derin öğrenme, yapay sinir ağları veya YSA adı verilen çok katmanlı, bağlantılı işlem birimlerine dayanır [13]. Son 10 yılda algoritmik gelişmeler, donanım iyileştirmeleri ve sinir ağları oluşturmaya yönelik üst düzey yazılımların demokratikleşmesi, popülerliklerinin ani bir şekilde artmasına katkıda bulundu. Derin öğrenme, sürücüsüz arabalar gibi yeni ortaya çıkan teknolojilerin merkezinde yer alır ve görüntü ve konuşma tanıma veya otomatik dil çevirisi gibi yaygın olarak kullanılan bilgi teknolojisi araçlarında önemli iyileştirmelerden sorumludur [14]. Bu başarılar, derin öğrenmenin diğer makine öğrenimi yaklaşımlarına göre büyük bir avantajı sayesinde mümkün oldu. Klasik makine öğrenimi genellikle önemli veri özelliklerinin öncelikle uzman alan bilgisi

kullanılarak tanımlanmasını gerektirir [15]. Bu, verileri yeterince tanımlayan özelliklerin, görüntülerde olduğu gibi belirgin olmadığı veya çıkarılmasının zor olmadığı bir sınırlamadır.

## SONUÇ

Giderek daha karmaşık ve daha büyük bölgelerin modellerinin oluşturulmasına yönelik yeni bir eğilim var. Gerçek şu ki, herhangi bir kaynak sistemini optimize etme kriteri, genel olarak kaynakları kullanma stratejisine ve insanın dönüştürücü faaliyetiyle ilgili diğer birçok faktöre bağlıdır. Dolayısıyla bu tür bir kaynağın optimal kullanımı daha genel bir sorun çerçevesinde optimal olmayabilir. Bu bağlamda, yalnızca doğal çevrenin bireysel parçalarını değil, aynı zamanda bir bütün olarak biyosferi de modellemek en uygun görünmektedir, çünkü bu durumda elde edilen sonuçlar, daha düşük yapısal seviyelerde bulunan doğal sistem modellerini daha iyi incelememize olanak sağlamaktadır. Biyosfer tek bir bütün olarak ele alındığından, insanın onu anlamaya ve dönüştürmeye yönelik eylemlerinin (bu modelleme için de geçerlidir) belirli bir birlik içinde olması gerekir.

Doğal çevrenin bilgi ve dönüşümü sorunlarını çözmek için bilgisayar modellemenin yaygın kullanımında, modern bilimin karakteristik iki eğiliminin (siberleşme ve ekolojileşme) bir kombinasyonu görülebilir. Bilgisayarlar şu anda çeşitli kaynak türlerinin kullanımı için en uygun seçenekleri seçmek, çevre kirliliğinin sonuçlarını tahmin etmek vb. için kullanılmaktadır.

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GEN İFADE VERİLERİNİ KULLANARAK KANSER SINIFLANDIRMASINDA  
YAPAY ZEKA

ARTIFICIAL INTELLIGENCE FOR CANCER CLASSIFICATION USING GENE  
EXPRESSION DATA

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**ÖZET**

Kanser, vücudun farklı bölgelerine yayılabilen hücrelerin anormal büyümesinden kaynaklanan bir grup hastalığı ifade eden bir terimdir. Dünya Sağlık Örgütü'ne (WHO) göre kanser, kalp-damar hastalıklarından sonra ikinci önemli ölüm nedenidir. Gen ekspresyonu, bir organizmanın genetik özelliklerinin yanı sıra doku ve hücrelerdeki biyokimyasal süreçlerin de göstergesi olduğundan, kanserin erken tespitinde temel bir rol oynayabilir. Gen ekspresyonu verileri için deoksiribonükleik asit (DNA) mikrodizileri ve ribonükleik asit (RNA) sıralama yöntemleri, genlerin ekspresyon seviyelerinin ölçülmesine olanak tanır ve hesaplamalı analiz için değerli veriler üretir. Bu çalışma, yapay zeka yöntemlerini kullanarak kanser sınıflandırmasına yönelik gen ekspresyon analizindeki son gelişmeleri gözden geçirmektedir. Bu çalışma aynı zamanda gen ekspresyonu analizi için veri toplama yöntemlerine genel bir bakış sunuyor ve bu görev için denetimli makine öğrenimi için yaygın olarak kullanılan önemli veri kümelerini listeliyor. Ayrıca, veri örneklerinde bulunan çok sayıda genin neden olduğu gen ekspresyonu verilerinin yüksek boyutluluğunu işlemek için tipik olarak kullanılan özellik mühendisliği ve veri ön işleme yönelik ilgili teknikleri gözden geçirilmiştir.

**Anahtar Kelimeler:** gen ekspresyon analizi, yapay zeka, kanser sınıflandırması, makine öğrenme

**ABSTRACT**

Cancer is a term that refers to a group of diseases caused by abnormal growth of cells that can spread to different parts of the body. According to the World Health Organization (WHO), cancer is the second leading cause of death after cardiovascular diseases. Because gene expression is indicative of an organism's genetic characteristics as well as biochemical processes in tissues and cells, it can play a fundamental role in the early detection of cancer. For gene expression data, deoxyribonucleic acid (DNA) microarrays and ribonucleic acid (RNA) sequencing methods allow measurement of the expression levels of genes and produce valuable data for computational analysis. This study reviews recent advances in gene expression analysis for cancer classification using artificial intelligence methods. This article also provides an overview of data collection methods for gene expression analysis and lists important datasets



commonly used for supervised machine learning for this task. Additionally, relevant techniques for feature engineering and data preprocessing that are typically used to handle the high dimensionality of gene expression data caused by the large number of genes present in the data samples are reviewed.

**Keywords:** gene expression analysis, artificial intelligence, cancer classification, machine learning

## 1. Giriş

Kanser, genetik değişim nedeniyle insan vücudunda kötü huylu hücrelerin oluştuğu bir hastalık sınıfını tanımlar. Bu hücreler gelişim sırasında ayırım gözetmeksizin bölünür, organların her tarafına yayılır ve çoğu durumda yaşam kaybına neden olabilir. Kanser, dünya çapında kardiyovasküler hastalıklardan sonra ikinci en önemli ölüm nedenidir [1]. Son zamanlarda, gen ekspresyon analizi, kanser tanısı ve ilaç keşfi ile ilgili temel zorlukların çözümünde önemli bir araç olarak ortaya çıkmıştır [2,3]. Gen ekspresyonu analizi aynı zamanda farklı genlerin kanserin başlamasına ve ilerlemesine katkısı hakkında da bilgi sağlar. Sonuç olarak gen ifadesindeki değişiklikler, kanserin erken teşhisinde ve ilaç geliştirme hedeflerinin belirlenmesinde belirteç olarak kullanılabilir. Bu tür yaklaşımlar, daha kişiselleştirilmiş, önleyici ve öngörücü sağlık hizmetleri olasılığının önünü açabilmektedir [4].

Gen ifadesi, DNA'da bulunan bilginin, protein veya diğer moleküllerin yapımına yönelik talimatlara dönüştürüldüğü süreçtir. DNA'nın haberci RNA'ya (mRNA) transkripsiyonunu ve ardından proteinlere translasyonunu içerir. Gen ekspresyon analizi, belirli koşullar altında dokuda veya tek bir hücrede meydana gelen genetik değişikliklerin sırasını değerlendirmek için kullanılır [5]. Hangi genlerin hangi düzeylerde ifade edildiği hakkında bilgi elde etmek için örnek bir doku veya hücrelerde bulunan DNA transkriptlerinin sayısının ölçülmesini içerir. Gen ekspresyonu miktarının belirlenmesinin bir bileşeni, bir DNA fragmanından tanınmış bir genomik veya transkriptom kaynağına sıralanan baz çiftlerinin sayısına ilişkin sıralı okumaların karşılaştırılmasıdır. Ölçümün kesinliği, okumaları uygun genlerle ilişkilendirmek için biyoenformatik algoritmaların uygulanmasına izin verecek yeterli ayırt edici bilgiye sahip sıralı okumalara bağlıdır. Gen ekspresyonunu tahmin etmeye yönelik yaygın yöntemler arasında DNA mikrodizileri ve yeni nesil dizileme (NGS) yöntemleri yer alır. DNA mikrodizi yöntemi, kısa dizilerin veya genlerin bir hibridizasyon işlemi yoluyla bilinen DNA moleküllerine bağlandığı mikroskobik noktalara sahip iki boyutlu bir dizi kullanır. Büyük ölçüde paralel dizileme yapan NGS yöntemleri olağanüstü derecede yüksek verimli analiz, ölçeklenebilirlik ve hız sunar ve tam bir genomun veya tek bir DNA veya RNA segmentinin nükleotid dizisini belirlemek için kullanılırlar [6,7]. RNA-Seq olarak da bilinen RNA dizilimi, RNA moleküllerinin tamamlayıcı DNA'ya (cDNA) dönüştürülmesini ve gen ekspresyonu analizi ve miktarının belirlenmesi için cDNA'daki nükleotid dizisinin belirlenmesini içeren bir NGS yöntemidir. DNA mikrodizileriyle karşılaştırıldığında, RNA-Seq [8,9] daha fazla özgüllük ve çözünürlük, diferansiyel ekspresyona karşı artan hassasiyet ve daha büyük dinamik aralık gibi çeşitli avantajlar sağlar. RNA-Seq ayrıca belirli bir zamandaki RNA miktarını belirlemek amacıyla herhangi bir türün transkriptomunu incelemek için de kullanılabilir.

Yayınlanmış literatürdeki çok sayıda derleme makaleleri, gen ekspresyonu analizine yönelik hesaplamalı yaklaşımlardaki ilerlemeleri gözden geçirmiştir. Bu incelemeye en yakın olan ve son üç yılda yayınlanan en alakalı makaleler Tablo 1'de listelenmiştir.

Kaynakça	DÖ Yaklaşımları	Mikrodizi Verileri	RNA-Sıra Verileri
Sathe et al., 2019 [10]	RNN and CNN	Evet	Evet
Koumakis et al., 2020 [11]	RNN and CNN	Evet	Evet
Zhu et al., 2020 [12]	MLPNN, RNN, CNN	Evet	Evet
Gunavathi et al., 2020 [13]	CNN	Evet	Evet
Tabares et al., 2020 [14]	MLP, CNN	Evet	Yok
Bhonde et al., 2021 [15]	MLPNN, RNN, CNN	Evet	Evet
Mazlan et al., 2021 [16]	CNN	Evet	Evet
Karim et al., 2021 [17]	MLPNN, RNN, CNN	Evet	Evet
Thakur et al., 2021 [18]	CNN	Evet	Evet
Montesinos-López et al., 2021 [19]	MLPNN, RNN, CNN	Evet	Evet
Bhandari et al., 2022 [20]	MLPNN, RNN, CNN	Evet	Yok
Khalsan et al., 2022 [21]	MLPNN, RNN, CNN	Evet	Evet
Alhenawi et al., 2022 [22]	yok	Evet	Yok

Tablo 1. Gen ekspresyonu analizine yönelik önceki derleme makalelerinin listesi

Yayınlanmış literatürdeki çok sayıda inceleme makalesi, gen ekspresyonu analizine yönelik hesaplamalı yaklaşımlardaki ilerlemeleri gözden geçirmiştir. Bu incelemeye en yakın olan ve son üç yılda yayınlanan en alakalı makaleler Tablo 1'de listelenmiştir.

Tablo, inceleme makaleleri hakkında karşılaştırmalı bilgi sağlar; yani bunların geleneksel ML yaklaşımlarını, özellik mühendisliği tekniklerini, DL yaklaşımlarını ve incelenen teknikler tarafından kullanılan gen ekspresyonu verilerinin türünü kapsayıp kapsamadığı. Örneğin, birkaç makale gen ekspresyonu analizi için yalnızca geleneksel ML yaklaşımlarını gözden geçirdi. Benzer şekilde incelemelerden bazıları yalnızca özellik mühendisliği tekniklerine veya gen ekspresyonu analizinin diğer yönlerine odaklandı. Ek olarak, önceki birçok çalışmada esas olarak DNA mikrodizi gen ekspresyonu verileriyle ilgili hesaplamalı yaklaşımlar tartışılmıştır. Tablo 1'de listelenen bazı incelemeler ve 2019'dan önce yayınlanan diğer incelemelerle benzerlikler ve örtüşmeler olmasına rağmen, bu inceleme önceki çalışmalarda ele alınmayan yeni bilgiler sunmaktadır. Bu araştırmanın ana katkısı, hem geleneksel ML yaklaşımlarının hem de gen ekspresyonu analizi için yeni DL yaklaşımlarının uygulamalarına kapsamlı bir genel bakış içermektedir. Önceki incelemelerden bazıları, MLP, CNN ve RNN gibi DL mimarilerini kullanan gen ekspresyonu analizindeki vaka çalışmalarını tartışsa da, daha önceki hiçbir inceleme GNN [23,24] ve TNN [25,26] mimarilerinin kullanımına ilişkin kapsamlı bir tartışma sunmamaktadır. gen ekspresyonu analizi için. Öte yandan GNN ve TNN, bu görev için yaygın DL mimarileri olma potansiyeline sahiptir. Ayrıca bu çalışmanın odak noktası, son yıllarda bu görev için kullanılan en baskın veri formatı olan RNA-Seq gen ekspresyonu verilerinin modellenmesine yönelik yaklaşımlardır. Ek olarak bu çalışma, birçok ilgili inceleme makalesinde yer almayan, ML tabanlı gen ekspresyonu analizi için ilgili özellik mühendisliği teknikleri ve veri kümelerinin bir incelemesini sağlar.

## 2. Gen İfade Verileri

Gen ekspresyonu analizi, eksprese edilen genlerin seviyesini tahmin etmek için belirli bir hücre veya doku tipinde mevcut olan transkript sayısını belirleme işlemidir. Transkriptomun niceliksel incelenmesine odaklanan bilim dalı transkriptomiktir. İlk hesaplamalı transkriptomik yöntemler, ifade edilmiş dizi etiketi (EST) kitaplıklarının Sanger dizilimini kullandı. EST kütüphaneleri, cDNA kütüphanelerinden rastgele seçilen klonlar üzerinde gerçekleştirilen tek bir sıralama prosedüründen elde edilen mRNA'nın kısa parçalarını temsil eder. Oysa bir cDNA kütüphanesi, klonlanmış ve bir organizmadan veya dokudan alınan mRNA'yı tamamlayıcı olan DNA dizilerinin bir koleksiyonudur. Bugüne kadar yaklaşık 1400 farklı hücresel türden 45 milyondan fazla EST kütüphanesi üretilmiştir. EST kütüphaneleri eksprese edilen gen

dizilerinin temel çözünürlük profilini sağlasa da, bu teknoloji genellikle tam uzunlukta gen dizileri içermez ve daha sonra EST kütüphanelerine dayalı yöntemlerin yerini Gen İfadesinin Seri Analizi gibi kimyasal etiket bazlı teknikler almıştır. (ADAÇAYI). SAGE yöntemi, genler hakkında önceden bilgi sahibi olunmadan, herhangi bir hücre sistemindeki çok sayıda transkriptin kantitatif ve eşzamanlı analizine olanak tanır. Bu yöntem, genom boyunca rastgele bir nükleotid dağılımını varsayan teorik bir hesaplamaya dayanmaktadır. EST kütüphanelerinin ve SAGE'nin Sanger dizilimi yöntemlerinin yerini, gen ekspresyonunu tahmin etmeye yönelik DNA mikrodizileri ve NGS yöntemleri (en önemlisi RNA-Seq) aldı.

## 2.1. Mikrodizi Verileri

Mikrodizi verileri, bir DNA dizisinin binlerce mikroskobik noktaya sahip iki boyutlu bir diziden oluşan bir araç içinde yer aldığı bir laboratuvar tekniğiyle elde edilir. Mikrodizi araçları aynı zamanda çip veya slayt olarak da bilinir ve slayttaki her nokta, tek bir DNA dizisi veya geni için ayrılmıştır. DNA örnekleri bir hibridizasyon süreci yoluyla mikrodizi slaytına bağlanır ve ardından her genin ifadesini ölçmek için slayt üzerindeki noktaların renkleri taranır. Mikrodizi verilerindeki bir satır gen ekspresyon seviyesini, sütunlar ise örnekleri temsil eder.

Mikrodiziler, proteinlere çevrilebilen veya çevrilemeyen DNA'yı (karşılaştırmalı genomik hibridizasyonda olduğu gibi) veya RNA'yı (çoğunlukla ters transkripsiyonu takiben cDNA olarak) tanımlamak için kullanılabilir. Mikrodizi verileri, kanser gibi belirli koşullar veya hastalıklarla ilgili genom çapında ekspresyon profilleri için hücresel süreçlerin anlaşılmasına olanak tanır. Benzer şekilde, yeni farmasötiklerin araştırılmasında, farmakogenomikte ve terapötik yöntemler için etkili ilaçların geliştirilmesinde kullanılan yararlı bilgiler sağlarlar.

DNA mikrodizilerinin temel avantajlarından biri binlerce genin ifade düzeyinin ölçülmesine olanak sağlamasıdır. Mikrodizilerin ayrıca nispeten zayıf doğruluk, kesinlik ve özgüllük gibi sınırlamaları da vardır. Diğer bir sınırlama ise deney düzeneğinin hibridizasyon sıcaklığındaki değişikliklere, genetik materyal bozulmasının saflığı ve hızına ve amplifikasyon sürecine karşı yüksek duyarlılığıdır; bunların tümü gen ifadesinin miktarını etkileyebilir.

## 2.2. RNA-Sıra Verileri

RNA-Sekanslama (RNA-Seq), hızlı profil oluşturma yeteneği ile karakterize edilen ve araştırmacıların herhangi bir tür için transkrip tome'u araştırmasına ve RNA'nın varlığını ve miktarını belirlemesine olanak tanıyan NGS yöntemlerine [27] ve belirli bir zaman [28] aittir. Bu yaklaşım, karmaşık RNA örneklerinden milyonlarca dizi üretmek için kullanılmıştır.

RNA-Seq, gen ekspresyonunu ölçmek, zaman içinde veya uygulanan tedavilere bağlı olarak gen ekspresyonundaki değişiklikleri incelemek, tam transkriptleri keşfetmek ve açıklama eklemek, transkripsiyon sonrası modifikasyonları incelemek ve alternatif birleştirme ve poliadenilasyonu karakterize etmek için kullanılır. Farklı uygulamalar, protein kodlayan RNA (mRNA) ve kodlamayan düzenleyici RNA (miRNA, siRNA) veya fonksiyonel RNA (tRNA, rRNA) dahil olmak üzere bir hücre veya dokudaki tüm RNA moleküllerini analiz etme ve uygun şekilde ölçme kapasitesine dayanmaktadır. onların bolluğu aynı anda. RNA-Seq'in diğer önemli nitelikleri arasında, büyük miktarda veri elde edilmesine yol açan ve transkriptomik araştırmalarında kayda değer ilerlemelere katkıda bulunan yüksek çözünürlüğü ve geniş dinamik aralığı yer almaktadır [29]. Yukarıdaki avantajlardan dolayı, RNA-Seq, gen ekspresyonu analizi için mikrodizilerin yerini almaktadır.

Tablo 2, keşfedilen gen aralığı, farklı izoformlar, çözünürlük, arka plan gürültüsü, maliyet, nadir/yeni transkript ve kodlamayan RNA açısından mikrodizi ve RNA-Seq verileri arasında bir karşılaştırma sunmaktadır. Sonuç olarak, RNA-Seq, mikrodizi verileriyle karşılaştırıldığında birçok önemli avantaj sağlar.

Özellikler	Mikrodizi Verileri	RNA-Seq Verileri
Gen Keşfi	Yok	Evet
Farklı İzofom	Yok	Evet
Yüksek çözünürlük	Yok	Evet
Arkaplan gürültüsü	Evet	Yok
Yüksek fiyat	Evet	Yok
Nadir/Yeni Transkript	Yok	Evet
Kodlamayan RNA	Yok	Evet

Tablo 2. Mikrodizi ve RNA-Seq verilerinin karşılaştırılması

### 3. Gelecek Yönergeler

Bu bölümde, ML tabanlı gen ekspresyonu analizine ilişkin araştırmayı potansiyel olarak ilerletebilecek gelecekteki yönler tartışılmaktadır.

- Gelecekteki araştırmaların bir yolu, mevcut öğrenme algoritmalarıyla ek girdi özellikleri türlerini dikkate almaktır çünkü gen ifadesinin tam etkisi tek başına genetik diziyile temsil edilemez. Spesifik olarak DNA metilasyonları ve mutasyonları, kanser sınıflandırmasında kullanılabilecek olası özellik türleridir. DNA metilasyonları CpG dinükleotitlerinde olduğu gibi CpG olmayan bölgelerde de meydana gelebilir. CpG, sitozin ve guaninin CG baz eşleşmesini tek sarmallı doğrusal diziden ayırmak için kullanılır. DNA metilasyonu normal gelişimsel süreçle ve patolojik süreçler sırasında gözlemlenebilir değişimle bağlantılıdır. Patolojik süreçler arasında DNA onarım genleri ve tümör baskılayıcı genlerin susturulması yer alır. Bu nedenle, metilasyonların ve mutasyonların RNA-Seq verileriyle entegre edilmesi, tümör sınıflandırmasını olumlu yönde etkileyen özellikler üretebilir.

- ML yöntemlerinin performansını artırmaya önemli ölçüde katkıda bulunabilecek özellik türünün seçilmesinin yanı sıra, hesaplamalı algoritmanın tasarımı da önemlidir. Bu bağlamda araştırmacılar, deneysel olarak kanıtlanmış referans genlere sahip benzersiz moleküler tanımlayıcı (UMI) gibi altın standart veri kümeleri üzerinde verimli bir şekilde performans gösterebilecek yenilikçi tekniklere odaklanabilirler. Bu tür çalışmalar araştırmacıların tek hücreli yöntemlerin deneysel bir karşılaştırmasını yapmasına olanak sağlayabilir. Ayrıca araştırma çalışmaları, SMART-Seq, Cel-Seqs ve damlacıklar gibi tek hücreli sıralama protokollerindeki algoritmaların performansını doğrulayabilir.

- Kanserle ilgili biyobelirteçlerin belirlenmesi, araştırmacıların her kanser türüyle ilgili biyobelirteçleri belirlemeye yönelik metodolojileri araştırabilecekleri önemli bir gelecek yönü olabilir. Örneğin, IntPath [31] ve diğerleri [32] için listelenen yöntemler, kanser türleri için ilgili genlerin fonksiyonel yol analizinin yapılmasına yardımcı olabilir.

2 boyutlu bir görüntü verildiğinde, kansere özgü biyobelirteçlerin tanımlanmasına yardımcı olabilecek görüntülerden umut verici özelliklerin çıkarılması için DL yöntemleri kullanılabilir.

- GNN aynı zamanda heterojen grafikler uygulayarak tek hücreli çoklu omik verilerin entegrasyonunu destekleyecek şekilde de tasarlanabilir. Bu tür veriler Damlacık scRNA-Seq'i [33] ve Smart-Seq2'nin intra-modalitesini içerebilir. Hücre tipine özgü gen düzenleyici mekanizmalar, özellikle scATAC-Seq ve scRNA Seq verileri entegre edilirken scGNN kullanılarak aydınlatılabilir. Ek olarak T hücresi ataları, T hücresi reseptör repertuarları tarafından benzersiz bir şekilde tanımlanabilir. T hücrelerinin benzersiz tanımlanması önemlidir çünkü hücre-hücre etkileşimlerine ilişkin tahmin yöntemlerinin performansını artırabilir. scGNN bağlantı kurmayı kolaylaştırabilir.

#### 4. Sonular

Karmařık yksek boyutlu verilerin iřlenmesine ynelik derin ğrenmeye dayalı yaklařımlardaki son geliřmeler, oklu omik verilerin rnt tanıma ve tahmine dayalı analitięi iin muazzam bir potansiyel sunmaktadır. Bu alıřma, kanser tespiti iin RNA dizilimi ve DNA mikrodizi verilerini kullanan gen ekspresyonu analizi iin hem geleneksel makine ğrenme yntemlerinin hem de derin ğrenme yntemlerinin uygulanmasındaki ilerlemeyi gzden geirmektedir. Makale, gen ekspresyonu analizi iin veri toplama yntemlerine kısa bir genel bakıř sunuyor ve denetimli makine ğrenimi iin yaygın olarak kullanılan ilgili veri kmelerini listeliyor. Bir sınıflandırma

Gen ekspresyonu analizinin nemli bir bileřeni olarak zellik mhendislięi ve veri n iřleme tekniklerinin kullanımı da saęlanmaktadır. Gen ekspresyonu analizine ynelik ML tabanlı yntemler, gen ekspresyonu analizine ynelik karřılařtırmalı avantajları nedeniyle derin ğrenmeye dayalı yaklařımlara odaklanarak daha sonra sunulacaktır. ok katmanlı algılayıcıların yanı sıra evriřimli, tekrarlayan, grafik ve transformatr aęları da dahil olmak zere, popler mimarilere sahip sinir aęlarını kullanan nceki alıřmalar ele alınmaktadır. RNA-Seq verilerini kullanarak kanser sınıflandırmasında derin ğrenme yntemlerinin kullanılması, farklı kanser trlerinin sınıflandırılmasında yksek doęruluk bildiren birok alıřma ile umut verici sonular vermiřtir. Bu alanda gelecekte yapılacak arařtırmaların genellenebilirlik, saęlamlık ve sonuların aıklanabilirlięi gibi mevcut zorlukları ele almasını ve kanser tanısının iyileřtirilmesine ve saęlık hizmetleri sonularının iyileřtirilmesine yol amasını bekliyoruz. Makale, gen ekspresyon analizini kullanarak kanser sınıflandırması iin gelecek vaat eden ynlerin bir taslaęıyla sonulanıyor.

Bu alıřmanın ana katkıları, zellik mhendislięi tekniklerini, gen ekspresyonu analizine ynelik veri kmelerini ve geleneksel ve derin ğrenme ML yntemlerinin uygulamalarını kapsayan, gen ekspresyonu analizi kullanılarak kanser sınıflandırmasına ynelik son arařtırma alıřmalarının kapsamlı bir incelemesinin saęlanmasıdır. Bu alıřma, son alıřmalarda baskın veri formatı olarak RNA-Seq yntemlerine odaklanmanın yanı sıra, yayınlanmış incelemelerde ele alınmayan grafik ve transformatr aęları gibi gncel sinir aęı mimarilerine dayalı yntemleri gzden geirmektedir.

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ANALYSIS OF STURM-LIOUVILLE PROBLEM INCLUDING PROPORTIONAL  
DERIVATIVE IN CONTROL THEORY

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**ABSTRACT**

This study provides a comprehensive analysis of Sturm-Liouville (S-L) problem by benefiting from the proportional derivative which is an important mathematical tool in control theory. This advantageous derivative, which has been presented to the literature with an interesting approach and a strong theoretical background, is defined by two tuning parameters in control theory and a proportional-derivative controller. Accordingly, this research is presented mainly to introduce the efficient aspects of the proportional derivative for investigating a S-L initial value problem. Additionally, we reach new representation of solutions for the S-L problem having a crucial place in physics, supported by various graphs including different values of arbitrary order and eigenvalues under a specific potential function.

**Keywords:** Proportional-derivative controller, Proportional integral, Sturm-Liouville problem, Control theory, local derivative.

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**FRACTIONAL METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS  
INFECTION MODEL UNDER CAPUTO OPERATOR**

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**ABSTRACT**

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a pathogen that is endemic in many hospital settings. In the current study, we aim to control the persistence and spread of MRSA infection in the population with a fractional mathematical model generated utilizing the non-local Caputo derivative. Furthermore, the effect of environmental contamination, which is an important parameter in the clinical epidemiology of healthcare-associated infection, is investigated. On the other hand, the baseline reproduction number is calculated to achieve the expected results. Numerical analysis is then carried out in order to observe the asymptotic behavior of the model. Also, real-data collected from Beijing Tongren hospital is used in numerical simulations of the model to obtain information about the process of the disease. As a result, it is shown that the results obtained by utilizing the advantages of the Caputo operator can be employed as a guide for the development of control methods such as paying attention to hand hygiene of healthcare workers, increasing the disinfection of the environment and reducing the risk of contamination between the patients-healthcare professionals and environment.

**Keywords:** Caputo fractional operator, Fractional modeling, Healthcare-associated infection, Non-local derivative, Mathematical biology.

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**BURSA İLİ, KIYI DENİZ SUYUNDAN İZOLE EDİLEN *Rhodococcus qingshengii* S58  
SUŞUNUN ANTİMİKROBİYAL DİRENÇ ve VİRÜLANS GENLERİNİN GENOM  
BAZLI ANALİZİ**

**GENOME-BASED ANTIMICROBIAL RESISTANCE and VIRULENCE GENE  
ANALYSIS of *Rhodococcus qingshengii* STRAIN S58 ISOLATED from the COASTAL  
SEAWATER of BURSA PROVINCE**

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**ÖZET**

*Rhodococcus* spp. hayvanlarda ve insanlarda, gıda işleme yüzeylerinde ve kirlenmiş toprak, deniz suyu, yeraltı suyu ve aşırı çevre koşullarını kapsayan çeşitli çevresel ortamlardan izole edilen Gram-pozitif bakteri grubudur. *Rhodococcus* türleri, hem hayvan hem de insan konakçılarda enfeksiyonlara yol açma kapasiteleri ile tanınan, bağışıklık sistemi zayıf olan bireyleri kapsayan, yerleşik patojenik mikroorganizmalardır. Yeni ortaya çıkan bazı zoonotik türler aynı zamanda önemli antimikrobiyal direnç genleri içermekte olup bazılarının bu cins içindeki olası gıda kaynaklı patojenler olduğu düşünülmektedir. Bu çalışmada, S58 suşu Bursa ili Marmara Denizi kıyısı, yüzey deniz suyundan izole edilmiştir. Tanımlama ve dizi analizi, 27F ve 1492R üniversal 16S rRNA primerleri ile yapıldı. S58 suşunun yeni nesil genom dizilimi Illumina NovaSeq 6000 platformu kullanılarak gerçekleştirildi. Yeni nesil sekans sonrası elde edilen S58'in yüksek kaliteli okumaları, Unicycler assembler v0.4.8 kullanılarak de novo algoritması kullanılarak birleştirildi. S58'in genom bazlı tür tanımlaması, Tip Suş Genom Sunucusu (<https://tygs.dsmz.de/>) ile yapıldı. S58 genomundaki antimikrobiyal direnç (AMR) ve virülans genleri, Kapsamlı Antibiyotik Direnci Veritabanı (CARD) ve Virülans Faktörü Veritabanı (VFDB) kullanılarak varsayılan ayarlar ile tanımlandı. S58 suşunun 16S rRNA dizisi, GenBank'taki *Rhodococcus qingshengii* (%100) ile benzerlik göstermiştir. Ayrıca genom bazlı tür tanımlamasına göre S58 izolatının *R. qingshengii* olduğu bulundu. S58 suşunun genomunda 13 virülans ve 4 AMR geni tespit edildi. Bu genlerin rifamisin, glikopeptid ve salisilik asit gibi bazı ilaç sınıflarına karşı direnci kodladığı belirlenmiştir. Ayrıca tespit edilen virülans genlerinin bağlanma, düzenleme ve beslenme/metabolik faktörlerden sorumlu olduğu tespit edilmiştir. *R. qingshengii*, bitki, hayvan, insan ve çevreden oluşan birbirine bağlı alanlarda antimikrobiyal direncin yayılmasını aydınlatmak için ilgi çekici bir model olabilir. Bu çalışma, Türkiye'de *R. qingshengii*'nin genomik analizinin yapıldığı ilk çalışmadır.

**Anahtar Kelimeler:** Antimikrobiyal Direnç Geni, Genom Sekanslama, *Rhodococcus qingshengii*, Virülans Geni

## ABSTRACT

*Rhodococcus* spp. represent a group of Gram-positive bacteria isolated in animals and humans, food-processing surfaces, and diverse environmental settings, encompassing contaminated soil, seawater, groundwater, and extreme environmental conditions. *Rhodococcus* species are established pathogenic microorganisms recognized for their capacity to induce infections in both animal and human hosts, with a predominant occurrence involving individuals with compromised immune systems. Some newly emerging zoonotic species also contain important antimicrobial resistance genes, and some are considered possible foodborne pathogens within this genus. In this study, the S58 strain was isolated from the coastal seawater of the Marmara Sea in Bursa Province. Identification and sequence analysis were done with 27F and 1492R universal 16S rRNA primers. Next-generation genome sequencing of the S58 strain was performed on an Illumina NovaSeq 6000 platform. The high-quality reads of the S58 were assembled into contigs by de novo assembly using the Unicycler assembler v0.4.8. Genome-based species delineation of the S58 was done with the Type Strain Genome Server (<https://tygs.dsmz.de/>). Antimicrobial resistance (AMR) and virulence genes in the S58 genome were identified using the Comprehensive Antibiotic Resistance Database (CARD) and Virulence Factor Database (VFDB). The 16S rRNA sequence of the S58 strain has similarities with the *Rhodococcus qingshengii* (100%) in GenBank. Also, according to genome-based species delineation, the S58 isolate was found as a *R. qingshengii*. Thirteen virulence and four AMR genes were detected in the genome of the S58 strain. These genes have been determined to encode resistance to some drug classes, such as rifamycin, glycopeptide, and salicylic acid. Also, the detected virulence genes were responsible for adherence, regulation, and nutritional/metabolic factors. *R. qingshengii* might be a compelling model for elucidating the dissemination of antimicrobial resistance within the interconnected domains of plants, animals, humans, and the environment. This study is the first to conduct a genomic analysis of *R. qingshengii* in Turkey.

**Keywords:** Antimicrobial Resistance Gene, Genome Sequencing, *Rhodococcus qingshengii*, Virulence Gene



**DEGRADATION OF MG DYE USING H<sub>2</sub>O<sub>2</sub>//UV/ZnO and UV/ZnO  
NANOPARTICLES: A COMPARATIVE STUDY**

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**ABSTRACT**

Recent increases in the amount of textile dyeing wastewater released into the environment have had negative consequences on human health and living things. There has been a lot of interest in the use of green nanoparticles for water purification. The extraction of floral waste requires the release of natural chemicals, which reduce and stabilize substances that are used in the production of nanoparticles. we report the utilization of Rosmarinus officinalis seeds extract to synthesis green ZnO nanoparticles for the photocatalytic degradation of Malachite green under UV light irradiation, using hydrogen peroxide. Fourier transform infrared (FTIR) spectroscopic results revealed zinc oxide's creation of chemical bonds. Outcomes of XRD confirmed the formation of ZnO Nanoparticles, with crystallite sizes of 31 nm, according to Debye–Scherrer's formula. The thermal stability of Nanoparticles was evaluated using thermogravimetric analysis (TGA) and differential thermal analysis (DTA) in a nitrogen atmosphere. The result reveals that the photodegradation efficiency of H<sub>2</sub>O<sub>2</sub>/ZnO/UV (99%) was higher compared to that of ZnO/UV (92%) just after 60 min.

**Keywords:** ZnO nanoparticles, MG degradation, Green, X-ray diffraction, Photocatalytic activity.

**PHOTOCATALYTIC DEGRADATION OF MALACHITE GREEN DYE USING BIO-  
GREEN SYNTHESIS NANOPARTICLES**

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**ABSTRACT**

The greenway method was used to try to create zinc oxide nanoparticles (ZnO-NPs) utilizing juice extract from *Rosmarinus officinalis*. Greener methods of ZnO-NP synthesis are less toxic, safer, more cost-effective, energy-efficient, and environmentally friendly than their chemically produced equivalents. X-ray diffraction (XRD), Fourier Transform-Infrared (FT-IR), and UV-Vis spectroscopy were used to determine the optical characteristics of the ZnO-NPs. Using UV-Vis spectroscopy, a distinctive absorption peak at 375 nm demonstrated the existence of ZnO-NP. The Zn-O bond's distinctive absorption peak was discovered in the FTIR spectrum at 416 cm<sup>-1</sup>. The ZnO XRD results revealed a propensity for the three strongest diffraction peaks. ZnO NPs crystallites were 31 nm in size on average. The produced ZnO nanoparticles is photocatalytic activity was investigated for the degradation of MG in aqueous solution under UV irradiation. The ZnO photocatalyst has a strong photocatalytic activity to remove MG from water, according to the results. Additionally, after 1-hour, total deterioration was accomplished.

**Keywords:** ZnO nanoparticles, malachite green, Biosynthesis, X-ray diffraction, Photocatalytic activity.

**CHEMICAL, PHYSICAL AND BIOLOGICAL ANALYSIS OF RIVER WATER AND  
SEDIMENT; SITNICA, IBRI, TREPÇA AND DRENICA - CORRELATION WITH  
EU STANDARDS - FOR SURFACE WATERS**

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**ABSTRACT**

Hazardous waste in water and sediment is a big problem facing developing countries, including our country. The research has highlighted the concentration of heavy metals in the water and sediment of the rivers; Sitnica, Trepça, Ibri and Drenica. Chemical analyzes of water and sediment are essential to determine the level of trace elements in these ecosystems. The water and sediment concentration level were used to determine the Health Risk Index (HRI) for the exposed population. Trace elements were determined in water and sediment using the ICP-OES method. The samples were collected in September/ 2023, at eight different sampling points. Concentration (maximum value) for: Cr (0.079 mg/l), Zn (0.084 mg/l), Mn (0.097 mg/l) Fe (0.305 mg/l) Ni (0.107 mg/l) Pb (0.101 mg /l) and Cu (0.052 mg/l) in all sampling points, such as: (M1-M2, Sitnica river), (M3-M4, Trepça river), (M5-M6, Ibri river) and (M7- M8, Drenica river) and it turned out that most of the heavy metals were below the recommended US-EPA and WHO standards. But the concentration (maximum value) for: Fe>Ni and Pb, at all sample points were found to be above the recommended norms of US-EPA and WHO. All these chemical elements, (their concentration in water and sediment) originate from urban and industrial sources, around the researched areas. From the statistical analysis, a very significant positive relationship of Fe and Ni with Pb was found, originating mainly from the minerals and manufacturing industries around these rivers.

**Keywords:** Rivers, pollution, heavy metals, urban and industrial discharges.

**STRUCTURE-BASED DRUG REPURPOSING TO INHIBIT THE DNA GYRASE OF  
MYCOBACTERIUM TUBERCULOSIS**

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**Short Introduction:**

Drug repurposing is an alternative avenue for identifying new drugs to treat tuberculosis (TB). Although TB can be cured with anti-tubercular drugs, the emergence of multidrug-resistant and extensively drug-resistant strains of *Mycobacterium tuberculosis* H37Rv (Mtb), as well as the significant death toll globally, necessitate the development of effective drugs to treat TB.

**Experiments and Key result findings:**

In this study, drug repurposing approach was employed to address this drug resistance problem by screening drugbank database to identify novel inhibitors of the Mtb target enzyme, DNA gyrase. The compounds were screened against the ATPase domain of gyrase B subunit (MtbGyrB47), and the docking results showed Echinacoside, Doxorubicin, Epirubicin, and Idarubicin possess high binding affinities against MtbGyrB47. Comprehensive assessment using fluorescence spectroscopy, SPR, and CD titration studies revealed that Echinacoside as a potent binder against MtbGyrB47. Further, ATPase, and DNA supercoiling assays exhibited IC<sub>50</sub> values of 2.1-4.7  $\mu$ M for Echinacoside, Doxorubicin, Epirubicin, and Idarubicin. Among these compounds, the least MIC<sub>90</sub> of 6.3  $\mu$ M and 12  $\mu$ M were observed for Epirubicin and Echinacoside, respectively. Hence, our findings indicate that Echinacoside and Epirubicin target mycobacterial DNA gyrase, inhibit its catalytic cycle, and retard mycobacterium growth. Further these compounds exhibits potential scaffolds for optimizing novel anti-mycobacterial agents that can act on drug-resistant strains.

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**INFLUENCE OF AGRICULTURAL PRACTICES AND SEASON INTERACTIONS  
ON VEGETATIVE GROWTH, SEED YIELD, AND OIL CONTENT OF BLACK  
MAHALAB (*MONECHMA CILIATUM*) A PROMISE OIL CROP**

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**ABSTRACT**

A field experiment was conducted for two growing seasons (autumn and winter) to evaluate the effect of agricultural practices and estimate genotype-season interaction on *Monechma ciliatum*. Four sample seeds from different locations were sown in the Abu Naama environment, with four different sowing dates and four plant spacings (10, 20, 30, and 40cm). The effects of sowing date and plant spacing on 50% seedling emergence and 50% flowering, plant height, leaves, and branch number, and population density. Yield, oil content, fresh and dry weight were expressed. The effect of the sowing date on yield indicated that the autumn season was better than the winter. Oil content was shown to be significantly affected ( $P \leq 0.01$ ) by season (sowing dates). Higher oil content was recorded for plants grown in autumn in both seasons, while the lower values were recorded for those grown in the winter season. Seeds, seasons, and spacing all were different.

**Keywords:** *Black mahalab; genotype-season; interaction; Monechma ciliatum; oil; seed; yield*



**ANALYZING FOREST RESIDENTS' PERCEPTION AND KNOWLEDGE OF  
FOREST ECOSYSTEM SERVICES TO GUIDE FOREST MANAGEMENT IN THE  
IFRANE NATIONAL PARK (MOROCCO)**

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**ABSTRACT**

The concept of ecosystem services is increasingly seen as a tool allowing the achievement of sustainable use of forest resources. However, it is not yet sufficiently integrated into participatory forest management approaches. For this purpose, a study was conducted to assess the direct and indirect benefits of Forest Ecosystem Services perceived by local communities around Ifrane National Park in Morocco and their involvement in its management. The data were collected from 279 households between April and June 2021 through face-to-face interviews. Perceptions of use, priority, and trends of Forest Ecosystem Services are analyzed using descriptive statistics. The Chi-square test was used to examine significant associations between wealth categories and prioritization of provisioning FES. Several provisioning Forest Ecosystem Services have been identified as essential for household subsistence and cash uses. The chi-square test shows an association between provisioning forest services for subsistence and cash use and household wealth categories. Regarding the prioritization of FESs, fifteen were prioritized, showing the need for their integration into any future forest management approach. 92.8% of participants perceived change in ecosystem services using the participatory approaches, this change was almost always positive (30.9%) and often negative (27.6%). Provisioning FES experienced the greatest negative change (59.2%), requiring several interventions to ensure their sustainability. These results confirm the importance of integrating participatory ecosystem service assessment with biophysical evaluations to evaluate the benefits of forest areas for the well-being of users. Lack of involvement in forest management can contribute significantly to unsustainable resource extraction by

**Keywords:** ecosystem services, Perceptions, integrating participatory ecosystem service, forest management

AI FOR CONTENT GENERATION IN DIGITAL MARKETING

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**ABSTRACT**

The implementation of complex mathematical models and their integration in various types of economic activity becomes possible thanks to the intensive development of information technologies. Cloud computing makes it possible to process large volumes of various information thanks to the use of machine learning algorithms. The process of data collection in the digital environment occurs thanks to the use of various tools and involves their accumulation on specialized servers. Digital marketing is one of the important activities of companies, which requires significant amounts of information to develop effective strategies for interacting with the target audience and achieving the optimal level of conversion. In the process of interaction with users in the digital environment, companies use various marketing tools and get the opportunity to accumulate information thanks to the use of various web analytics services. The accumulated information is a valuable source for making effective management decisions regarding the implementation of the company's marketing strategy on the Internet. For data processing and their use in the company's digital marketing strategy, it is advisable to use artificial intelligence, which functions on the basis of machine learning algorithms and is characterized by the ability to learn in accordance with the action of environmental factors. For modern users, relevant content plays an important role, first of all, companies should place photo and video materials in the digital environment. The market offers specialized services with integrated artificial intelligence that allow companies to create images of varying complexity based on a text description. First of all, it is advisable to pay attention to Dall-E 3, which interacts with ChatGPT and allows, based on a text request, to generate complex images that reflect the interaction between several objects.

**Keywords:** artificial intelligence, content, digital marketing, optimization, target audience.

**THE INFLUENCE OF PLANTS ON THE MICROBIOME IN PATIENTS WITH  
AUTOIMMUNE DISEASES**

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**ABSTRACT**

**Background** It is now evident that the gut microbiota has a profound effect on the host immune system. The interactions between the gut microbiota and host immunity are complex, dynamic and context-dependent. The gut microbiota and its metabolites have been shown to influence immune homeostasis both locally and systemically. Bacterial contents such as lipopolysaccharide and bacterial antigens can induce a systemic inflammatory environment. The biggest question in the field is whether inflammation causes gut dysbiosis or dysbiosis leads to disease induction or propagation.

**Objectives** To demonstrate role of plants in the management of dysfunctional immune responses. The direct modulation of gut microbiome that could diminish chronic inflammatory responses and ameliorate adaptive immune responses is major pathway to stabilize autoimmune diseases.

**Materials and methods** Recent reports indicate that dysbiosis is increased in autoimmune diseases. Plant modulation of the immune system can also have a role in the autoimmune disease, acting to reduce or delay the onset of immune-mediated diseases. Ongoing research in this field will ultimately lead to a better understanding of the role of diet and plants in chronic inflammation in patients with autoimmune diseases.

**Results** Plants may restore the composition of the gut microbiome and introduce beneficial functions to gut microbial communities, resulting in amelioration or prevention chronic inflammatory responses.

**Conclusion** The gut microbiota is considered to be a master regulator of immune homeostasis. Besides modifying the gut microbiota, plants modulates the immune system in patients with autoimmune diseases.

**Keywords:** plants, autoimmune diseases, microbiome, immunomodulation

**IMPACT OF BASKETBALL TRAINING ON FUNCTIONAL PARAMETERS OF  
FRESH-YEAR YOUTH STUDENTS**

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**Introduction.** High physical activity capable of providing pronounced positive changes in all tissues. Aerobic physical activity is becoming very popular among modern youth. A common variant is basketball, which attracts a large number of students. At the same time, the impact of basketball lessons on the body of students enrolled in the first year of the university needs to be clarified.

**Purpose:** to trace the influence of a systematic visit to the basketball section on the general physical abilities of first-year students of youthful age.

**Methodology and organization of research.** The study was carried out on 24 young men who did not have deviations in the state of health, studying in the first year of the university. The surveyed were divided into a group of 12 people who started training regularly in the basketball section and into a comparison group, which included 12 clinically healthy male students who maintained initially low physical activity. All subjects underwent a series of standard functional tests. The processing of their results was carried out using Student's criterion (t).

**Research results and discussion.** Initially, all students had low speed-strength parameters, which were revealed in the course of running tests at a distance of 30 meters and 60 meters and in the long jump test. At the first examination, all young men of both observed groups had low endurance, weak strength characteristics and unexpressed coordination. After three months of observation, a significant increase in speed-strength parameters, improved coordination and a significant increase in endurance were noted in the group of trainees. In the comparison group, the estimated indicators remained at a low level throughout the entire observation period.

**Conclusions.** Regular visits to the volleyball section provide freshmen of youthful age with an improvement in speed, strength and coordination parameters. Preservation of low physical activity among first-year boys ensures a consistently low level of physical capabilities.

**Keywords:** sports, students, adolescence, football, physical abilities, muscle activity.

**DYSLIPIDEMIA AS A RISK FACTOR FOR CARDIOVASCULAR DISEASE  
DISEASES**

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**ABSTRACT**

**Introduction**

Worldwide, over 4 million people die each year from cardiovascular disease, which is thought to be significantly increased by dyslipidemia. Studies on the link between high lipid levels and cardiovascular illnesses have produced contradictory results. This study sought to determine the prevalence of dyslipidemia, a CVD risk factor, among adult patients in Elbasan City.

**Methods**

This cross-sectional study was carried out at the "Cardiology Clinic Austriake" from June 2022 to March 2023. Adults with cardiovascular illnesses were surveyed using a standardized questionnaire related to sociodemographic, clinical, and anthropometric characteristics. Additionally, for each of them, we have played measurements for their lipid profiles and uric acid levels from the next morning's fasting blood. The data were examined using SPSS software, version 20.0.

**Results**

The average age of the 124 patients enrolled in this study was 63.2 11.4 years, and 76 of them (61.3%) had at least one dyslipidemia. There were 32.2% (40/124) cases of high total cholesterol, 39.5% (49/124) cases of hypertriglyceridemia, hypercholesterolemia, and 45.2% (56/124) cases of low levels of high-density lipoprotein (HDL) 40 mg/dl, respectively. With a p-value of <.05, risk variables such as age, obesity, sedentary lifestyle, and family history of dyslipidemia and heart disease were linked to high cholesterol and high triglyceride levels. On the other hand, hypercholesterolemia had a statistically significant association with the risk of cardiovascular disease (p-value= 0.002; OR = 1.08; 95% CI). Additionally, the levels of TC and TG were strongly linked with uric acid.

**Conclusion**

Our data show that persons with cardiovascular diseases have a significant prevalence of dyslipidemia. More focus should be placed on adults, particularly those with cardiovascular illnesses to ensure regular and frequent lipid profile monitoring. All of this will result in fewer complex instances and healthier living overall. Furthermore, these findings may serve as a guide for the creation of clinical preventative measures and guidelines as well as further investigation of the underlying mechanisms that link dyslipidemia to cardiovascular illnesses.

**Key words:** Cardiovascular Disease, Dyslipidemia, Patient, Cholesterol, Triglyceride

**CARREAU MODEL FOR LIQUID THIN FILM FLOW OF DISSIPATIVE  
MAGNETIC-NANOFUIDS OVER A STRETCHING SHEET**

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**ABSTRACT**

In recent days, external magnetic fields are very effective to set the thermal and physical properties of magnetic-nanofluids and regulate the flow and heat transfer characteristics. The strength of the applied magnetic field affects the thermal conductivity of magnetic-nanofluids and makes it anisotropic. With this incentive, we investigate the flow and heat transfer characteristics of electrically conducting liquid film flow of magnetic-nanofluids over a stretching sheet by considering the aligned magnetic field with space and temperature dependent heat source/sink, viscous dissipation and thermal radiation. For this study, we considered  $\text{Fe}_3\text{O}_4$  and  $\text{CoFe}_2\text{O}_4$  nanoparticles embedded in water. Numerical results are determined by adopting Runge-Kutta based shooting technique. Graphs are exhibited and explained for various parameters of interest. The influence of pertinent parameters on reduced Nusselt number, friction factor, flow and heat transfer is discussed with the assistance of graphs and tables. It is found that aligned magnetic field regulates the momentum boundary layer and heat transfer rate. It is also observed that increasing the volume fraction of nanoparticles effectively enhances the thermal conductivity of  $\text{Fe}_3\text{O}_4$ -water nanofluid when compared with  $\text{CoFe}_2\text{O}_4$ -water nanofluid.

**Keywords:** film flow, inclined magnetic field, viscous dissipation, radiation, non-uniform heat source/sink.



## AZEOTROPIC DISTILLATION OF NATURAL PRODUCTS

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### ABSTRACT

Azeotropic distillation is a technique used to separate mixtures that form a constant-boiling mixture, or an azeotrope. It can be applied to natural product extraction and purification processes. Azeotropic distillation of natural products involves the addition of an entrainer or azeotrope breaker to modify the azeotropic behavior and improve separation.

Azeotropic distillation is a technique used in distillation processes that involves the addition of an entrainer or azeotrope-forming agent to alter the relative volatility of the components in a mixture. This technique can be applied to the distillation of natural products, such as essential oils, to separate and concentrate specific compounds.

In the context of natural products, azeotropic distillation can be used to extract and separate desired compounds from a mixture of volatile components. By adding an entrainer, which forms an azeotrope with one or more components of the mixture, the relative volatility between different components can be modified, allowing for their separation. The entrainer forms a new azeotropic mixture with the desired compound(s), and upon distillation, the target compounds can be collected. For natural products, a common application of azeotropic distillation is the separation of volatile compounds from their complex mixtures. Many natural products contain heat-sensitive or fragile compounds that can be damaged or lost during traditional distillation processes. Azeotropic distillation helps overcome these challenges by employing an entrainer to form a heterogeneous azeotrope, which alters the vapor-liquid equilibrium and enables efficient separation.

The choice of entrainer depends on the specific natural product and the compounds of interest. Common entrainers used in azeotropic distillation of natural products include ethanol, water, and hydrocarbons. The selection of an appropriate entrainer is based on factors such as the boiling points and solubilities of the compounds, the desired separation efficiency, and the compatibility of the entrainer with the natural product. Azeotropic distillation of natural products is a valuable technique in industries such as flavor and fragrance, pharmaceuticals, and herbal extracts, allowing for the extraction and purification of desired compounds from complex mixtures. It also depends on the specific natural product and desired target compound. Common entrainers include water, organic solvents, or other volatile compounds that can form a ternary azeotrope. By carefully selecting and controlling the operating conditions, such as temperature and pressure, it becomes possible to preferentially separate the desired compounds from the natural product.

Overall, azeotropic distillation provides a valuable tool for the extraction and purification of natural products, allowing for the selective separation of target compounds while minimizing heat-induced degradation or loss.

In azeotropic distillation of natural products, the process typically involves the following steps:

**Selection of entrainer:** The choice of an appropriate entrainer depends on the nature of the natural product and the target compounds to be separated. The entrainer should have favorable azeotropic behavior with the desired compounds.

**Formation of azeotrope:** The natural product mixture is combined with the entrainer to form a heterogeneous mixture. The entrainer modifies the vapor-liquid equilibrium, forming an azeotropic mixture that boils at a different temperature than the individual components.

**Distillation process:** The mixture is heated under controlled conditions in a distillation apparatus. As the mixture vaporizes, the azeotropic vapor is generated, containing the desired compounds along with the entrainer.

**Condensation and separation:** The azeotropic vapor is then condensed, typically using a condenser. The resulting liquid is subjected to phase separation to separate the entrainer and the target compounds. Various techniques such as decantation, liquid-liquid extraction, or fractional distillation can be employed for this purpose.

Azeotropic distillation offers several advantages for the separation of natural products. It allows for the extraction and purification of sensitive or fragile compounds without excessive heat exposure. It can enhance the efficiency of separation and reduce the energy requirements compared to traditional distillation methods. However, the selection of an appropriate entrainer and optimization of process conditions are crucial to achieving desired separation outcomes.

**Recovery and recycling:** The separated entrainer can be recovered and recycled for use in subsequent distillation cycles, reducing costs and minimizing waste.

**Keywords:** distillation, azeotropic, extraction, volatile, entrainer.

TRIDIMENSIONAL EXTENSION OF BALANCING NUMBERS

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ABSTRACT

Currently, several sequences of numbers have been investigated by many researchers. An example of such sequences is the balancing numbers  $\{B_n\}_{n \geq 0}$  given by the recurrence relation

$$B_{n+2} = 6B_{n+1} - B_n,$$

with the initial conditions  $B_0 = 0$  and  $B_1 = 1$ . (See for more information the works [1], [2], [3], [6], [7], among others).

The bidimensional version of this sequence is denoted by  $\{B_{(n,m)}\}_{n,m \geq 0}$  and satisfies the following recurrence relations:

$$\begin{cases} B_{(n+1,m)} = 6B_{(n,m)} - B_{(n-1,m)}, \\ B_{(n,m+1)} = 6B_{(n,m)} - B_{(n,m-1)}, \end{cases}$$

with the initial conditions  $B_{(0,0)} = 0$ ,  $B_{(1,0)} = 1$ ,  $B_{(0,1)} = i$ ,  $B_{(1,1)} = 1 + 1$  and  $i^2 = -1$ . (See the works [4] and [5] for more information).

In this work, we introduce the tridimensional version  $\{B_{(n,m,p)}\}_{n,m,p \geq 0}$  of the balancing numerical sequence to the detriment of its unidimensional and bidimensional version and study some its properties.

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**AN REVIEW ON ANTIOXIDANTS: SOLUTION TO OXIDATIVE STRESS**

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**ABSTRACT**

In recent times, there has been a lot of discussion on the mechanism of free radicals and how antioxidants neutralize them. Oxidative stress results from an unfavorable oxidant-antioxidant ratio that delays development, impairs immunity and causes other clinical manifestations. The fundamental goal of using antioxidants is to reduce oxidative stress by eliminating oxidants, restoring damaged biomolecules and membranes, boosting the immune system and preserving physiological homeostasis. The current review provides significant data on superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx) as enzymatic, glutathione, uric acid and lipoic acid as endogenous non-enzymatic antioxidants. This study focuses on natural and synthetic non-enzymatic exogenous antioxidants. Its purpose is to provide a description of the roles that antioxidants serve in feed and food industry with regard to animal's health and product's quality and it briefly focuses on the future recommendations as well. Thus, novel and innovative ideas are required to extract and develop antioxidant compounds for feed and food sectors that are economical and kind to environment.

**Keywords:** Antioxidant; feed additive; free radical; glutathione; oxidative stress

**A REVIEW ON HARMFUL ALGAL BLOOMS: ITS CAUSES, IMPACTS AND  
MITIGATION**

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**ABSTRACT**

Harmful algal blooms (HABs), an unchecked growth of algae, have become more prevalent and widespread over the past decades. These HABs produce biotoxins which has resulted in loss of biodiversity, fisheries as well as economy. Marine HABs belongs to dinoflagellates and diatoms whereas cyanobacteria are freshwater HABs. This review is the global overview of toxic genera of algae, its causes, impacts and particular attention is given to its mechanisms. Eutrophication, climate change and ballast water transport are the main reasons for the dispersion of HABs. Various outbreaks of this wreaking havoc have been and continue to be reported on the entire globe that critically damage the terrestrial and aquatic life. To combat the deleterious effects, its monitoring and control is requisite. New strategies for the management, mitigation, and control of HABs should be developed to make them more cost effective and environment friendly.

**Keywords** biotoxins, eutrophication, monitoring, mitigation



**INFLUENCE OF SHRINKING PARAMETERS OF THIN WALL CROSSLINKED  
POLYOLEFIN TUBES USED OVER WIRES INSULATED WITH LOW WORKING  
TEMPERATURE MATERIALS**

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**ABSTRACT**

One of the biggest issues on automotive industry related with manufacturing process is the watertightness of welded splices. Watertightness is mainly related to splice configuration, insulation material of wires, its compatibility with polyolefin tubes and the parameters defined during shrinking process.

Polyolefin suppliers recommend the usage of insulation materials for wires that can be used at working temperature of 125°C, but due to material cost, companies are more and more requested to use materials with lower temperature class. This may lead to damages in the insulation while shrinking the polyolefin tubes and consequently lack of watertightness.

In our study we were trying to see the impact of shrinking parameters on the behavior of insulation materials for low temperature class wires, compared with recommended ones. Studies were being done using design of experiments method. Were chosen wires insulated with PVC with working temperature 105°C and XLPE insulated wires that had working temperature 125°C. Tubes were shrunk using parameter manipulation to identify the differences

As a conclusion it was seen that shrinking parameters for polyolefin tubes can be set in a way to have good watertightness properties and maintaining the characteristics of insulation materials of wires for both cases studied.

**Keywords:** shrinking process, cross linking, XPLE, PVC, welded splices

**HEAVY METALS AS WATER AND SEDIMENT POLLUTANTS OF THE LLAP  
RIVER, DISTRICT; PODUJEV-LLUZHAN-BARILEV**

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**ABSTRACT**

Most of the rivers in Kosovo are highly polluted by the anthropogenic factor. Different types of pollution in river waters are further transmitted through the water cycle, which means that river pollution has a negative impact on people and the environment. Some of the research conducted in this field have shown that the concentration of heavy metals in water and sediment is constantly increasing, compared to previous scientific research. Our scientific research aimed to evaluate the quality of water and mud of the Llap River, where through scientific research, we will analyze heavy metals, such as: Cu> Zn> Cd> Pb> Ni> Cr> Mn and Fe, found in the analyzed environments, and we will identify the factors that affect the quality of this River. The results for this study will be extracted using the analytical method: Atomic Absorption Spectrometry (SAA). It is estimated that the mass concentration, for: Fe (0.594 mg/l), Ni (0.458 mg/l), Pb (0.360 mg/l) and Mn (0.336 mg/l) in some sampling sites, exceeds the criteria allowed according to; US-EPA and WHO for water and sediment quality. Ultimately, this research will serve as one of the scientific facts, for local and central authorities, to create a national strategy for monitoring toxic wastes and managing these wastes, in protected and well-preserved deposits, from the impact of them in water-environmental ecosystems.

**POLİPROPİLEN/MISIR KABUĞU KOMPOZİTİNİN MEKANİK ÖZELLİKLERİNE  
KALSİYUM KARBONAT KATKISININ ETKİSİNİN İNCELENMESİ**

**THE INVESTIGATION OF THE EFFECT OF CALCIUM CARBONATE ADDITIVE  
ON THE MECHANICAL PROPERTIES OF POLYPROPYLENE/CORN HUSK  
COMPOSITES**

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**ÖZET**

Son yıllarda artan polimerik kompozit malzemelerin geniş bir endüstri yelpazesinde kullanımının yanı sıra bu malzemelerin çevresel etkilerinin farkındalığı artarak plastik miktarını azaltma ve yenilenebilir biyokütle kaynaklarıyla yer değiştirme ihtiyacını doğurmuştur. Bu bağlamda, polipropilen/mısır kabuğu tozu granüllerine kalsiyum karbonat ( $\text{CaCO}_3$ ) katkısının eklenmesinin elde edilecek kompozitin mekanik özelliklerine etkisini inceleyen bir çalışma gerçekleştirilmiştir. Kompozitler, ekstrüzyon ve enjeksiyon kalıplama işlemleri kullanılarak üretilmiştir. Mısır kabuğu tozu (100-200  $\mu\text{m}$ ) ağırlıkça % 2 oranında PP içerisine katılıp ekstrüze edilmiştir. Sonrasında elde edilen kompozit, ağırlıkça %5 ve %10 oranlarında kalsiyum karbonat konsantrasyonu ile enjeksiyonlu kalıplama ile şekillendirilmiştir. Çalışmada, kompozit malzemelerin mekanik özellikleri çekme, eğilme, darbe dayanımı, yük altında deformasyon sıcaklığı ve Vicat yumuşama sıcaklığı testleri ile değerlendirilmiştir. Mekanik test sonuçlarına göre en yüksek çekme mukavemeti ve en yüksek eğilme direnci %2 mısır kabuğu tozu katkılı kompozitte elde edilirken, kopma noktasındaki birim uzama ve darbe dayanımlarında düşüş gözlemlenmiştir. Vicat yumuşama sıcaklığı test sonuçlarına bakıldığında ise mısır kabuğu tozunun Vicat yumuşama sıcaklığına etkisi olmadığı görülürken,  $\text{CaCO}_3$  ilavesinin ise yumuşama sıcaklığını arttırdığı saptanmıştır. Yük altında deformasyon sıcaklıklarına bakıldığında ise mısır kabuğu tozunun yük altında deformasyon sıcaklığını 49,6 °C'den 46,9 °C'ye düşürdüğü gözlemlenmiş ve  $\text{CaCO}_3$  eklenmesi ile sıcaklık değerinin arttığı saptanmıştır. Sonuçlar, mısır kabuğu tozunun polipropilen esaslı malzemelerin üretiminde alternatif biyobozunur katkı olarak değerlendirilebileceğini göstermiştir.

**Anahtar Kelimeler :** Polimerik Kompozitler, Biyobozunur Katkı, Mısır Kabuğu, Polipropilen, Kalsiyum Karbonat

## ABSTRACT

Recently, in addition to the increasing use of polymeric composite materials in a wide range of industries, awareness of the environmental impacts of these materials has increased, leading to the need to reduce the amount of plastic and replace it with renewable biomass resources. In this context, a study was carried out examining the effect of calcium carbonate ( $\text{CaCO}_3$ ) additive addition to polypropylene/corn husk powder granules on the mechanical properties of the resulting composite. Composites were manufactured using extrusion and injection molding processes. Corn husk powder (100-200  $\mu\text{m}$ ) was added into PP at a rate of 2% by weight and extruded. The resulting compound was then shaped by injection molding with a calcium carbonate concentration of 5% and 10% by weight. In this study, the mechanical properties of composite materials were evaluated with tensile, bending, impact strength, deformation temperature under load and Vicat softening temperature tests. According to mechanical test results, the highest tensile strength and highest bending strength were obtained in the composite with 2% corn husk powder addition, while a decrease in unit elongation at break and impact strength was observed. Considering the Vicat softening temperature test results, it was determined that corn husk powder had no effect on the Vicat softening temperature, while the addition of  $\text{CaCO}_3$  increased the softening temperature. When looking at the deformation temperatures under load, it was observed that corn husk powder reduced the deformation temperature under load from 49.6  $^\circ\text{C}$  to 46.9  $^\circ\text{C}$ , and it was determined that the temperature value increased with the addition of  $\text{CaCO}_3$ . The results showed that corn husk powder can be considered as an alternative biodegradable additive in the production of polypropylene-based materials.

**Key Words:** Polymeric Composites, Biodegradable Additive, Corn Husk, Polypropylene, Calcium Carbonate

## 1. GİRİŞ

Son yıllarda, polimerik kompozit malzemeler, otomotiv, endüstriyel uygulamalar ve inşaat gibi birçok farklı sektörde yaygın bir şekilde kullanılmaktadır (Vasanthakumari, 2012). Polimer ürünlerinin çevresel etkilerinin göz önüne alınması, yeni malzemelerin geliştirilmesine yol açmış ve bu malzemeler polimerleri ve yenilenebilir kaynakları bir araya getirmiştir. Doğal kaynaklardan elde edilen katkıları, sentetik olanlarla karşılaştırıldığında birçok avantaja sahiptir, bunlar düşük maliyet, düşük enerji tüketimi, düşük yoğunluk, yüksek spesifik mekanik özellikler, aşındırıcı olmama ve özellikle biyolojik olarak parçalanabilme gibi avantajlar içerir (Tran ve ark., 2013).

Tahıl sapsarı, mısır sapsarı, keten sapsarı, mısır koçanları, pirinç kabukları gibi yenilenebilir biyokütle kaynakları, düşük maliyetleri, çevre dostu ve sürdürülebilir doğaları nedeniyle potansiyel olarak değerli doğal kaynakları temsil ederler (Dani ve ark., 2013). Mısır kabuğu, bitki büyürken mısır başağının dış kabuğunu oluşturan lignoselülozik bir malzemedir. Kabuğun büyük kısmını selüloz oluştururken az miktarda lignin ve kül bulunmaktadır (Alshahrani ve Prakash, 2022). Kabuklar bir kısmı hayvan yataklarında altlık ya da biyoyakıt üretiminde değerlendirilirken genellikle katı atık olarak kabul edilmektedir. Mısır kabukları geleneksel bertaraf yöntemleri olan yakma ve gömmeye maruz kaldığında, çevre kirliliğine ve kaynak israfına neden olabilir (Ratna ve ark., 2022). Mısır kabuklarının farklı polimer esaslı malzemelerin geliştirilmesi için katkı olarak değerlendirilmesine yönelik çalışmalar yapılmaktadır. Literatürde mekanik olarak parçalanmış mısır kabuğu ile polipropilen karıştırılarak oluşturulan kompozitlerin, jüt lifi ile takviye edilmiş polipropilen kompozitlerine göre daha düşük mekanik özelliklere sahip olduğunu bildirilmiştir (Yang ve ark., 2009). Ek

olarak, Vasanthakumari ve arkadaşları, mısır kabuğu oranının artmasıyla polipropilen esaslı kompozitlerin mekanik özelliklerinin düştüğünü belirtmişlerdir (Vasanthakumari, 2012).

İnorganik dolgu maddeleri, polimerlerin mekanik özelliklerini artırmak amacıyla yaygın olarak kullanılmaktadır (Chan ve ark., 2002). Endüstride yaygın olarak kullanılan bazı inorganik dolgu maddeleri arasında kalsiyum karbonat, mika ve talk tozu yer almaktadır (Lam ve ark., 2009). Kalsiyum karbonat ( $\text{CaCO}_3$ ), plastıklere yüksek yükleme kapasitesi ve düşük maliyeti nedeniyle en popüler dolgu malzemesi olarak kabul edilmektedir. Bu katkı kompozitlerin mekanik özelliklerini önemli ölçüde iyileştirebilir (Nekhamanurak ve ark., 2014).

Bu çalışmada, mısır kabuğu tozu katkılı otomotiv sınıfı polipropilen granüllerine kalsiyum karbonat ilavesinin elde edilen kompozitin mekanik özellikler üzerindeki etkisini incelemeyi amaçlamaktadır.

## 2. MATERYAL VE YÖNTEM

### 2.1 Malzemeler

Deneyel çalışmalarda, PP kompond (%15 mineral katkı), Sabic compound (Yoğunluk: 1.0 g/cm, Erime Sıcaklığı: 230°C MFI (Melt Flow Index): 14), Orhaneli, Bursa, Türkiye; PP-g-MAH Olebond 7401 HH, Tisan, (Yoğunluk: 0.93 g/cm<sup>3</sup>, Erime Sıcaklığı: 162°C, MFI (Melt Flow Index): >100);  $\text{CaCO}_3$  (%80 saflıkta), Tosaf, (Yoğunluk: 2.1 g/cm<sup>3</sup>, Partikül Boyutu: 3-15 Mikron) kullanıldı.

### 2.2 Mısır Kabuğu Tozu Eldesi

Hasat sonrası mısır kabukları etüvde 100 °C sıcaklıkta 24 saat kurutuldu. Mekanik olarak toz haline getirildi ve elendi. 100-200 µ boyutunda olan mısır kabuğu tozları kullanılabildi kadar rutubetsiz ortamda bekletildi.

### 2.3 Mısır Kabuğu Tozu/PP Kompond Üretimi

PP'nin ve mısır kabuğu tozu ile kompond üretimi Plasmot A.Ş' de bulunan çift vidalı ekstrüder kullanılarak gerçekleştirildi (Tablo 1). Kompond işlemi ve vida hızı 150 devir/dakika olacak şekilde 190-245 °C bölge sıcaklıkları arasında gerçekleştirildi (Şekil 1).

Mısır Kabuğu Tozu/PP Kompond (MPP)		
PP	Mısır Kabuğu Tozu	PP-g-MAH
% 98 wt.	%2 wt.	%3 wt.

Tablo 1. Kompond Karışım Oranları



Şekil 1. Kompond Karışımı Dijital Kamera Görüntüsü

## 2.4 Kompozitlerin Hazırlanması

Üretilen mısır kabuğu tozu katkı PP kompond farklı oranlarda  $\text{CaCO}_3$  kullanılarak karışım (Tablo 2) yapıldıktan sonra Plasmot A.Ş' de bulunan 50 Ton Asian Enjeksiyon makinesi kullanılarak baskı alındı (Şekil 2).

Numune Kodu	MPP	$\text{CaCO}_3$
MPPC0	%100	-
MPPC1	%95	5
MPPC2	%90	10

Tablo 2. Kompozitlerin Kompozisyonu



Şekil 2. MPPC2 Kompozitinin Dijital Kamera Görüntüsü

## 2.5 Kompozitlerin Karakterizasyonu

### Çekme Özellikleri Tayini

Kompozitlerin çekme özellikleri, Zwick Z020 universal test cihazı ile ISO 527 standardına göre gerçekleştirildi.

### Eğilme Özellikleri Tayini

Kompozitlerin eğilme özellikleri, Zwick Z020 universal test cihazı ile ISO 178 standardına göre gerçekleştirildi.

### İzod Darbe Dayanımı Tayini

Kompozitlerin darbe dayanım testleri, Ceast Izod darbe cihazı ile ISO 180/A standardına göre gerçekleştirildi.

### Yük Altında Sapma Sıcaklığı (HDT) Tayini

Kompozitlerin yük altında sapma sıcaklığı testleri, Ceast HDT cihazı ile ISO 75-2/A standardına göre gerçekleştirildi.

### Vicat Yumuşama Sıcaklığı Tayini

Kompozitlerin Vicat yumuşama sıcaklığının belirlenmesi testleri, Ceast Vicat cihazı ile ISO ISO 306/B50A standardına göre gerçekleştirildi.



### 3. BULGULAR VE TARTIŞMA

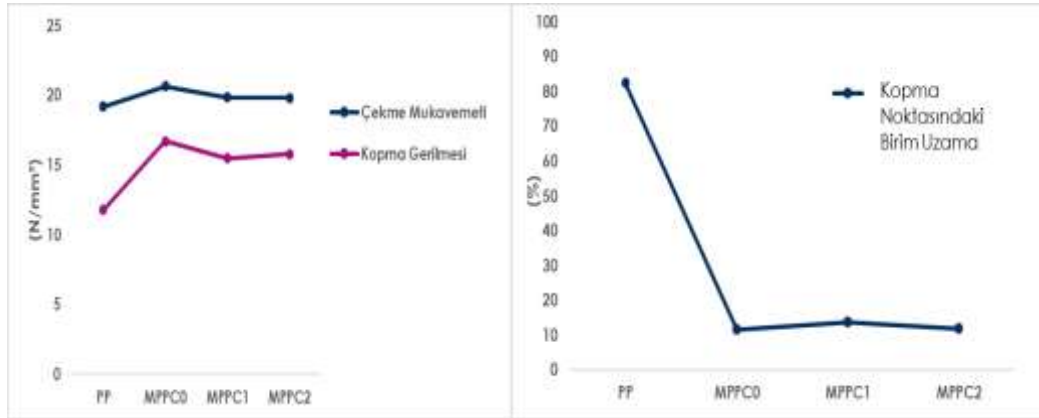
#### 3.1 PP Esash Kompozitlerin Çekme Özellikleri

PP'ne farklı katkıları katılarak elde edilen kompozitlerin mekanik özellikleri belirlenmiştir. Tablo 3 ve Şekil 3' te kompozitlerin çekme mukavemeti, kopma gerilmesi ve kopma noktasındaki birim uzama değerleri verilmiştir.

Mısır kabuğu tozu eklenmesi ile çekme mukavemeti ve kopma gerilmesinde artış gözlemlenirken  $\text{CaCO}_3$  ilavesi ile değerlerde düşüş görülmüştür. Diğer yandan mısır kabuğu tozu ve  $\text{CaCO}_3$  ilavesi ile uzama değerlerinde önemli ölçüde düşüş gözlemlenmiştir. Vasanthakumar ve ark. (2012) yaptığı çalışmada kopma noktasındaki birim uzama değerinin düştüğünü raporlamıştır. Bu çalışmada  $\text{CaCO}_3$  ilavesi ile kopma noktasındaki birim uzama değerinde iyileşme görülmediği görülmüştür.

	Çekme Mukavemeti (N/mm <sup>2</sup> )	Kopma Gerilmesi (N/mm <sup>2</sup> )	Kopma Noktasındaki Birim Uzama (%)
PP	19,16 ± 0,05	11,75 ± 0,13	82,34 ± 12,08
MPPC0	20,61 ± 0,03	16,68 ± 0,18	11,64 ± 1,67
MPPC1	19,80 ± 0,08	15,45 ± 0,15	13,57 ± 3,43
MPPC2	19,77 ± 0,22	15,75 ± 0,5	11,84 ± 4,28

Tablo 3. Çekme Test Sonuçları



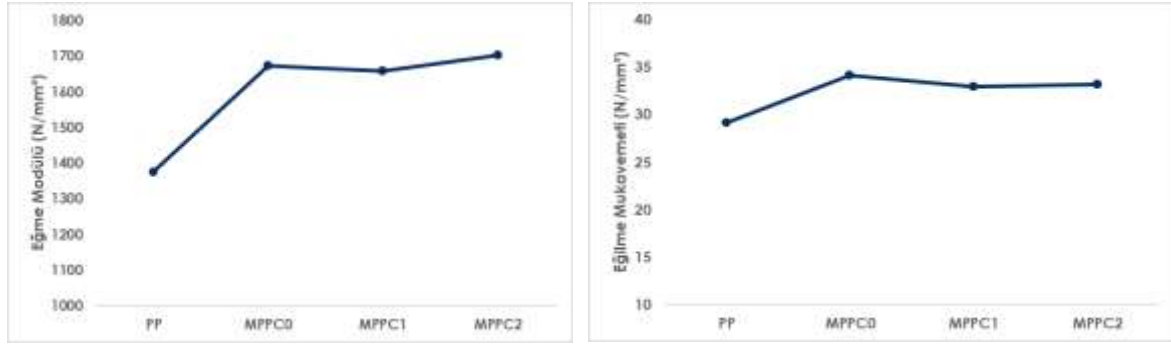
Şekil 3. Çekme Testi Grafikleri

#### 3.2 PP Esash Kompozitlerin Eğilme Özellikleri

Kompozitlerin eğilme özellikleri sonuçlarına göre mısır kabuğu tozunun polipropilenin eğme modülü ve eğilme mukavemetini arttırdığı saptanmıştır. %5  $\text{CaCO}_3$  ilavesi ile eğme modülü ve eğilme mukavemetinde düşüş gözlemlenirken %10  $\text{CaCO}_3$  ilavesi ile değerlerde artış gözlemlenmiştir (Tablo 4). Hongzhen ve ark. (2017), kalsiyum karbonat oranının artması moleküler arasındaki kuvvetleri zayıflatıp, içyapıların istikrarını yetersiz hale getirebileceğini ve eğilme modülünü azaltabileceğini bildirmişlerdir.

	<b>Eğme Modülü (N/mm<sup>2</sup>)</b>	<b>Eğilme Mukavemeti (N/mm<sup>2</sup>)</b>
<b>PP</b>	1376,38 ± 10,4	29,16 ± 0,06
<b>MPPC0</b>	1672,56 ± 15,2	34,13 ± 0,18
<b>MPPC1</b>	1658,12 ± 7,8	32,93 ± 0,10
<b>MPPC2</b>	1702,40 ± 14,5	33,18 ± 0,12

**Tablo 4. Eğilme Test Sonuçları**



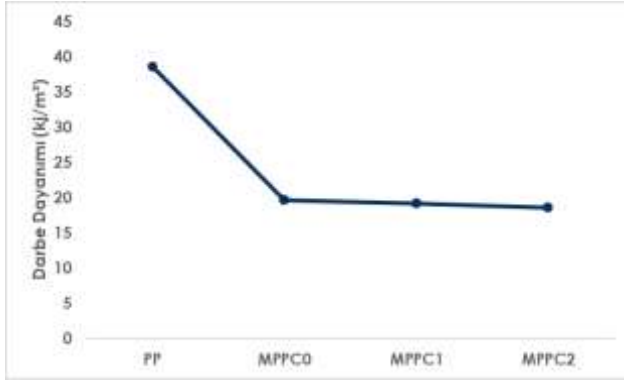
**Şekil 4. Eğilme Testi Grafikleri**

### 3.3 PP Esaslı Kompozitlerin İzod Darbe Dayanımını

Polipropilen matrisine mısır kabuğu eklenmesi ile kompozitlerin darbe dayanımlarında önemli ölçüde düşüş yaşanmıştır (Tablo 5). CaCO<sub>3</sub> ilavesinin ise darbe dayanım değerlerini iyileştirmede bir etkisi gözlemlenmemiştir.

	<b>Darbe Dayanımı (kJ/m<sup>2</sup>)</b>
<b>PP</b>	38,63 ± 1,06
<b>MPPC0</b>	19,64 ± 0,08
<b>MPPC1</b>	19,12 ± 1,25
<b>MPPC2</b>	18,56 ± 0,52

**Tablo 5. Darbe Dayanım Test Sonuçları**



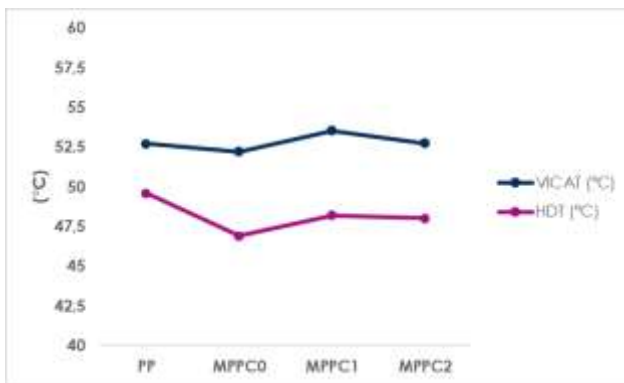
Şekil 5. Darbe Dayanım Testi Grafikleri

### 3.4 PP Esaslı Kompozitlerin Vicat Yumuşama Sıcaklığı ve Yük Altında Sapma Sıcaklığı

Kompozitlerin, Vicat yumuşama sıcaklığına bakıldığında %5 oranında CaCO<sub>3</sub> ilavesinin Vicat yumuşama sıcaklığını 52,7 °C'den 53,5 °C'ye yükselttiği görülmüştür. Yük altında sapma sıcaklıklarına bakıldığında ise polipropilen matrisine mısır kabuğu tozu eklenmesiyle başlangıçta 49,6 °C olan yük altında sapma sıcaklığının 46,9 °C'ye düştüğü gözlemlenmiştir. Kalsiyum karbonat eklenmesi ile yük altında sapma sıcaklığında artış olduğu görülmüş ve kalsiyum karbonat oranının yük altında sapma sıcaklığını arttırmadığı görülmüştür.

	Vicat (°C)	HDT (°C)
PP	52,7 ±2,8	49,6±1,6
MPPC0	52,2±2,9	46,9±1,5
MPPC1	53,5±0,44	48,2±0,08
MPPC2	52,7±0,49	48±1,8

Tablo 6. Vicat ve HDT Test Sonuçları



Şekil 6. Tablo 6. Vicat ve HDT Test Sonuçları

## 4. SONUÇ

Ekstrüzyon yöntemi ile mısır kabuğu tozu katkılı PP esaslı granüller elde edilmiş ve CaCO<sub>3</sub> eklenerek enjeksiyon yöntemiyle kompozitler başarılı bir şekilde üretilmiştir. Kompozitlerin çekme mukavemeti mısır kabuğu tozu ilavesi ile 19,17 N/mm<sup>2</sup> 'den 20.61 N/mm<sup>2</sup> 'ye artmıştır. Kompozitlere sırasıyla %5 ve %10 CaCO<sub>3</sub> ilavesi ile değerlerde lineer bir düşüş gözlemlenmiştir. Kompozitlerin kopma noktasındaki birim uzama değerlerinde ise mısır kabuğu ve CaCO<sub>3</sub>

eklenmesi ile yaklaşık %85'lik bir düşüş saptanmıştır. Kompozitlerin eğilme özelliklerinde mısır kabuğu tozu ile birlikte artış görülürken  $\text{CaCO}_3$ 'ün değerleri düşürdüğü görülmüştür. Darbe testi sonuçlarında darbe dayanımı  $38,63 \text{ kJ/m}^2$  olan matrise katkıların ilavesinin dayanımı  $18-19 \text{ kJ/m}^2$  civarlarına düşürdüğü belirlenmiştir. Mısır kabuğu tozunun Vicat yumuşama ve yük altında deformasyon sıcaklığı düşürdüğü belirlenirken, kalsiyum karbonat ilavesinin ise bu düşüşü giderip değerleri matris değerlerine yaklaştırdığı saptanmıştır. Sonuçlar genel olarak değerlendirildiğinde mısır kabuğu tozunun kompozitlerde alternatif biyokatki olarak kullanabileceği ortaya koyulmuştur. Kompozitlerin mekanik özelliklerinde daha iyi sonuçlar elde edebilmek için mısır kabuklarının modifiye edilerek matris- katkı uyumunun artırılmasına yönelik çalışmalar yapılması önerilmektedir. Otomotiv sektöründe kullanımı için mısır kabuğu tozu içeren kompozitlere kopma noktasındaki birim uzama ve darbe dayanımını iyileştirecek farklı katkıların eklenmesi gerektiği düşünülmektedir.

### Teşekkür

Kompozit üretimi, kompozit üretimi ve mekanik testlerin yapılmasına olanak sağladığı için Ermetal Otomotiv ve Eşya Sanayi Ticaret A.Ş ve Plasmot Mobilya ve Otomotiv Plastikleri A.Ş' ne teşekkür ederiz.

$\text{CaCO}_3$  konsantrisi katkısının temini için Tosaf A.Ş' ne ayrıca teşekkürlerimizi sunarız.

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**BİR KUMAŞ BOYAMA TESİSİNİN ÇEVRESEL ETKİLERİNİN YAŞAM DÖNGÜSÜ  
ANALİZİ YÖNTEMİ İLE DEĞERLENDİRİLMESİ**

**EVALUATION OF THE ENVIRONMENTAL IMPACTS OF A FABRIC DYEING MILL  
WITH LIFE CYCLE ASSESSMENT**

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**ÖZET**

Günümüzde tüketim her geçen gün artmakta ve doğal kaynaklar hızla azalmaktadır. Sanayileşmenin de artması ile beraber çevre kirliliği büyük bir sorun haline gelmiştir. Tekstil sanayi de kaynak kullanımının en yoğun olduğu ve çevresel kirlenici yükü yüksek bir endüstri olarak öne çıkmaktadır. Çevresel kirliliğin hesaplanabilmesi ve değerlendirilerek önüne geçilebilmesi için bir çok farklı yöntem bulunmaktadır. Yaşam Döngüsü Analizi bir ürünün hammadde elde edilme sürecinden kullanım sonrası atık yönetimi işlemlerine kadar tüm süreci ele alıp çeşitli etki kategorileri bakımından incelenmesine olanak sağlayan bir yöntem olarak öne çıkmaktadır. Ayrıca tekstil endüstrisi de kullandığı yüksek miktarlarda su ve farklı karakteristiklerdeki kimyasallar ile, çevre kirliliğine en çok neden olan sektörlerin başında gelmektedir.

Bu tez çalışmasında bir örgü kumaş boyama tesisinin çevresel etkileri kapıdan kapıya yaklaşım ile Yaşam Döngüsü Analizi (YDA) yöntemiyle hesaplanmıştır. Hesaplama ve analizleri yaparken SimaPro yazılım programının 8.2.3.0 sürümü kullanılmıştır. Tesisten kaynaklanan kirlilik YDA ile değerlendirilmiştir. YDA ile 18 farklı etki kategorisi ile ilgili hesaplamalar yapılmış olup tesisin Küresel ısınma etki kategorisi olarak 701,3 kg CO<sub>2</sub> eşdeğeri katkı sağladığı, tatlı su ötrofikasyonu açısından 2,9 kg Fosfor eşdeğeri kirliliğe sebep olduğu ortaya konmuştur.

**Anahtar Kelimeler:** Çevresel etki, Sürdürülebilirlik, Yaşam Döngüsü Analizi, Tekstil Endüstrisi

**ABSTRACT**

Nowadays, consumption is increasing day by day and natural resources are rapidly decreasing. Environmental pollution has become a big problem with the increase in industrialization. Textile industry stands out as an industry that the most intensive use of resources and high environmental pollutant load. There are many different methods to calculate and evaluate environmental pollution and to prevent it. Life Cycle Assessment Analysis stands out as a method that allows a product to be examined in terms of various impact categories by considering the entire process from raw material acquisition to post-use waste management processes. In addition, the textile industry is one of the sectors that causes the most environmental pollution, with the high amounts of water it uses and chemicals of different characteristics.



In this thesis, the environmental impacts of a knitted fabric dyeing plant were calculated using the door-to-door approach and the Life Cycle Assessment Analysis (LCA) method. The 8.2.3.0 version of the SimaPro software program was used while performing the calculations and analyzes. The pollution originating from the facility has been evaluated by LCA. Calculations were made on 18 different impact categories by LCA. It was determined that the facility contributed 701.3 kg CO<sub>2</sub> equivalent as the Global warming effect category, and 2.9 kg Phosphorus equivalent pollution in terms of fresh water eutrophication has been revealed.

**Keywords:** Environmental impact, Sustainability, Life Cycle Assessment, Textile Industry

## GİRİŞ:

Tekstil endüstrisi en büyük sanayi kollarından biri olarak öne çıkmaktadır. Hazır giyimden halıya kadar kullanılan birçok ürün tekstil endüstrisini tarafından üretilmektedir. Aynı zamanda tekstil endüstrisi gerek üretim sürecinde gereken hammadde ihtiyacı ve ortaya çıkan hava ve su emisyonları gerek kullanım sonucu ortaya çıkan atıklar bakımından çevreyi ciddi oranda kirletmektedir. Tekstil endüstrisi ülkemizdeki sanayi üretiminin çok büyük bir paya sahip olup ülke ihracatına payı yadsınamaz düzeydedir. 2022 yılı verilerine göre ülkemizin 254 milyar dolar olan ihracatının yaklaşık %13'ü tekstil endüstrisi tarafından gerçekleştirilmektedir (TİM, 2023). Dünyada yeşil ve sürdürülebilir üretim kavramı her geçen gün önemini artırırken ülkemizde bu konuda üretim alanında daha çevreci yaklaşımlara geçmek durumundadır. Ayrıca, tekstil ve hazır giyim sektörü istihdam ve üretim açısından dünyadaki en büyük ve en önemli endüstrilerden biri olarak ön plana çıkmaktadır. Tekstil sektörü ülkemizde 29 milyar dolar ihracatı ve 1 milyon kayıtlı istihdam ile en büyük üretim ve istihdam kollarından biridir (BSTB, 2014). Diğer sektörler için önemli olan sürdürülebilirlik tekstil sektörü için de önem arz etmektedir. Zorunlu ihtiyaç olan giysi, aksesuar ve ev tekstili ürünlerini üreten bu sektörde hammadde ve yardımcı malzemelerin doğal kaynaklı olması, lif üretiminde en az miktarda pestisit ve zararlı kimyasal kullanılan liflerin tercih edilmesi, kimyasal madde kullanımının azaltılması, geri dönüştürülen malzemelerin mümkün olduğunca üretime dahil edilmesi, uzun ömürlü ürünler, ürünün üretim ve tüketim aşamalarında geri dönüşüm sağlanabilmesi, mümkün olan en az atığın ortaya çıktığı bir sürecin oluşturulması ekolojik ve ekonomik açıdan oldukça değerli ve önemlidir.

Sürdürülebilirlik, ekosistemdeki çeşitliliğin ve yenilenemez kaynakların gelecek nesillere aktarılabilmesi için, bugünkü neslin yenilenemez kaynak kullanımını sınırlandırması ve ekosistem üzerindeki olumsuz etkilerinin sistemin kapasitesinin üzerine çıkmayacak düzeyde tutulmasıdır (Ercoşkun, 2007). Sürdürülebilirlik, insan geçim ve refahını etkileyen, hem küresel hem de yerel olarak ekolojik, ekonomik ve sosyopolitik boyutları kesişen, karmaşık çevresel dinamikleri içerir (Joy vd., 2012). Dünya'da ve ülkemizde büyük bir yeri olan tekstil sektörünün üretim ve kullanımı sırasında çevreye büyük zararları olmaktadır. Bu büyük zararın önüne geçmek için sürdürülebilir malzemelerin ve üretim yöntemlerinin kullanılması gerekmektedir. Bunun için geleneksel üretim yöntemleri yerine geri dönüştürülmüş liflerin ve organik tarım yöntemleri ile üretilmiş liflerin kullanımı tercih edilmelidir. (Eser vd., 2016). Tekstil terbiyesi kapsamında ise; ön terbiye, boya/ baskı ve bitim işlemlerinde plazma, ultrason, enzim, ozon, ultraviyole, mikrodalga, nanoteknoloji, süper kritik karbondioksit (scCO<sub>2</sub>), dijital baskı kullanımı gibi enerji, su ve zaman tasarrufu sağlayan çok sayıda çalışma yapılmaktadır. Bu çalışmaların artırılması ve tekstilin çevresel zararlarının anlaşılabilir olarak önüne geçilmesi gerekmektedir. Bu çalışmaların önemi ise buradan kaynaklanmaktadır. Bu anlamda kullanılan bir araç ise Yaşam Döngüsü Analizidir.

Yaşam Döngüsü Analizi (YDA) kısaca endüstriyel sistemlerin beşikten mezara yaklaşımı ile değerlendirilmesidir. Hammaddenin doğadan elde edilmesinden üretim aşamasına oradan kullanım ve doğaya tekrar geri dönüşüne kadarki süreci kapsar. Daha detaylı bir tanım ile Yaşam Döngüsü Analizi, bir ürün ya da hizmet üretiminde kullanılan ham maddelerin elde edilmesinden başlayarak, ilgili tüm üretim, sevkiyat, tüketici tarafından kullanım ve kullanım sonrası atık olarak bertarafı da kapsayan yaşam döngüsünün farklı aşamalarındaki çevresel etkilerini belirlemek, raporlamak ve yönetmek için kullanılan bir yöntemdir (Demirer, 2011). Yaşam Döngüsü Analizi çalışması yapılırken prosese dahil olan her türlü girdi ve çıktının tanımlanması ve belirlenmesi gerekmektedir. Bir ürünün hammadde

temininden başlayarak, üretim, kullanım ve geri dönüşüm/atık yönetimi de sistemini sınırlarına dahil edilerek çevresel etkileri bütünlük olarak değerlendirilip raporlandırılabilir.

“EPA Life-Cycle Assessment: Inventory Guidelines and Principles” dokümanına göre yaşam döngüsü envanteri için aşağıdaki 4 adım önemli olarak tanımlanmıştır (USEPA, 2006):

1. Değerlendirilen süreçlerin bir akış diyagramının geliştirilmesi
2. Veri toplama planının geliştirilmesi.
3. Veri toplanması
4. Sonuçların değerlendirilmesi ve raporlanması.

Linhares ve Amorin (2017) gerçekleştirdikleri çalışmada pamuklu kumaşın doğrudan doğal boyanmasında Akdeniz bölgesinde istilacı tür olan ve azaltılmaya çalışılan Acacia Dealbata ağacı kabuğunun özütünün kullanılmasının YDA yapılmıştır. Çalışmada GABi yazılım programı kullanılmış ve kapıdan kapıya yaklaşım ile boyama prosesi ele alınmıştır. Fonksiyonel birim olarak 1 kg pamuklu kumaş belirlenmiştir. Boyama performansını karşılaştırmak için 3 farklı boyama çalışması karşılaştırılmıştır. Doğal pamuk boyaması 5 g/L NaCl elektrolit eklenerek ve eklenmeden gerçekleştirilmiştir. Bu 2 farklı boyamanın performansı RGB (Kırmızı, Yeşil, Mavi Renk Skalası) renk skalasına göre literatürdeki sentetik reaktif boyama verileri ile karşılaştırılmıştır. NaCl elektroliti eklenen proseste biraz daha koyu renk elde edilmesi ile beraber sentetik reaktif pamuk boyama ile yakın skala puanı değerleri elde edilmiştir. Ayrıca çalışmanın devamında NaCl Elektroliti eklenen boyama banyosunda kalıntı boya ile 2. boyama yapılmış rekte çok az dalgalanmalar olsa bile ilk boyamaya çok yakın renk değerleri elde edilmiştir. Ayrıca gerçekleştirilen doğal boyama ile elde edilen ürünler tekstil ürünleri için ISO 6330:2012 e göre yapılan evsel yıkama ve kurulum ve ISO 105-X12: 2003'e göre yapılan sürtünmeye karşı renk dayanım testlerinden yüksek başarı elde etmiştir. Yapılan doğal boyama çalışmasının YDA etki kategorilerinden biri olan iklim değişikliği açısından bakıldığında 1 kg pamuk doğal boya ile boyandığında 0,7 kg CO<sub>2</sub> eşdeğeri üretirken benzer boyama sürecinin sentetik reaktif boya ile yapıldığında 12,4 kg ortaya çıkardığı literatürde bilinmektedir. Azaltılmaya çalışılan bir istilacı tür olan Acacia Dealbata ağacı tarım endüstrisi atıklarının tekstikle sürdürülebilir bir doğal boyama sürecinde kullanılabilmesi bu çalışma ile ortaya konmuştur.

Tekstil endüstrisi dünyada ve özellikle Türkiye’de önemli bir üretim kolu olarak faaliyet göstermektedir. Tekstil endüstrisi proseslerinde su, enerji ve çeşitli kimyasalların fazlaca kullanıldığı kaynak tüketimi öne çıkmaktadır. Tekstil sektöründe sürdürülebilir üretimlerin desteklenmesi ve kaynak kullanımının azaltılması için birçok çalışma yürütülmektedir. Tekstil sektöründe çevreye etkisi en yüksek proseslerden biri iplik ve kumaş boyama olarak öne çıkmaktadır. Gerek ısı, elektrik ve yüksek miktarda su kullanımı gerekse yüksek miktarda atıksu oluşumu nedeniyle çevreye kirlenici etkisi yüksek bir proses olduğu gerçektir. Bu çalışmada örgü kumaş boyama ve kasa yapma yapan bir tesisin üretim sürecinin kapıdan kapıya yaklaşım ile yaşam döngüsü analizi değerlendirilmesi yapılmıştır. Bu bağlamda çalışmanın amacı, kumaş boyama sektöründe faaliyet gösteren bir tekstil işletmesindeki kimyasal, enerji, su vb. gibi kaynak kullanımları neticesinde ortaya çıkan çevresel etkilerin tespit edilmesidir. Ayrıca bu çalışmada farklı senaryolar oluşturularak, tüketimlerin azaltılması durumunda çevresel etkilerin değişimi de incelenmiştir.

### **MATERYAL VE METOT**

Tez çalışması kapsamında örgü kumaş boya tesisi prosesinin kapıdan kapıya yaklaşım ile Yaşam Döngüsü Analizi çalışması gerçekleştirilmiştir. Tez çalışması Gaziantep ili 2.Organize Sanayi Bölgesi’nde yerleşik bulunan bir tesisten alınan veriler ile gerçekleştirilmiştir. Tesisin toplam boyama kapasitesi 1262 ton pamuklu örgü kumaş boyama, 326.4 ton pamuk-polyester örgü kumaş boyama ve 153 ton polyester örgü kumaş boyama olmak üzere 1741,4 ton/yıldır.

Tesiste sağlıklı olarak verilen tutulduğu 2023 yılının Ocak, Şubat ve Mart aylarına ait aşağıdaki veriler tesis yetkililerinin alınmıştır:

- Su Tüketim Miktarı
- Boyar Madde Tüketim Miktarı

- Yardımcı Kimyasal Tüketim Miktarı (Tuzlar, Asitler, Bazlar, Yağ Sökücüler vb.)
- Elektrik Tüketimi
- Doğalgaz Tüketimi
- Buhar Kullanım Miktarları
- Oluşan Atıksu Miktarı
- Atıksu Analiz Sonuçları

Tesisten alınan tüm veriler yukarıda detaylı şekilde açıklanan YDA yazılım programlarından olan SimaPro yazılımının 8.2.3.0 versiyonuna işlenmiştir. Böylece tesisin mevcut işletme şartlarında çevreye kirlenici etkileri YDA ile ortaya konmuştur.

### BULGULAR VE TARTIŞMA

Tez kapsamında tesisten alınan veriler ile gerçekleştirilen Yaşam Döngüsü Analizi çalışması sonuçları Tablo 1'deki gibidir. 18 farklı etki kategorisi bakımında tesisin çevreye etkisi irdelenmiştir. Tabloda görülebildiği için Yaşam Döngüsü Etki kategorilerinin herbirinin sonuçları farklı bir birime göre verilmiştir. Bu yüzden tüm etki kategorilerinin sonuçlarının birbiriyle toplamak mümkün olmayıp herbiri ayrı ayrı değerlendirilir. Tesisin Küresel Isınma Potansiyeli bakımından çevresel etkisi 701,313 kg CO<sub>2</sub> eq (eş değeri)'dir.

**Tablo 1.** Etki kategorilerine göre YDA sonuçları

Etki Kategorisi	Birim	Sonuçlar
Küresel Isınma	kg CO <sub>2</sub> eq	701,313
Stratosferik Ozon İncelmesi	kg CFC11 eq	0,000
İyonlaştırıcı Radyasyon	kBq Co-60 eq	1,006
Ozon Oluşumu İnsan Sağlığı	kg NO <sub>x</sub> eq	0,104
İnce Parçacıklı Madde Oluşumu	kg PM <sub>2.5</sub> eq	0,047
Ozon Oluşumu Karasal Ekosistem	kg NO <sub>x</sub> eq	0,105
Karasal Asitlenme	kg SO <sub>2</sub> eq	0,100
Tatlısı Ötrofikasyonu	kg P eq	2,949
Deniz Ötrofikasyonu	kg N eq	0,929
Karasal Ekotoksitesite	kg 1,4-DCB	46,265
Tatlı Su Ekotoksitesitesi	kg 1,4-DCB	273,977
Deniz Ekotoksitesitesi	kg 1,4-DCB	360,355
İnsan Kanserojen Toksikitesitesi	kg 1,4-DCB	10,812
İnsanlar İçin Kanserojen Olmayan Toksikitesitesi	kg 1,4-DCB	6064,003
Arazi Kullanımı	m <sup>2</sup> a crop eq	1,327
Maden Kaynağı Kıtlığı	kg Cu eq	0,041
Fosil Kaynak Kıtlığı	kg oil eq	6,870
Su Tüketimi	m <sup>3</sup>	0,295

### SONUÇ

Yaşam Döngüsü Analizi çalışması sonucunda ortaya çıkan sonuçların gösterdiği en önemli noktalardan bir tanesi bir üretim zincirinde yada proste yapılan bir değişikliğin çevre açısından pozitif etkileri olduğu gibi bazı olumsuz etkilerinin de olabileceği bilinmelidir. Örneğin bir tesis yada ürünün karbon ayak izini azaltmak istediğinde sebep olduğu doğrudan yada dolaylı karbon emisyonlarını azaltması yeterlidir ancak çevreye olan farklı alanlardaki olumsuz etkilerini azaltmak için tek taraflı yapılan iyileştirmeler

yeterli değildir. 1 kg ürün başına 0.295 m<sup>3</sup> su kullanan tesiste proste yapılacak aşağıdaki iyileştirmeler ile tesisin su kullanım etki kategorisinde çevreye olan olumsuz etkileri azaltılabilir:

- Mevcut boyama kazanlarını Flotte oranı düşük boyama kazanları ile değiştirmek,
- Tesiste oluşan atıksuların uygun arıtma sistemleri kullanılarak proste tekrar kullanılabilir şartları sağlayacak seviyede arıtılarak tekrar kullanılması.

Tesisin toplam boyama kapasitesinin %72,4 lük bölümü pamuklu örgü kumaş boyama olup tesis hammadde olarak geleneksel tarım ile elde edilen pamuk kullanmak yerine organik pamukla üretilmiş kumaş kullandığında Esteve-Turrillas ve Guardia (2017)'nin çalışmalarında ortaya koyduğu gibi küresel ısınma potansiyeli, asidifikasyon potansiyeli, Ötrofikasyon potansiyeli ve su kullanımı etki kategorileri açısından büyük oranda çevresel kirlilik etki kategorileri açısından kazanım elde edilebilir. Ayrıca organik pamuk sertifikalı ürünle üretim yapmak bir pazarlama stratejisi olarak sürdürülebilirlik ve çevresel etkilerin günden güne önem kazandığı ve dikkat edildiği sektörde büyük bir avantaj getirecektir. Çünkü ürünlerini organik pamuk hammaddeli etiketi ile pazarlamaya çalışan ve sürdürülebilir moda anlamında önemli çalışmalar yapan Zara ve H&M gibi büyük hazır giyim markaları daha maliyetli olsa dahi organik pamuk ile üretim yapılan malzemeleri tercih etmektedir. Tesislerin uluslararası alanında rekabet gücünü artırabilmesi ve yeşil dönüşümün başladığı günümüzde sebep olduğu çevresel kirlilikleri iyi analiz edip azaltabilmesi için YDA büyük önem arz etmektedir.

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**PRODUCTION OF FUNCTIONAL YOGURT ENRICHED WITH VEGETABLE AND  
FRUIT WASTE**

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**ABSTRACT**

Food waste is increasing, and there is growing interest in developing dairy products fortified with natural fruits and vegetables for human consumption. As a result, this study looked at the manufacture of beneficial yogurt enhanced with vegetable and fruit waste. Food waste impacts food and nutrition security, safety, natural resource conservation, and environmental preservation. It entails the economic and long-term development of food systems. Food loss, waste, and by-product management have previously piqued the interest of the food business and scientists for these reasons. For example, plant residues and vegetable by-products can be upgraded with value addition to produce improved goods such as dietary fibres, food tastes, food polyphenols, supplements, protein concentrates, pectin, phytochemicals, and plant enzymes. Yogurt, is a useful dairy product, ferments milk with lactic acid bacteria. Because of its properties, it is historically regarded as a healthy meal. It is widely consumed around the world, and it has been enhanced by combining natural components such as fruit extracts, olive leaf extracts, tea and cumin seeds, and so on. According to current research, the use of different vegetables and fruits in the manufacture of yogurt significantly impacts its quality. As a result, the addition of natural foods boosts the nutritional value of yogurt. On the other side, the presence of carotenoids in a fermented maize product comparable to yogurt was linked to a decreased cholesterol impact. The primary commercial source of betalains is beet (*Beta vulgaris* sp.). It also includes polyphenols, which are both potent antioxidants. The functional qualities that these chemicals contribute to health have recently been explored, with antioxidant, anti-diabetic, anti-inflammatory, and anticancer activities standing out. Overall, the findings of this study suggest that combining fruit and vegetable waste may be used to create a functional yogurt high in phenolic components, antioxidant activity, vitamins, and minerals.

**Keywords:** Yogurt, waste, vegetables, fruits



## **INTRODUCTION**

Yogurt is a dairy product that is made by fermenting milk. Milk fermentation is often achieved using bacterial cultures, the most popular of which are *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgaricus*. It is classified into three types: fixed, mixed, and drinkable (Hashemi et al., 2015), and Figure 1 depicts the main plan of yogurt manufacturing. Yogurt is a nutrient-dense dairy product that aids in human health. Yogurt, a fermented dairy product, is rich in essential nutrients such as potassium, calcium, riboflavin, and magnesium due to its production processes. The amounts are larger than for other dairy products, including milk, from which yogurt is derived (Tremblay & Panahi, 2017). Even though vegetables and fruits are high in nutrients, researchers have attempted to incorporate them into yogurt. Similarly, yogurt is fortified with several nutrients to help alleviate human nutritional inadequacies.

Antioxidants are essential in the prevention and treatment of such chronic diseases. Functional foods are rich in phytochemicals, which operate as bioactive medicines and have a favourable effect on organs (Syta et al., 2018). Phytochemicals are plant-produced compounds that are commonly found in fruits, vegetables, and other plants. Antioxidants protect organs and cells by lowering reactive oxygen and nitrogen species (Shashirekha and Zhang, 2015). Vegetables and fruits are the most typical sources of antioxidant foods and the preferred products for food fortification.

Yogurt, a popular food product enriched with fruits and vegetables, has gained global popularity due to its functional qualities and health benefits. The addition of fruits and vegetables to yogurt has enhanced its nutritional content, sensory properties, and marketability (Arslan and Vatansever, 2012). Considering the increasing consumption of yoghurt in the world, efforts are being made to meet the need for yoghurt and to ensure diversity while maintaining food standards. This research looks at how enriching yogurt with fruit and vegetable waste improves the nutritional and functional characteristics of yogurt.

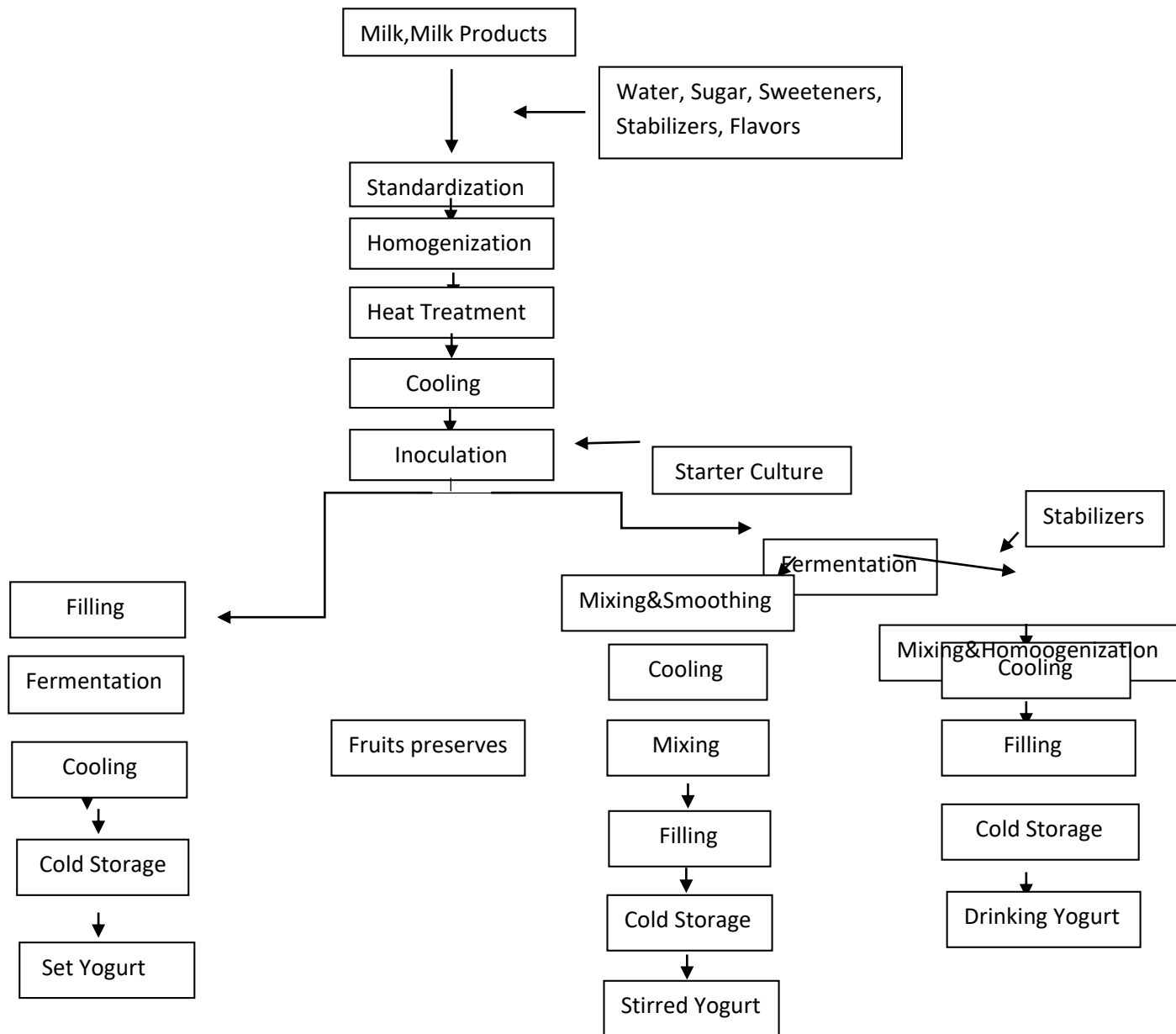
## **FOOD WASTE**

Food waste significantly impacts food security, quality, safety, natural resource conservation, and environmental protection. It has an impact on the long-term viability and economic development of food systems. Food loss and waste have piqued the interest of food scientists and businesses for these reasons. Primary agriculture is the beginning of the food supply chain, which continues through manufacturing and retail to home consumption. For technological, economic, and sociological reasons, food is lost or squandered during this cycle. According to the FAO (2022) global voluntary definition framework, "food loss" is defined as a decrease in the amount or quality of food caused primarily by the operation of the food production and supply system or its institutional and regulatory framework.

The 2023 report by the FAO reveals that between 691 and 783 million people experienced hunger in 2022, with a midpoint of 735 million. Despite hunger and food security, 13% of the world's food is lost in the supply chain before retail, and 17% is wasted in households, food services, and retail.

Food processing companies produce a significant amount of trash (liquid and solid), largely organic remnants of processed raw materials. The majority of these resources, referred to as "waste" under European law, might be used to create value-added products. Food waste recovery is the process of recapturing valuable components from food waste and generating new goods with commercial value. Utilising food waste can significantly decrease waste and offer new benefits to all parties involved in the food production system.





**Figure 1.** The industrial preparation method for yogurt (Nagaoka, 2019).

As a result, decreasing food waste by recovering useful components is a critical step towards boosting the sustainability of food production systems. Wastes from diverse food industry branches can be classified into two major classes and seven subcategories.

The food sector generates waste in two main classes and seven subcategories: cereals, roots, oil crops, fruits, vegetables, meat, fish, seafood, and dairy products, which are categorised into two groups (Carlos Álvarez et al., 2021).

### WASTE OF FRUIT AND VEGETABLES

Many fruits and vegetables are discarded in landfills or rivers, posing environmental risks due to their high biodegradability, leachate, and methane emissions. However, these resources offer a high potential for the recovery of value-added goods. Fruit and vegetable processing technologies generate solid and liquid waste streams, including pomace, pulp, peels, cores, seeds, and stems, depending on the production process. Because these wastes contain a high concentration of biologically active substances, they can be used to recover high-value products

such as polyphenols, glucosinolates, dietary fibres, essential oils, pigments, enzymes, and organic acids.

### **ENRICHED FOODS WITH VEGETABLE AND FRUITS WASTE**

Fruits have been linked to a plethora of substances that are helpful to human health. Prestes et al. (2022) highlight fruits as a rich source of dietary fibre, antioxidants, phenolic compounds, and carotenoids, with sugars being abundant. Furthermore, fruits are abundant in fibre, which has digestive advantages and is linked to a lower risk of cancer, gastrointestinal disease, and cardiovascular disease. It also contains oligosaccharides, which aid in the colonisation of lactobacilli and bifidobacteria (Fernandez et al., 2017).

It helps people eliminate nutritional deficiencies and meets the critical nutrients needed by the human body. However, the concentration and availability of nutrients may vary depending on the type of fruit that enriches the yogurt. Researchers have explored yogurt enriched with fruit pulps or extracts like grapes, berries, papaya, apple pomace, seabuckthorn, orange, pineapple, grape, banana, rutub date, and pomegranate. Table 1 depicts the fruits utilized to make enriched yogurt within the scope of the study.

Apple is a popular fruit globally, with high consumption per person and 65% of processed products being apple juice. (Lyu, F., Luiz, S. F., Azeredo et al., 2020). The pulp is the portion of the apple that remains after the juice has been extracted. Because of its nutritional characteristics and the fact that it is largely wasted, apple pulp has been employed in the majority of studies on apples for yogurt manufacturing. As a result, experiments have concentrated on using pomace and its products to utilise the waste part while gaining nutritional benefits (Lyu et al., 2020). Because of its texturizing and stabilizing characteristics, apple pulp is widely employed in the dairy sector.

The stability and hardness of apple pulp (Wang et al., 2019) or products such as powder obtained from it (Ahmed et al., 2022; Jovanovi'c et al., 2020; Karaca et al., 2019) were increased for the preparation of functional yogurt. Karaca et al. prepared functional yogurt with apple powder (1%) and investigated its parameters. The study found that adding a powder to yogurt significantly enhanced its mineral content and altered its characteristics. There was no substantial change in the sensory qualities of yogurt, and it also had a favourable effect on p. bacteria, making it more agreeable and useful (Karaca, O. B., Saydam, I. B., & Güven, M. (2019).

Adding apple powder significantly enhanced the hardness and consistency of yogurt during its storage period. The quality of yogurt was influenced by its fat content. Wang et al. (2019) also provided data demonstrating that apple pulp powder increases the stickiness and hardness of yogurt. The casein gel structure was enhanced by 1% apple pulp powder, but this effect was only noticeable at 0.5% concentration.

**Table 1.** The fruits utilized in the preparation of enriched yogurt (Routray, W., & Mishra, H. N. 2011).

<b>Simple</b>	
Black cherry	Kiwi
Black currant	Lime
Mandarin	Papaya
Apricot	Passion fruit
Peach	Pear
Pineapple	Quince
Strawberry	Prune
Banana	Blackberry
Bilberry	Grape
Lemon	Damson
Orange	Guava
Mango	Elderberry
<b>Mixed</b>	
Fruit cocktail	
Raspberry*redcurrant	
Strawberry*kiwi	
Strawberry*blackberry	
Strawberry*coconut	
Fruit of the forest	
Apple*raisin	
Apple*orange	
Apple*wortleberry	
Grape*figs	
Cherry*orange	

Few researchers made yogurt from apple pulp, but the vast majority used apple pomace. Apple pulp was employed by Saleh, Abdelwahed, & El-ella (2018) to make enriched yogurt. Apple pulp significantly increased yogurt's acidity and decreased its pH over a 15-day storage period at concentrations of 5%, 10%, and 15%. The yogurt's moisture content decreased over storage, but its protein, fat, and total solids levels raised significantly. Rheological investigation revealed an increase in viscosity and syneresis in yogurt due to difficulties.

Chaitali Chakraborty and colleagues (2019) found that adding apple pulp to yogurt reduced syneresis and significantly increased its water-holding capacity. Apple pulp yogurt with added probiotics significantly increased the bacterial count, indicating its potential to support bifid and lacto probiotics (Saleh et al., 2018). Chakraborty and colleagues (2019) found that the sensory properties of functional yoghurt prepared with apple pulp were higher than the control, and the best concentrations were 10% apple pulp and 20% apple pulp, respectively. Investigations have found that combining fruit pulp and wheat causes greater syneresis.

While flour or powders consistently provide greater stability to yoghurt, variable results have also been found in terms of their physicochemical qualities. To produce an optimum, balanced yogurt with better advantages, careful and planned inputs are required. Fruits were used more for enrichment than vegetables. However, only a few vegetables or their products have been tested and improved for industrial preparation of plant-based goods.

Yogurts are fortified with veggies, extracts, and flours. As a result, research have looked into a number of vegetable tables that can be used in yogurts, such as carrots, cassava, spinach, sweet potatoes, and maize juice (Janu'ario, J.G.B.,da Silva, Oliveriaet al., 2017)—pumpkin with black carrots (Sa et al., 2013), among others. Vegetable powders in functional yogurt manufacturing improve nutrition and modify the resulting yogurt's properties. Herbal flavours significantly alter the physicochemical properties, while potatoes, despite their health benefits, are a waste-producing vegetable.

Potatoes, which have a variety of physicochemical features and are employed in a variety of products, are used to make a variety of products. Potatoes' greater starch content makes them appropriate for amylose content and bonding properties. For these reasons, potato powder can be combined with other items to improve the resulting product's qualities (Ahmad et al., 2022). The study utilised enzymatically hydrolyzed potato powder for yogurt synthesis, revealing that 25% of the powder improved microbiological, rheological, and sensory properties. Few studies have been conducted on the use of potatoes as a yogurt supplement. Vegetables also increased the nutritional value of yogurt; however, higher concentrations of vegetable products were found to be unsuitable for producing yogurt due to considerable changes in sensory qualities. As a result, alternative product combinations, such as flour or powder, must be researched in order to acquire additional benefits and stabilize the yogurt.

## **CONCLUSION**

Finally, it can be stated that a small number of vegetables and fruits were given more priority in the functional yogurt production. The increase in food product diversity led to the creation of market-specific products and improved waste recycling. Fortification can also be viewed as a beneficial technique for delivering food products that contain some nutrients and functional elements that can provide customers improve their health and conquer disease conditions, hence assuring food waste sustainability. Increasing the concentration of fruits and vegetables, flour, and extracts has been shown to increase the nutritional profile of yogurt. To produce biofortified, improved yogurt a mix of diverse items such as honey, potato powder, grain flour, plant-based essential oils or extracts, and fruits or vegetables may be advised. Using fruit and vegetable waste to fortify yogurt can cut food waste dramatically while also creating new opportunities and advantages for everyone involved in the food production system. Overall, the bulk of studies demonstrate that combining fruit and vegetable waste to make functional yogurt is high in phenolic compounds, antioxidant activity, and minerals.

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## UTILISATION OF SEAFOOD WASTE PRODUCTS IN FUNCTIONAL FOODS

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### ABSTRACT

According to the Food and Agriculture Organization, worldwide production of fisheries and aquaculture in 2020 was 177.8 million tonnes, with capture fisheries contributing 90.3 million tonnes and aquaculture 87.5 million tonnes. The rise in global fishing production has resulted in approximately 20 million tonnes of fisheries by-products, which, if not used efficiently, could pose an environmental pollution problem. Properly managing sea resources is vital to reduce environmental issues and guarantee the long-term sustainability of these resources. By-products represent over 60% of the seafood processing industry's output, including bycatch and other secondary products generated during production, such as commercial fish heads, gills, skin, trimmings, fins, frames, bones, viscera, blood, and roes. By-products from fish can be used to create various products for food and nutrition, including fish oils, fish enzymes, gelatin, collagen, carotenoids, chitin, chitosan, glucosamine, fish protein hydrolysates, and concentrates. Fish oil, known for its many health benefits, can add functional value to food products. Fish enzymes can be used as a natural and consumable alternative to chemical substances in the process of protein hydrolysis or denaturation. Chitin, chitosan, and their oligosaccharides are employed in the food industry as functional compounds, antioxidants, and antibacterial and antifungal agents. Gelatine can gel foods, act as a coating for consumable items, emulsify substances, and produce small capsules. Fish protein hydrolysate and concentrate are beneficial as protein supplements or food additives because of their advantageous properties. Hence, this review comprehensively analyses contemporary utilization of chemicals derived from seafood by-products within food systems.

**Keywords:** Seafood wastes, Bioactive compounds, Functional Foods

### INTRODUCTION

Over the past ten years, more than 178 million tonnes of sea fish and aquaculture products have been caught each year around the world. Around 87% of the world's fish production is used to feed people directly. The rest makes non-food goods, mostly fishmeal and fish oil ((FAO, 2022). On the other hand, global fish farming and advances towards more fish processing are making more by-products. This is why the use of by-products is growing into a significant industry. In the past, by-products were considered worthless and either thrown away or fed to farm animals. But now more attention is paid to how they are handled safely, controlled, and cleanly (Šimat et al., 2020).

The solid components generated during the post-processing of fishing products encompass various parts such as the head, tails, skin, gut, fins, and frames. Typically, a significant portion of meat, ranging from 30% to 50%, is left unused while filleting a whole fish. The remaining components, including around 4% to 5% of skin, 21% to 25% of the head, and 24% to 34% of

the bones, collectively constitute over 45% of the entire fish body. However, these components are primarily unutilized (Ghaly et al., 2013). Many fish by-products and waste from farming and processing behaviours are disposed of in landfills or released into the sea. This disposal method gives rise to detrimental environmental consequences, such as producing hazardous hydrogen sulphide and creating toxic conditions due to the presence of odorous substances and bacteria (Šimat et al., 2020).

One thing that could be done to help is to turn fish waste into valuable products that can be used for many things, like food for animals, beauty products, medicine, and human nutrition, or to get back valuable substances like protein, liver oil, gelatine, and omega-3 fatty acids. Marine organisms are known for having extensive functional materials, including polyunsaturated fatty acids (PUFA), collagen, gelatine, polysaccharides, minerals, vitamins, antioxidants, enzymes, and bioactive peptides. These materials exhibit significant potential in nutraceuticals, pharmaceuticals, and cosmeceuticals (Barrow and Shahidi, 2007). This study aims to present a short overview of recent approaches employed in valorizing bioactive compounds obtained from discards and by-products from seafood processes to produce functional foods.

### **Fish oil/ Polyunsaturated fatty acids**

The utilization of fish oil derived from fish waste holds considerable significance owing to its potential for sustainable resource utilization. The disposal of fish processing waste, including heads, frames, and viscera, is frequently carried out without proper consideration, resulting in cause to significant environmental concerns. Nevertheless, it is worth noting that these discarded substances possess the potential to serve as an abundant source of fish oil, characterized by elevated concentrations of omega-3 fatty acids, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Turchini et al., 2009). Omega-3 fatty acids, known as n – 3 FAs, constitute around 26–28% of the total fatty acids. The primary omega-3 fatty acids present are DHA with a concentration of 10.5–11.5%, and EPA, at a concentration of 6.5–7.2% (Aitta et al., 2023). EPA and DHA positively affect lipoproteins, blood pressure, cardiac performance, colon cancer development, mental health, endothelial function, vascular reactivity, and cardiac electrophysiology.

EPA and DHA are also antiplatelet and anti-inflammatory. Experimental evidence shows EPA and DHA reduce TAG levels. Omega-3 fatty acids lower plasma triglycerides by 30% when consumed daily at 3-4 g (Atef and Ojagh, 2017). Two fatty acids could promote fetal development, prevent cardiovascular and Alzheimer's disease, and boost newborn immunity. The study conducted in this field is expected to demonstrate significant advantages in neurological development and mental well-being, particularly in enhancing cognitive function (Šimat et al., 2020). Omega-3 oils have been included in various food items, including dairy and non-dairy options. These include bakery products, biscuits, crackers, pasta, eggs, and dairy products like milk and yogurt. Additionally, juices and nutrition bars have been fortified with omega-3 oils (Atef and Ojagh, 2017).

### **Concentrated Fish Proteins**

Fish protein is considered a very nutritious source of critical nutrients, including high-quality protein, essential fatty acids, vitamins, and minerals crucial for optimal health (Rajkowska-Myśliwiec et al., 2022). The residual materials generated during the processing of fish and other seafood, including head, skin, bones, scales, fins, gills, dark muscle, viscera, and similar components, possess a significant quantity of proteins that hold significant nutritional value (Ozogul et al., 2021). The amino acid composition of fish protein is considered to be appropriately balanced, comprising a range of 16-18 amino acids. However, it is essential to note that this composition may exhibit variability based on factors such as specific fish species

and seasonal fluctuations (Ghaly et al., 2013). The most prevalent techniques employed for extracting hydrolysates from fish waste include fermentation, synthesis, and enzymatic hydrolysis (Sarmadi and Ismail, 2010).

Fish protein is used in functional foods due to its biochemical and functional properties. Fish protein hydrolysates (FPHs), made by enzymatically breaking down fish muscle proteins, are of interest for many food systems (Kristinsson and Rasco, 2000). These foods can be healthier by adding dried fish protein, which contains important vitamins and minerals and necessary amino acids like lysine, valine, and phenylalanine (Shaviklo, 2015). Eating fish is a key way to avoid malnutrition and improve people's nutritional health, especially in developing countries (Maulu et al., 2021). These nutrients can be added to cereals, snacks, and ready-to-eat meals to increase protein and give them important amino acids, vitamins, and minerals (Shaviklo, 2015).

Different functions can be performed by proteins derived from fish waste, such as the ability to mix, gel, and bind water. Because of these qualities, they work great in many food scenarios as stabilisers in prepared foods, emulsifiers, and meat extenders, among other things. Even though it has many benefits, getting proteins from fish waste is hard. These include the need for effective separation and purification processes, worries about allergens, and the ability of consumers to accept goods made from waste. These problems should be investigated in future studies to make the process more efficient.

Furthermore, incorporating fish protein hydrolysates possessing antioxidant properties into food products presents a viable approach to prolonging their shelf life. An illustration of this can be seen in enhancing carp loach stability and shelf life by applying Tilapia protein hydrolysates, which effectively suppress lipid oxidation (Gao et al., 2021). Moreover, the essential amino acid content of seaweed proteins surpasses that of grains and vegetables, indicating the prospective utilization of seaweed as a viable source of nutrition for human consumption in future times (Boziaris, 2014).

### **Bioactive Peptides**

Fish waste can be utilized to create protein hydrolysates with bioactive peptides of relatively small size, typically consisting of 2 to 20 amino acids (Sarmadi and Ismail, 2010). Certain countries, particularly Japan, have already successfully commercialized bioactive peptides obtained from fish. Nevertheless, there exist several obstacles that must be surmounted prior to achieving broader adoption. The current techniques employed for synthesizing bioactive peptides are limited in scale, efficiency, and cost-effectiveness. Therefore, there is a demand for more extensive and economically feasible approaches to facilitate their large-scale production in commercial settings. Furthermore, identifying peptide composition in protein hydrolysates remains a formidable task, necessitating the development of improved methodologies for peptide identification. Furthermore, a limited comprehension of peptide structure-function relationships exists, necessitating further investigation in this domain. In addition, many bioactive peptides exhibit undesirable flavors that hinder oral administration. Consequently, it becomes imperative to develop appropriate strategies to mitigate or conceal these flavors (Gao et al., 2021).

### **Marine Collagen and Gelatin**

Collagen and gelatine are distinct forms of a same macromolecule, with gelatine representing a partially hydrolyzed and denatured form of collagen. Gelatine is a fibrous protein that is derived by the process of heat denaturation of collagen. Collagen is found in significant quantities (about 30% by weight) in discarded fishery products' skin, fins, and bones. The primary constraint on the industrial demand for collagen, which now stands at approximately

320,000 tonnes per year, is the significant expense associated with its production (Caruso et al., 2020).

Collagen, comprising around 30% of the overall protein composition, serves as the primary structural protein in fish's skin and bones. It finds application in numerous health-related disciplines as well as in the realm of food processing (Caruso et al., 2020). Fish by-products such as skin, scales, bones, skull, swimming bladder, and residual viscera can potentially serve as valuable sources of collagen. The extraction of fish collagen has long been reported to be most effectively derived from fish skin, among all fish by-products (Rajabimashhadi et al., 2023).

Fish collagen and gelatine are obtained from fish tissues and utilised in a wide range of industries, encompassing food, medicine, cosmetics, and biomaterials. Fish collagen is abundant in amino acids, specifically glycine, proline, and hydroxyproline, which play a crucial role in the biosynthesis of collagen within the human body. In contrast, gelatine can be described as a modified state of collagen. The production of this substance occurs by partial hydrolysis of collagen, which leads to the fragmentation of collagen fibres into smaller peptide molecules. Gelatine is frequently employed in the food business for its multifunctional properties, as a gelling agent, stabiliser, and thickening. The use of this substance is prevalent in the manufacturing processes of confectionery items, desserts, and dairy-based products. The utilization of fish-derived gelatine as a substitute for gelatine sourced from bovine or swine origins has been investigated, specifically focusing on its suitability for halal and kosher applications (Ramli and Zain, 2023).

Fish gelatine demonstrates exceptional film-forming characteristics, rendering it highly versatile for many uses within the realms of medical and food packaging (Hosseini and Gómez-Guillén, 2018). Collagen is essential for optimal physiological development. In the ageing human body, there is a decline in the synthesis of collagen. One effective method of increasing collagen levels is consuming food products containing collagen. Hence, seafood-derived collagens have found application in a diverse range of food and beverage items. The utilisation of collagen generated from seafood has been proposed as a potential ingredient for several purposes, including functional food, beverages, dietary supplements, and confectionery products. Collagen-enriched beverages derived from seafood have emerged as a prevailing trend in the international market (Bilek and Bayram, 2015; Regenstein and Zhou, 2007). (Pal and Suresh, 2016). Collagen has been utilised as a substitute for around 50% of hog fat in various processed food items such as sausages, sausage rolls, ham, hotdogs, and hamburgers. This substitution has resulted in notable improvements in the texture, namely hardness and chewiness, and enhanced stability during the cooking process.

Additionally, incorporating collagen has increased the ability to retain water inside these food products. Moreover, the use of fish collagen in beverages, such as natural fruit juice, might augment their nutritional and functional attributes owing to its elevated protein concentration, enhanced bioavailability, mild viscosity, and exceptional water solubility. Currently, there is continuing research into the utilization of fish waste, specifically minced fillets, in the production of food products (Rajabimashhadi et al., 2023).

### **Marine Polysaccharides**

Marine algae possess significant quantities of polysaccharides, particularly those that contribute to cell wall structure, as well as mucopolysaccharides and storage polysaccharides. The observed polysaccharide concentrations in the seaweed species under investigation exhibit a wide range, from 4% to 76% of the dry weight (Holdt and Kraan, 2011).



Polysaccharides has many different kinds of applications within the field of food technology. Hydrocolloids derived from seaweeds, namely alginate, carrageenans, and agar, are commonly employed in the food industry as gelling agents, stabilizers, and edible films. Additionally, certain compounds found in seaweeds and sea vegetables, such as fucans/fucoids, have been observed to possess a range of advantageous properties, including antioxidant, anticancer, anti-arteriosclerosis, anti-tumor, and other beneficial effects (Boziaris, 2014).

### **Natural Pigments**

Marine pigments possess significant potential for application as antioxidants and natural food colorants. Carotenoids, such as astaxanthin, fucoxanthin, and various seaweed chemicals, have demonstrated antioxidant properties and other benefits. Consequently, these substances have garnered interest from the food industry for potential use. Pigments sourced from marine bacteria, microalgae, and plants have also been identified as viable options for natural food colorants (Boziaris, 2014). Carotenoids have a significant role in determining the yellow, orange, and red pigmentation observed in aquatic organisms' skin, shell, or exoskeleton. Algal species also harbor these entities. The primary physiological role of carotenoids, particularly  $\beta$ -carotene, is their activity as precursors of vitamin A in mammals. Previous studies have demonstrated that marine carotenoids could impede the activity of lipase inside the gastrointestinal lumen, thereby suppressing triacylglycerol absorption (Matsumoto et al., 2010).

### **Chitin and Chitosan**

Chitin and chitosan are derived from the exoskeletons of sea crabs and shrimps, as these substances constitute a significant proportion of their structural composition. Chitosan, being a structural polysaccharide, exhibits a lower cost profile due to its derivation from chitin polymers through the removal of acetyl group derivatives. Both chitin and chitosan offer several health benefits, including wound healing, immune system stimulation, antiulcer properties, bactericidal effects, antioxidant properties, and applications in antiaging cosmetics. Additionally, chitin and chitosan has use in the field of nutraceutical applications and can be enhanced through the promotion of absorption of derivatives such as fibres, films, and chitosan-based nanomaterials. These compounds are readily accessible in the commercial market and are characterised by their non-toxicity and natural origin. Chitin, chitosan, and their derivatives, predominantly sourced from crustaceans, exhibit diverse applications encompassing gelling and emulsifying properties, natural antimicrobial preservation, and the development of edible antimicrobial films, among others (Boziaris, 2014). Chitosan has been widely utilised for nanoencapsulation of various nutrients and bioactive substances present in food, particularly in the context of fish. Its applications encompass facilitating nutrition delivery, absorption, and protection. It has wide use in many pharmaceutical, nutrition, and biomedical applications. The incorporation of chitin into nutritious food products serves as a probiotic ingredient, facilitating the process of digestion and ameliorating gastrointestinal problems. Chitin is anticipated to serve as a functional ingredient within the food industry to mitigate gastrointestinal inflammation. Its primary mechanism of action involves the regulation of intestinal microbes and immune cytokines, so restoring the equilibrium in the gastrointestinal tract (Lv et al., 2023). Chitin exhibits notable potential as an active ingredient in functional meals and anti-aging treatments.

Additionally, it can serve as an active tissue carrier in cosmetic applications, including masks and lotions, with the aim of retarding the aging process in humans (Morganti et al., 2019). One possible constraint associated with chitin is its potential toxicity within the human respiratory tract. The specific adverse effects seen are contingent upon the route of exposure (Satitsri and Muanprasat, 2020).



## CONCLUSION

The utilization of marine foods has been expedited due to the growing understanding of their biofunctional qualities. Bioactive compounds in fish and marine products present a highly promising alternative to synthetic counterparts. Marine resources offer a diverse array of bioactive compounds and nutraceuticals. Fish oils, proteins, peptides, and carbohydrates have been identified as significant contributors to the bioactivities seen in many marine food sources. The marine environment possesses immense promise as a storehouse for valuable bioactive compounds. The capacity of this system to supply essential nutrients appears to be sufficient to assist in attaining the desired level of food security. The utilisation of contemporary technology to enhance the productivity and sustainability of value-added food production is a forthcoming problem that the scientific and technological community must address to foster a more prosperous future. The market for food products, supplements, and natural health products containing marine bioactives is anticipated to experience significant growth, primarily attributed to these products' numerous potential health benefits. The various bioactivities, including antihypertensive, antioxidative, anticancer, and calcium absorption acceleration discovered in diverse marine by-products, are promising for advancing nutraceuticals that can improve and support human health.

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**DETERMINATION OF THE EFFECTIVENESS OF *BACILLUS AMYLOLIQUEFACIENS* AGAINST *SCLEROTINIA SCLEROTIORUM* IN SUNFLOWER IN *IN VITRO* CONDITIONS USING DIFFERENT METHODS**

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**ABSTRACT**

Dual culture studies conducted under *in vitro* conditions are among the most common methods employed in the initial stage to assess the efficacy of bacterial antagonists against phytopathogenic fungi. The choice of dual culture methods varies depending on the specific objectives of the study. In this research, the effectiveness of *Bacillus amyloliquefaciens* isolates against *Sclerotinia sclerotiorum* in sunflower was evaluated using two distinct dual culture methods.

The inhibition levels of bacteria showed variations in the range of approximately 38-59% when applied in a line-shaped petri dish, whereas inhibition levels were consistently higher, ranging from approximately 88-90%, in the circular method. Consequently, the selection of a method should be made with consideration given to the targeted pathogen.

In conclusion, when comparing the efficacy of bacteria obtained in a study with previous research, it is crucial to use the same methods for a meaningful interpretation. Therefore, methodological consistency is essential for accurately assessing the effectiveness of the obtained bacterial isolates.

**Keywords:** Biological control, Antagonism, Bacterial antagonists, Dual culture

**INTRODUCTION**

Sunflower, a widely cultivated oil plant, encounters various challenges in its cultivation. Among these, *Sclerotinia sclerotiorum* (Lib.) de Bary stands out as a significant fungal disease agent affecting production areas. This polyphagous pathogen induces root rot in over 500 plant species across 75 families, resulting in substantial yield and quality losses (Saharan and Mehta 2008; Koçak and Boyraz 2021).

Several agricultural methods are applied to manage the disease, but the broad host range of the pathogen limits the effectiveness of cultural control practices. In chemical control, fungicide application often fails due to improper timing with pathogen development (Heffer Link and Johnson 2007; Lindbeck et al. 2014). However, numerous studies report that biological control agents offer an alternative method for infection control. Bioagent microorganisms in nature significantly reduce disease incidence by inhibiting ascospore and sclerotial development. These biocontrol agents encompass bacteria, fungi, viruses, yeasts, and protozoa commonly

found in nature and can directly or indirectly control plant diseases (Eilenberg et al., 2001; Fravel, 2005; Fernando et al. 2007; Gupta et al., 2015; Köhl et al., 2019).

The initial step in the selection of agents for biological control involves evaluating bioagents under *in vitro* conditions (Raymaekers et al., 2020). The most common method in this selection process is the dual culture test, known for its simplicity and rapid production of antagonistic effects. This test is generally based on determining the antagonistic effect by measuring the inhibition zone formed due to the inhibition of mycelial growth of phytopathogenic fungi by bacterial isolates, providing insights into the mechanism of action of biocontrol agents (Pliego et al., 2011; Sales et al., 2017).

Different dual culture techniques exist and vary depending on the research's purpose. A candidate bacterial isolate can be screened against various phytopathogens, as well as a pathogenic fungus, to discover the antagonistic properties of many bacterial isolates. For dual culture, the bioagent bacterial isolate-phytopathogenic fungus combination is studied in the same petri dish (Ali et al., 2020). The selection of a suitable dual culture method is determined according to the planned scientific studies (Santoyo et al., 2019).

The choice of the streaking method for the bacterial bioagent in *in vitro* dual culture studies, whether as a "line" or a "circle," influences the evaluations based on the antagonist effect it demonstrates. For instance, in a study examining the antagonistic effect of *Bacillus* and *Pseudomonas* isolates against *Sclerotinia sclerotiorum* in dual culture using the circle method, successful inhibition rates between 50-100% were determined (Salman and Raziye 2022). A similar study testing different *Bacillus* isolates against the same pathogen using the line method found inhibition rates ranging from 49.19-57.95% (Koçak, 2019). When these two studies are evaluated in terms of antifungal activity, it is emphasized that the method is crucial in selecting highly effective bacteria. Similar results are observed when examining dual culture studies for *S. sclerotiorum* (Li et al., 2011; Dunlap et al., 2016).

The need to select antagonistic isolates to control plant diseases *in vivo*, and the rapid evaluation of bacterial antagonistic effects against the pathogen, begin with *in vitro* tests, specifically dual culture. Therefore, the general aim of this study is to determine the effectiveness of bacterial antagonist microorganisms with antifungal activity against *Sclerotinia sclerotiorum* using two different dual culture tests.

## Material and Methods

### Material

#### Test Pathogen and Biocontrol Agents

In our research, *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* isolates were sourced from the culture collection of Selçuk University Mycology Laboratory. *S. sclerotiorum*, utilized in previous studies in our laboratory, underwent morphological characterization, while *B. amyloliquefaciens* isolates were characterized through Malditof Biotyping. Bacterial isolates were obtained through isolation from the rhizosphere of different plants. Information regarding the bacterial codes and the plants from which rhizospheric soil was collected is provided in Table 1.

Table 1. Code of the bacteria used in the experiment and the plant species from which they were isolated

Number	Code of Bacteria	Name of the Plant
1	SAK-1	Melon
2	SME-1	Tomato
3	ÇK-1	Sugar Beet
4	KKA-2	Sugar Beet
5	SAK-2	Sugar Beet
6	SME-2	Potato
7	DEK-3	Common Bean

### Methods

#### Determination of *In Vitro* Biocontrol Activities of Bacterial Isolates

Fokkema (1978) demonstrated the antifungal activity of *Bacillus* spp. using the dual culture method. In this study, the effectiveness of each bacterium against the same pathogen was determined using two different dual culture methods.

To assess *in vitro* effectiveness, hyphae from the previously stored *S. sclerotiorum* culture in slant agar were inoculated into PDA medium containing streptomycin and incubated at 25 °C for 4-5 days. Bacterial cultures preserved in glycerol were transferred to nutrient agar and incubated for 24-48 hours at 25 °C. Antibiotic-free PDA medium was prepared for both methods used to determine the effectiveness of bacteria. Additionally, the effectiveness of each bacterial isolate in each method was assessed in two replicates.

In the first method, a loopful of the developing bacterial culture was inoculated in a line dividing the petri dish in the middle. Two discs were taken from fresh *S. sclerotiorum* cultures and placed opposite each other near the edges of 9 cm petri dishes containing PDA. The control group received no bacterial inoculation. Petri dishes were incubated at 27°C for 5 days.

The inhibition percentage of the candidate biological control agent against *S. sclerotiorum* was calculated as follows:

Inhibition % =  $(r_1 - r_2 / r_1) \times 100$  Accordingly,  $r_1$  represents the radial growth of the pathogen without the antagonist organism, while  $r_2$  represents the radial growth of the pathogen with the antagonist organism (Ghildiyal and Pandey, 2008).

In the second method, the pathogen was placed in the center of the petri dish and surrounded by a 30 mm circle. No bacterial inoculation was performed in the control group. Similar to the first method, dual culture petri dishes were incubated at 27°C for 5 days. Inhibition percentages of bacteria were determined compared to the control. Antifungal activity was assessed by inhibiting mycelial growth of bacteria using the following calculation:

% Inhibition =  $(1 - (\text{Treatment Growth} / \text{Control Growth})) \times 100$  (Tariq et al., 2010). Furthermore, the mycelial growth of the fungus was measured and recorded in mm over 5 days. Since the experiment was conducted in 2 replicates for each bacterium, mycelial growth was calculated



by averaging the growth observed in two petri dishes. Thus, observations were made to determine whether the methods used reduced fungal growth.

### Results and Discussion

The control groups for both methods are depicted in Figure 1. According to the 5-day measurements, the mycelial growth of *S. sclerotiorum* completely covered the petri dishes.

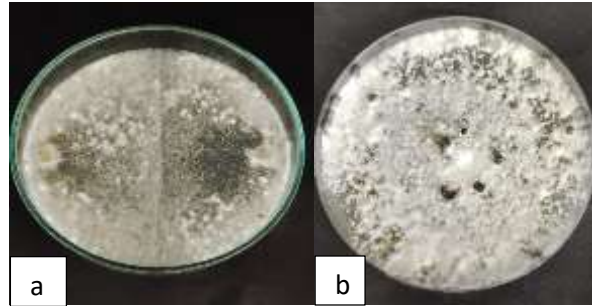


Figure 1. Control group of the line method on the right, control group of the circle method on the left.

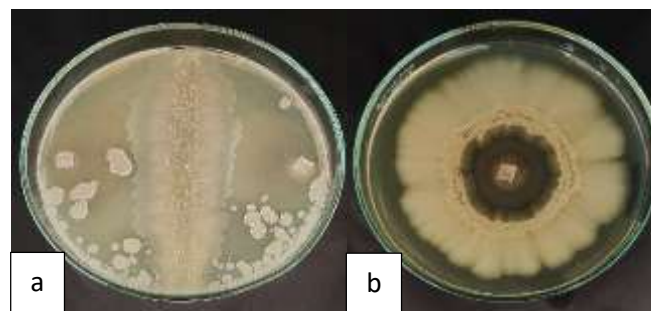


Figure 2. Appearance of double cultures of *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* SAK-1 in petri dishes. a- line method b- circle method.

In petri dishes where the *in vitro* effectiveness of *Bacillus amyloliquefaciens* SAK-1 against *Sclerotinia sclerotiorum* was determined, the growth of the pathogen was measured as 23 mm after 5 days according to the line method. According to the circle method, mycelial growth was measured as 12 mm after 1 day, and the development of the pathogen remained stable at the end of the first day. While the inhibition rate was 37.5% according to the line method, it was 86.1% according to the circle method.

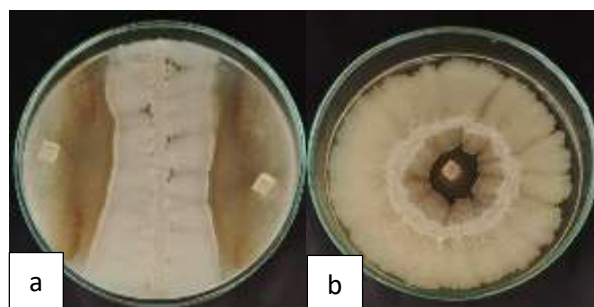


Figure 3. Appearance of double cultures of *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* SME-1 in petri dishes. a- line method b- circle method.



In the petri dishes where the effectiveness of *B. amyloliquefaciens* SME-1 was tested, the mycelial growth of the pathogen was measured as 29 mm according to the line method at the end of 5 days, while it was measured as 10 mm in the circle method. The inhibition rates of the line and circle methods were determined as 52.5% and 88.4%, respectively.

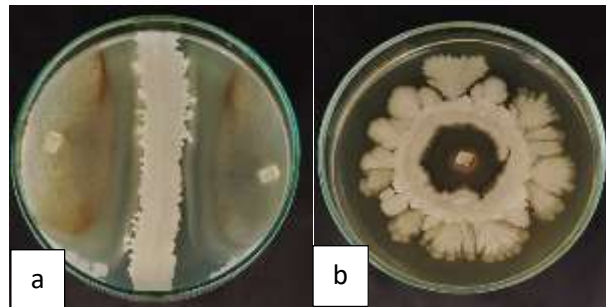


Figure 4. Appearance of double cultures of *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* ÇK-1 in petri dishes. a- line method b- circle method.

In the *S. sclerotiorum*-*B. amyloliquefaciens* ÇK-1 dual culture experiment, the mycelial development of the pathogen was determined as 29 mm according to the line method and 10 mm according to the circle method. While the inhibition rate was 47.2% according to the line method, it was 88.4% according to the circle method.

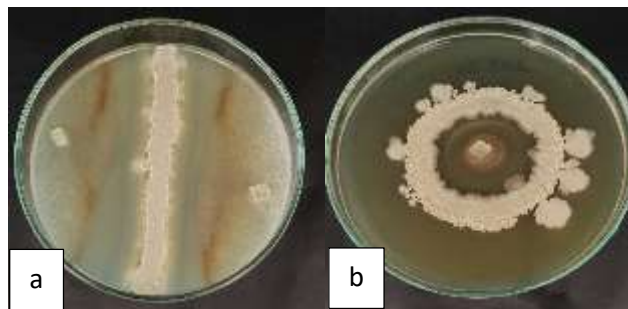


Figure 5. Appearance of double cultures of *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* KKA-2 in petri dishes. a- line method b- circle method.

According to the dual culture experiment of *B. amyloliquefaciens* KKA-2 and *S. sclerotiorum*, the mycelial development of the pathogen was determined as 30 mm according to the line method and 10 mm according to the circle method. Additionally, in the circle method, the growth of the pathogen did not change after the measurement on the first day. Consequently, when the pathogen was evenly surrounded, the bacteria quickly limited and stopped pathogen growth. Inhibition percentages were calculated as 55.5% in the line method and 84.9% in the circle method.

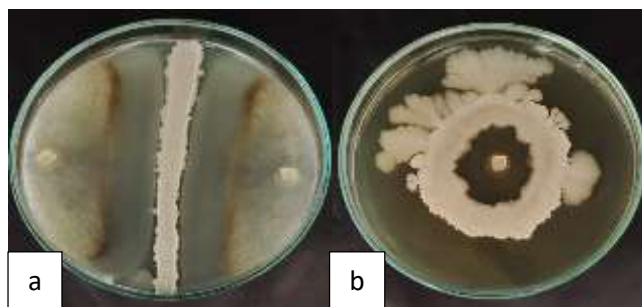


Figure 6. Appearance of double cultures of *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* SAK-2 in petri dishes. a- line method b- circle method.

In the *S. sclerotiorum*-*B. amyloliquefaciens* SAK-2 dual culture experiment, according to the line method, the mycelial growth of the pathogen stopped at the end of the 3rd day and was measured as 28 mm. According to the circle method, at the end of the first day, the mycelial growth of the pathogen was measured as 9 mm, and the pathogen was suppressed. Inhibition percentages are 48.6% according to the line method and 89.6% according to the circle method.

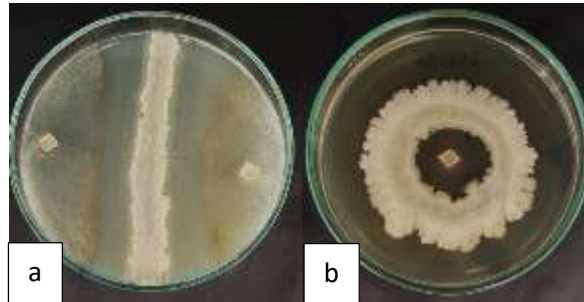


Figure 7. Appearance of double cultures of *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* SME-2 in petri dishes. a- line method b- circle method.

In the test where the effectiveness of *B. amyloliquefaciens* SME-2 against *S. sclerotiorum* was determined, according to the line method, the mycelial growth of the pathogen was 29 mm and remained stable after the 3rd day. According to the circle method, mycelial growth of 10 mm stopped at the end of the first day. Inhibition percentages were measured as 58.5% according to the line method and 88.4% according to the circle method.

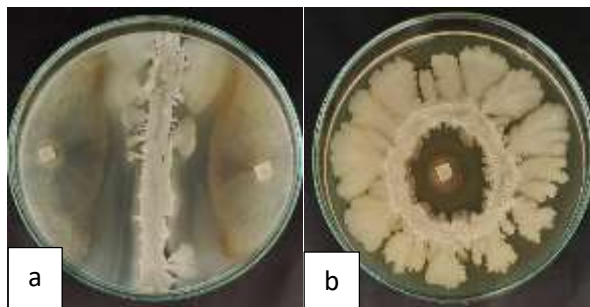
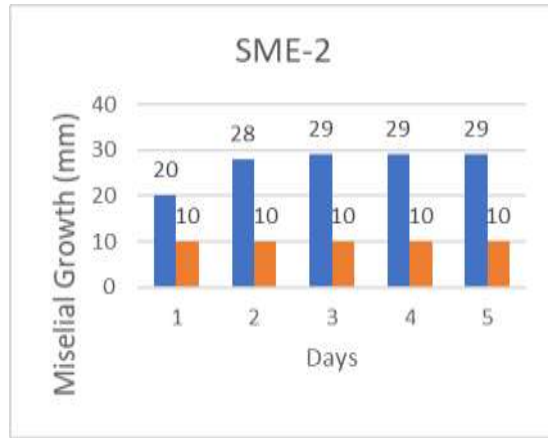
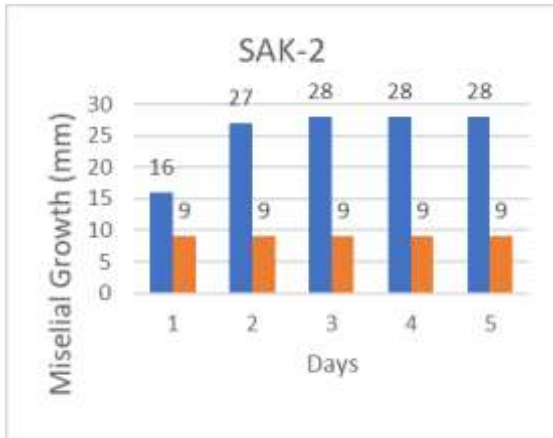
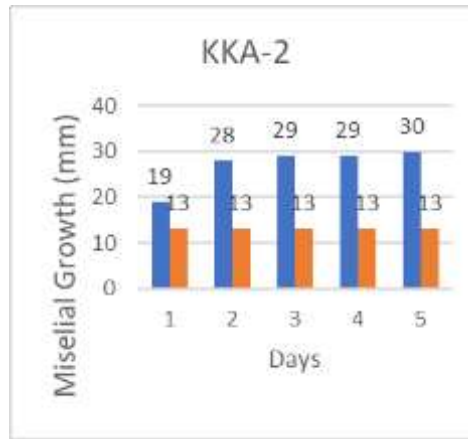
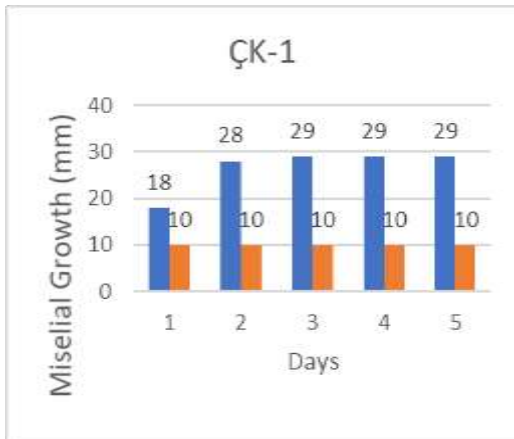
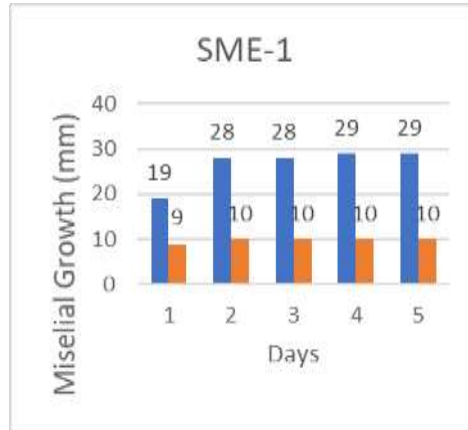
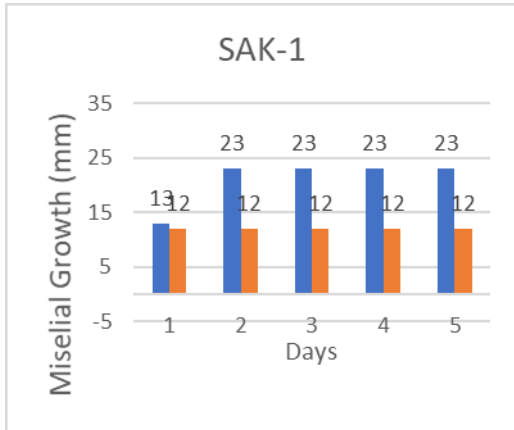


Figure 8. Appearance of double cultures of *Sclerotinia sclerotiorum* and *Bacillus amyloliquefaciens* DEK-3 in petri dishes. a- line method b- circle method.

In the experiment where the effectiveness of *B. amyloliquefaciens* DEK-3 against *Sclerotinia sclerotiorum* was determined, the mycelial growth of the pathogen was measured as 30 mm in the line method and 13 mm in the circle method. The inhibition percentage of the pathogen was determined as 55.5% in the line method and 84.9% in the circle method.



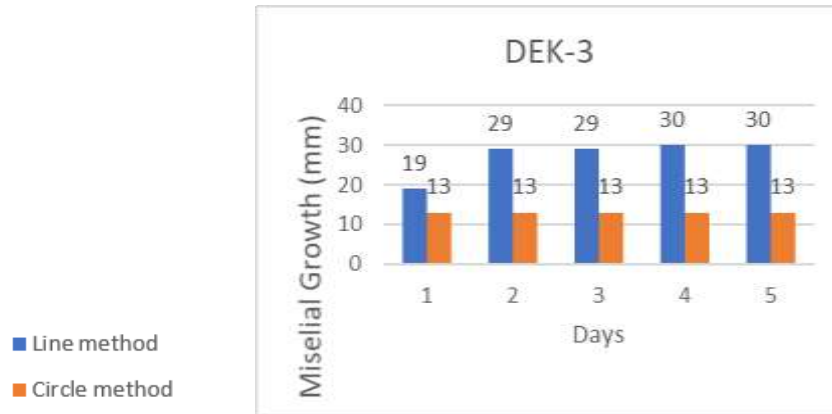


Figure 9. Mycelial growth of the pathogen in double cultures of *Sclerotinia sclerotiorum*-*B. amyloliquefaciens* using line and circle methods.

Ruqıya and colleagues (2022) used the dual culture method to determine the effectiveness of *Bacillus subtilis* against *S. sclerotiorum*. In this application, the bacteria placed on the edge of the pathogen petri dish are streaked opposite the pathogen. In this study, 5 *Bacillus subtilis* isolates were used in the dual culture experiment. Accordingly, it was determined that bacteria inhibited the pathogen at a rate of 29.5-18.33%. In another study where the pathogen and bacteria were applied in the same way. *B. amyloliquefaciens* VB7 prevented the growth of *S. sclerotiorum* by 45% (Vinodkumar et al., 2017).

Salman and Koçak (2022) determined the effectiveness of 13 different bacterial isolates against *S. sclerotiorum* in sunflower. In this research, they used the circle method and found that the bacteria inhibited the pathogen at a high level (60-100%). It was determined that *Pseudomonas koreensis*, *Bacillus amyloliquefaciens*, *Bacillus cereus*, *Pseudomonas chloraphis*, *Stenotrophomonas* sp. used in the research inhibited the mycelial growth of the pathogen by 100%. Using the circle-shaped dual culture method, Koçak et al. (2023) determined that 4 of the bacteria they isolated from *Salvia officinalis* L. inhibited the growth of *S. sclerotiorum* by 22-68%.

As a result, the inhibition percentage of *S. sclerotiorum* of *B. amyloliquefaciens* isolates used as bioagents in this study varied between approximately 38-56% according to the line method, and approximately 85-90% according to the circle method. As in this study, the effectiveness of the same bacteria against the same pathogen varies depending on the method used. For this reason, when comparing dual culture studies preferred according to the line method or vice versa, studies should be evaluated with data obtained according to the same method. *Bacillus amyloliquefaciens* SME-1 and ÇK-1 isolates suppressed the mycelial growth of the pathogen at the end of the 2nd day. Except for these two isolates, all isolates included in the study suppressed the mycelial growth of the pathogen at the end of the 1st day. In the line method, no isolate could suppress the growth of *S. sclerotiorum* in 24 hours. As a result, the circle method gives faster results. Essentially, these bacteria obtained from rhizosphere soil colonize the root and root surface of the plant and surround and suppress soil-borne disease factors. Considered from this perspective, we can say that the circle method reflects the ability to completely surround the pathogen, slowing down and stopping its growth, as in nature. However, regardless of the dual culture method used to determine the effectiveness of each bacterium, it must be tested under *in vivo* conditions.

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**EFFECT ON GRAIN WAREHOUSES OF INCREASED SOLAR RADIATION DUE  
TO CLIMATE CHANGE**

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**ABSTRACT**

This study was carried out to determine the effect of increasing solar radiation due to climate change on radiation heat gain in grain storage structures. The increase in temperature caused by radiation in the warehouse occurs from the sum of the solar radiation on the vertical (lateral wall) and inclined (roof) surfaces of the building. The monthly average hourly amounts of solar radiation to the vertical warehouse surfaces (lateral wall) were 384.08 W/m<sup>2</sup>h, 455.14 W/m<sup>2</sup>h and 469.16 W/m<sup>2</sup>h in January, February and March, respectively, and 829.18 W/m<sup>2</sup>h, 825.89 W/m<sup>2</sup>h and 883.06 W/m<sup>2</sup>h in June, July and August. The total solar radiation acting on inclined (roof) surfaces differs according to the roof slope angle. Considering the roof slope angles, the amount of solar radiation acting on the warehouse roofs in the winter season (January, February, March) is the lowest on the warehouse surfaces with a roof slope angle of 7°, while it is highest on the warehouse surfaces with a roof slope angle of 40°. In the summer season (June, July, August), it was determined that the heat gain by radiation on the roof surfaces was the lowest on the warehouse surfaces with a roof slope angle of 40° and the highest on the warehouse surfaces with 23°. In January, February and March, the total amount of solar radiation per hour per unit area of the warehouse surfaces with a roof slope angle of 7° is 333.19 W/m<sup>2</sup>h, 449.84 W/m<sup>2</sup>h and 579.37 W/m<sup>2</sup>h, respectively. In June, July and August, the total amount of solar radiation per hour on the warehouse surfaces with a roof slope angle of 23° was determined as 848.22 W/m<sup>2</sup>h, 842.08 W/m<sup>2</sup>h and 874.52 W/m<sup>2</sup>h, respectively. Although the total amount of solar radiation per hour on the warehouse surfaces with a roof slope angle of 40° is 452.14 W/m<sup>2</sup>h, 578.33 W/m<sup>2</sup>h and 680.99 W/m<sup>2</sup>h in January, February and March, respectively, it is 805.79 W/m<sup>2</sup>h, 806.89 W/m<sup>2</sup>h and 869.70 W/m<sup>2</sup>h in June, July and August, respectively. In addition, solar radiation on vertical and inclined structural elements causes an average of 17732 kcal/h and 15664 kcal/h on these surfaces, respectively, while the heat gain caused by the total solar radiation acting on the storage structures in the warehouse is 32704 kcal/h on average. Due to climate change and global warming, in determining the net heat gain by radiation, which is one of the main sources of overheating in grain warehouses, it is necessary to consider not only the location of the warehouse, but also its construction, surface areas and thermal properties of the building elements.

**Keywords:** solar radiation, grain storages, radiation heat gain, building elements, roof slope angle

## **1. INTRODUCTION**

From the creation of humanity to the present day, the world climate has undergone constant changes, resulting in an increase in average temperatures on the Earth's surface. According to Kadioğlu and Dokumacı (2005) and Ögüt (2008), there has been a 0.5-0.8°C increase in average temperatures from the 1860s to the present, and if necessary, measures are not taken, it is predicted that this temperature increase will reach up to 2°C by the end of this century. If the temperature continues to rise at this rate, it is estimated that by the year 2100, the average temperature on the Earth's surface will increase in the range of 1.4 to 5.8°C.

While 30% of the visible wavelength light from the sun is reflected by the atmosphere, a portion of the light reaching the Earth's surface is absorbed by both the atmosphere and the Earth's surface. Some gases in the atmosphere, although more transparent to the direct visible wavelength light from the sun, become less transparent to the reflected light, causing surface temperatures to unexpectedly rise.

Climate change, directly affecting the continuity of agricultural activities, also indirectly influences the storage structures where agricultural products are stored to meet human food needs throughout the year. As a result of climate change in our country, crop losses in barley, wheat, and corn production will increase, and yields will decrease. Studies indicate that there will be a halt in yield increase in wheat from the 2030s, and approximately 10% losses in corn production until the year 2050 (Voyvoda et al., 2017). Considering the decreasing trend in yields due to climate change, the proper storage of agricultural products such as grains, which are the main source of energy in human nutrition, in suitable storage conditions is crucial until consumption.

One significant source of heating in grain storage facilities is solar radiation, which must be taken into account in indoor climate control studies. Solar radiation refers to the electromagnetic waves emitted by the sun in both long and short wavelengths, reaching the Earth through absorption, reflection, and scattering (direct, diffuse) (Yenisey, 2015). Radiation reaching the ground in parallel rays is direct radiation, while the part of the radiation sent from the sun to the atmosphere that is scattered and diffused by clouds, dry air, and dust molecules before returning to the Earth's surface is diffuse radiation. In a study by Yenisey (2015), it is stated that both direct and diffuse radiation occur on both inclined and horizontal surfaces, and on inclined surfaces, there is also a reflected portion of radiation. Rather than the amount of heat generated by solar radiation on the surfaces of building elements (walls, roof, windows), it is important to consider how much of this heat will be transferred into the storage.

## **2. MATERIALS AND METHODS**

The research was conducted in Konya, a province where grain storage structures, known as grain warehouses due to their significant share in total production (approximately 12%), are intensively used for storage activities. The aim was to determine the effects of solar radiation on storage structures and to identify the net heat gain through radiation in the storage environment. The study was carried out in 30 enterprises and 72 different size of storage structures.

To better assess the net heat gains due to solar radiation in grain warehouses, radiation amounts were separately calculated for both winter months (January, February, March) when solar radiation is at low levels and summer months (June, July, August) when solar radiation is intense. Radiation gains through building elements in these months were calculated based on characteristic days proposed by Klein (1977), corresponding to the average of each month. In order to accurately interpret radiation heat gains through building elements in the storage

facilities, calculations were made separately for the hours when radiation is highest during the day, namely 11:00, 12:00, 13:00, and 14:00, and the averages were taken.

### 2.1. Determination of Solar Radiation Impact on Horizontal Surfaces

Equations 1 and 2 have been employed in the calculation of the monthly average daily total radiation incident on a horizontal plane from the extraterrestrial atmosphere (Duffie and Beckman, 1980).

$$H_0 = \frac{24}{\pi} I_{sc} * f * \left[ \cos(e) * \cos(d) * \sin(w_s) + \frac{\pi}{180} w_s * \sin(e) * \sin(d) \right] \quad (1)$$

$$f = 1 + 0,033 \cos\left[360 * \frac{n}{365}\right] \quad (2)$$

The declination angles and sunset hour angles for the calculated days throughout the year have been determined using Equations 3 and 4 (Duffie and Beckman, 1980).

$$d = 23,45 * \sin\left(\frac{360}{365} * (n + 284)\right) \quad (3)$$

$$w_s = \text{ArcCos}(-\tan(e) * \tan(d)) \quad (4)$$

The daily total radiation amounts on a horizontal plane for Konya, Samsun, İzmir, Şanlıurfa, Ankara, and Antalya provinces were calculated using the equation proposed by Aksoy (1997), denoted as Equation 5. The monthly average daily maximum sunshine duration was determined using Equation 6 (Ågnström, 1924).

$$\frac{H}{H_0} = 0,148 + 0,668 * \left(\frac{S}{S_0}\right) - 0,079 * \left(\frac{S}{S_0}\right)^2 \quad (5)$$

$$S_0 = \left(\frac{2}{15}\right) * w_s \quad (6)$$

In the calculation of the instantaneous total solar radiation incident on a horizontal plane using the solar hour angle and sunset hour angle during a specific time period, equations 7 to 10 proposed by Collares-Pereira and Rabl (1979) have been utilized.

$$\Gamma_t = \frac{I}{H} \quad (7)$$

$$\Gamma_t = \frac{\pi}{24} * \frac{(a+b*\cos w) * (\cos w - \cos w_s)}{(\sin w_s - \left(2\pi * \frac{w_s}{360}\right) * \cos w_s)} \quad (8)$$

$$a = 0,409 + 0,5016 * \sin(w_s - 60) \quad (9)$$

$$b = 0,6609 + 0,4767 * \sin(w_s - 60) \quad (10)$$

In the calculation of the hourly total and diffuse radiation incident on a horizontal plane from the extraterrestrial atmosphere, equations 11 and 12 proposed by Liu and Jordan (1960) have been utilized, taking into account the rd coefficient. For the determination of the daily diffuse radiation incident on a horizontal plane, Equation 13 has been employed (Bulut et al., 1999; De Miguel et al., 2001; Wong and Chow, 2001).

$$\Gamma_d = \frac{I_0}{H_0} = \frac{I_d}{H_d} \quad (11)$$

$$\Gamma_d = \frac{\pi}{24} * \frac{(\cos w - \cos w_s)}{(\sin w_s - \left(2\pi * \frac{w_s}{360}\right) * \cos w_s)} \quad (12)$$

$$H_d = H_0(0,384 - 0,416k_t) \quad (13)$$

The hourly direct solar radiation incident on a horizontal plane has been calculated using Equation 14 (Liu and Jordan, 1960), while the hourly diffuse solar radiation and clearness index have been determined using Equation 15 (Bulut et al., 1999; De Miguel et al., 2001; Wong and Chow, 2001).

$$I_b = I - I_d \quad (14)$$

$$k_t = \frac{I_t}{I_o} \quad (15)$$

## 2.2. Determination of Solar Radiation on Vertical (Vertical Wall) and Inclined (Roof) Surfaces

The hourly total solar radiation on inclined (roof) and vertical (wall) surfaces is the sum of hourly direct (direct), diffuse (scattered), and reflected radiations incident on the inclined and vertical surfaces. Equation 16 has been employed to calculate the hourly total solar radiation on vertical and inclined building surfaces (Liu and Jordan, 1961; Duffie and Beckman, 1980; Hsieh, 1986; Gueymard, 2000; Diez-Mediavilla et al., 2005; Iqbal, 2012).

$$I_{TE} = I_{be} + I_{de} + I_{re} \quad (16)$$

The Liu and Jordan model has been utilized for determining the amount of direct solar radiation incident on inclined and vertical surfaces. This model incorporates equations 17-20, as proposed by various researchers such as Liu and Jordan (1960), Liu and Jordan (1963), Wong and Chow (2001), Notton et al. (2006), and Basunia et al. (2012).

$$I_{be} = I_b * R_b \quad (17)$$

$$R_b = \frac{\cos\theta}{\cos\theta_z} \quad (18)$$

$$\cos\theta_z = \text{sind} * \text{sine} + \text{cosd} * \text{cose} * \text{cosw} \quad (19)$$

$$w = (t - 12) * 15 \quad (20)$$

In a study conducted by Kaynaklı et al. (2012), it was determined that the south direction is more significant when considering solar radiation throughout the year, and the calculations were performed taking this direction into account. However, due to the high thermal conductivity of steel and the presence of heat conduction (flux) from the heated point to other points, calculations for steel silos took into account the entire surface area and were corrected using the coefficient of 0.637 as suggested by Lovell-Smith and Baldwin (1992). For concrete silos, all calculations were made considering the south direction. The solar altitude angle was calculated with respect to the south direction using equations recommended by Liu and Jordan (1960), Liu and Jordan (1963), Duffie and Beckman (1980), Wong and Chow (2001), Notton et al. (2006), Yiğit and Atmaca (2010), and Basunia et al. (2012) (Equations 21-22).

On inclined surfaces facing south:

$$\cos\theta = \text{sind} * \sin(e - \beta) + \text{cosd} * \cos(e - \beta) * \text{cosw} \quad (21)$$

On vertical surfaces facing south:

$$\cos\theta = \text{cosd} * \text{sine} * \text{cosw} - \text{sind} * \text{cose} \quad (22)$$

The hourly diffuse (scattered) and hourly reflected solar radiation incident on inclined and vertical surfaces were calculated according to Equations 23 and 24, reported by Duffie and Beckman (1980), Hsieh (1986), Notton et al. (2006), and Iqbal (2012).

$$I_{de} = \frac{1}{2} * I_d * (1 + \cos\beta) \quad (23)$$

$$I_{re} = \frac{1}{2} * \rho * I * (1 - \cos\beta) \quad (24)$$

### 2.3. Determination of Heat Increase within the Storage Due to Conduction and Radiation from Building Components

The heat increase from building components' surfaces due to conduction and radiation has been calculated using equations 25 to 27 proposed by Mutaf and Sönmez (1984).

$$Q_{BR} = F * k * (t_s - t_i) \quad (25)$$

$$t_s = t_a + \frac{I * a}{a_a} \quad (26)$$

$$Q_R = F * I * D \quad (27)$$

## 3. RESULTS AND DISCUSSION

### 3.1. Solar Radiation on the Horizontal Plane

According to the research results, the amounts of solar radiation on the horizontal plane in the locations of grain silos during January, February, March, June, July, and August are presented in Table 1 and Figure 1. In January, the monthly average daily solar radiation reaching the outer atmosphere is calculated to be an average of 4545 W/m<sup>2</sup>, and the daily total solar radiation on the horizontal plane in the locations of the silos is determined to be 1922 W/m<sup>2</sup>. In February and March, the monthly average daily solar radiation reaching the outer atmosphere is 6007 W/m<sup>2</sup> and 7860 W/m<sup>2</sup>, respectively. The monthly average daily total solar radiation amounts are calculated to be 2844 W/m<sup>2</sup> in February and 4025 W/m<sup>2</sup> in March (Table 1). The monthly average daily total solar radiation increased by 109% from January to March, rising from 1922 W/m<sup>2</sup> to 4025 W/m<sup>2</sup>. This increase is attributed to the sun being at a steeper angle in March compared to January. To better interpret the effect of solar radiation on building elements, it is essential to understand how much radiation is effective during specific time intervals.

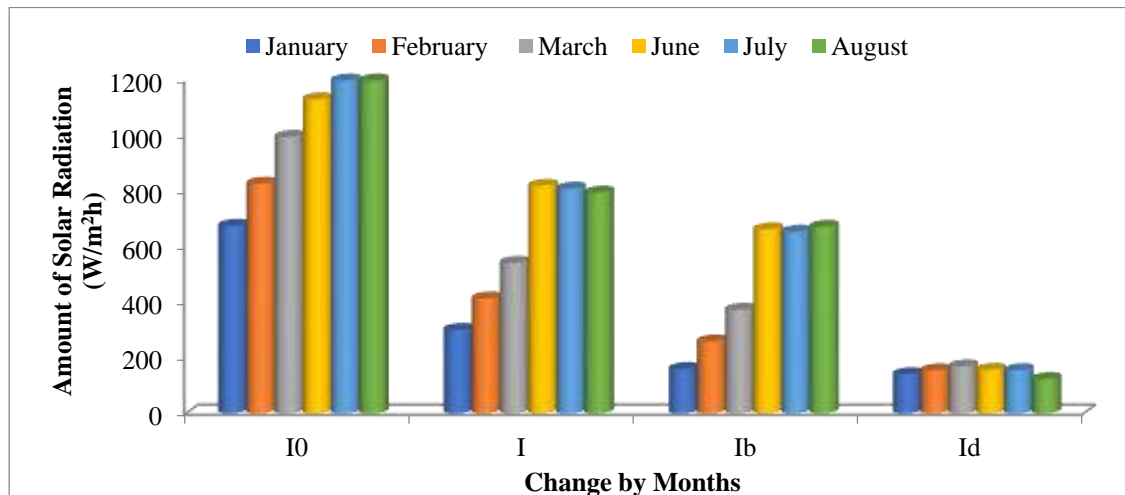
In these months, although the monthly average hourly solar radiation incident on the outer atmosphere is 676.14 W/m<sup>2</sup>, 827.78 W/m<sup>2</sup>, and 996.76 W/m<sup>2</sup>, respectively, the monthly average hourly total solar radiation is determined to be 300.44 W/m<sup>2</sup>, 413.93 W/m<sup>2</sup>, and 542.17 W/m<sup>2</sup> (Table 1). The hourly average solar radiation on the horizontal plane during a day is composed of the total of direct and diffuse radiations. According to Table 1, in the locations of grain silos in Konya, the monthly average hourly direct solar radiation amounts are 159.72 W/m<sup>2</sup>, 259.11 W/m<sup>2</sup>, and 373.30 W/m<sup>2</sup> in January, February, and March, respectively. The diffuse radiation amounts are 140.72 W/m<sup>2</sup>, 154.82 W/m<sup>2</sup>, and 168.86 W/m<sup>2</sup>. The clearness index values, an indicator of the ratio of monthly average hourly total solar radiation to monthly average hourly extraterrestrial solar radiation, are calculated to be 0.443, 0.499, and 0.543 in January, February, and March, respectively. Additionally, the maximum daily sunshine durations are 9.66 hours, 10.61 hours, and 11.75 hours in these months (Table 1, Figure 1).

In June, when solar rays are most perpendicular, the monthly average solar radiation incident on the outer atmosphere is determined to be an average of 11588 W/m<sup>2</sup>. The monthly average daily solar radiation amounts in July and August are 11308 W/m<sup>2</sup> and 9954 W/m<sup>2</sup>, respectively. The monthly average daily total solar radiation decreases by approximately 9% from June to August, dropping from 7156 W/m<sup>2</sup> to 6536 W/m<sup>2</sup>. This decrease can be explained by the fact that solar rays reach the Earth at angles close to 90° only in June and decrease in subsequent months. For storage structures, the monthly average hourly total solar radiation amounts in June, July, and August are 820.23 W/m<sup>2</sup>h, 810.22 W/m<sup>2</sup>h, and 795.83 W/m<sup>2</sup>h, respectively. The

monthly average hourly extraterrestrial solar radiation on the horizontal plane is determined to be 1132.50 W/m<sup>2</sup>h, 1233.14 W/m<sup>2</sup>h, and 1221.45 W/m<sup>2</sup>h in the same months. In these months, while 663.19 W/m<sup>2</sup>h, 654.96 W/m<sup>2</sup>h, and 672.51 W/m<sup>2</sup>h of the hourly total solar radiation are composed of direct solar radiation, 157.04 W/m<sup>2</sup>h, 155.26 W/m<sup>2</sup>h, and 123.32 W/m<sup>2</sup>h are attributable to diffuse solar radiation, respectively. There is no significant difference in terms of maximum monthly average daily sunshine durations among the operations, calculated as approximately 14.58 hours, 14.34 hours, and 13.43 hours for June, July, and August, respectively. The clearness index (kt) values are approximately 0.665, 0.663, and 0.702 for June, July, and August, respectively (Table 1, Figure 1).

**Table 1.** Solar radiation amounts on the horizontal surface, maximum sunshine durations, and clearness indices in the locations of grain silos during winter and summer seasons

Months	H <sub>0</sub> (W/m <sup>2</sup> )	H (W/m <sup>2</sup> )	I <sub>0</sub> (W/m <sup>2</sup> h)	I (W/m <sup>2</sup> h)	I <sub>b</sub> (W/m <sup>2</sup> h)	I <sub>d</sub> (W/m <sup>2</sup> h)	S <sub>0</sub> (h)	k <sub>t</sub>
January	4545	1922	676,14	300,44	159,72	140,72	9,66	0,443
February	6007	2844	827,78	413,93	259,11	154,82	10,61	0,499
March	7860	4025	996,76	542,17	373,3	168,86	11,75	0,543
June	11588	7156	1132,50	820,30	663,19	157,04	14,58	0,665
July	11308	6983	1233,14	810,22	654,96	155,26	14,34	0,663
August	9954	6536	1221,45	795,83	672,51	123,36	13,43	0,702



**Figure 1.** Instantaneous Solar Radiation Amounts on the Horizontal Plane and Distribution as Direct and Diffuse Radiation in Winter and Summer Seasons at the Locations of Grain Silos

### 3.2. Solar Radiation Amounts on Vertical Storage (Side Wall) Surfaces

The total solar radiation incident on the walls and roofs of grain silos is composed of three functions: direct, diffuse, and reflected solar radiation. The instantaneous total solar radiation on the vertical surfaces effective during winter (January, February, March) and summer (June,



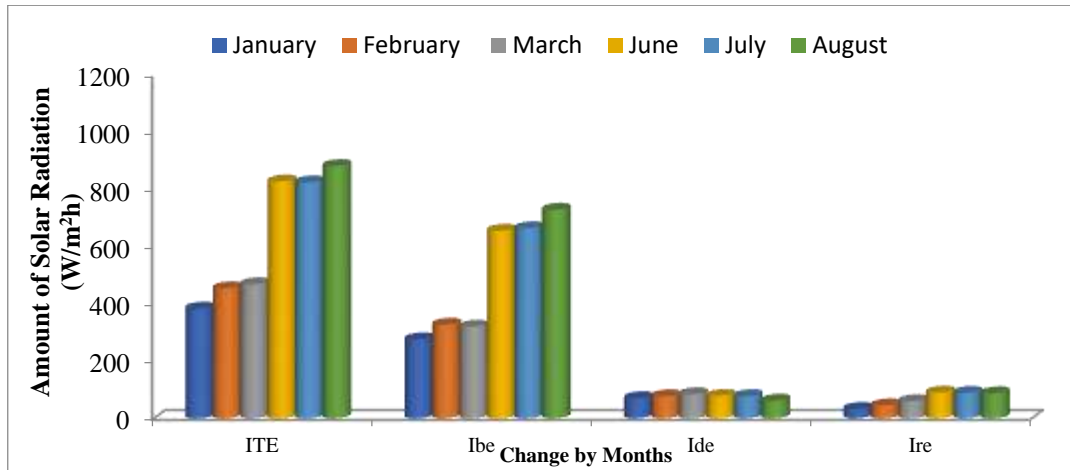
July, August) seasons, along with the distribution of direct, diffuse, and reflected radiation within the total, is provided in Table 2 and Figure 2.

In January, February, and March, the average monthly total hourly solar radiation on the vertical surfaces of storage structures is determined to be 384.08 W/m<sup>2</sup>h, 455.14 W/m<sup>2</sup>h, and 469.16 W/m<sup>2</sup>h, respectively (Table 2, Figure 2). According to Table 2, in January and February, 72% of the hourly total solar radiation consists of direct radiation, 19% of diffuse radiation, and 9% of reflected radiation. In March, 68% of the hourly total solar radiation on vertical surfaces is direct, 19% is diffuse, and 13% is reflected radiation.

In June, July, and August, for the vertical surfaces facing south in the grain storage units in the province, the average monthly hourly direct solar radiation amounts for each storage unit are 656.56 W/m<sup>2</sup>h, 655.21 W/m<sup>2</sup>h, and 729.91 W/m<sup>2</sup>h, respectively. In the same months, the amounts of diffuse solar radiation are 78.49 W/m<sup>2</sup>h, 77.64 W/m<sup>2</sup>h, 61.77 W/m<sup>2</sup>h, and reflected solar radiation is 90.22 W/m<sup>2</sup>h, 89.12 W/m<sup>2</sup>h, and 87.54 W/m<sup>2</sup>h, respectively (Table 2, Figure 2). In June and July, 80% of the hourly total solar radiation consists of direct radiation, 9% of diffuse radiation, and 11% of reflected radiation. In August, 83% of the hourly total solar radiation on vertical surfaces is direct, 7% is diffuse, and 10% is reflected radiation (Table 2, Figure 2).

**Table 2.** Total, Direct, Diffuse, and Reflected Solar Radiation Amounts on the Vertical Surfaces (Side Wall) of Grain Silos

Months	$I_{TE}$ (W/m <sup>2</sup> h)	$I_{be}$ (W/m <sup>2</sup> h)	Ratio (%)	$I_{de}$ (W/m <sup>2</sup> h)	Ratio (%)	$I_{re}$ (W/m <sup>2</sup> h)	Ratio (%)
<b>January</b>	384,08	276,32	72	70,60	19	33,05	9
<b>February</b>	455,14	327,73	72	77,41	19	45,53	9
<b>March</b>	469,16	320,6	68	84,43	19	59,64	13
<b>June</b>	829,18	656,56	80	78,49	9	90,22	11
<b>July</b>	825,89	665,21	80	77,64	9	89,12	11
<b>August</b>	883,06	729,91	83	61,77	7	87,57	10



**Figure 2.** Distribution of Total Solar Radiation and Direct, Diffuse, and Reflected Solar Radiation on Storage Walls in January, February, March, June, July, and August

### 3.3. Impact of Solar Radiation on Inclined Storage Surfaces (Roofs)

The total amount of solar radiation on sloped (roof) surfaces varies according to the roof slope angle. It has been determined that surfaces with a 7-degree roof slope experience the lowest, while those with a 40-degree roof slope experience the highest solar radiation during the winter months (January, February, March). Accordingly, in January, February, and March, the total solar radiation on roof surfaces with a 7-degree slope is determined as 333.19 W/m<sup>2</sup>h, 449.84 W/m<sup>2</sup>h, and 579.37 W/m<sup>2</sup>h, respectively. In contrast, for the same months, the total solar radiation on surfaces with a 40-degree roof slope is found to be 452.14 W/m<sup>2</sup>h, 578.33 W/m<sup>2</sup>h, and 680.99 W/m<sup>2</sup>h, respectively (Table 3). In June, July and August, although the amount of heating caused by solar radiation on the roof surfaces varies according to the altitude and latitude of the silos, it has been determined that it reaches the highest value on the roof surfaces with a roof slope angle of 23°, while it is the lowest on the roof surfaces with a roof slope angle of 40°. In June, the total hourly solar radiation on a storage surface with a 23-degree roof slope is 848.22 W/m<sup>2</sup>h, whereas it is 805.79 W/m<sup>2</sup>h on a surface with a 40-degree roof slope. Additionally, in July and August, the total solar radiation on surfaces with a 23-degree roof slope is 842.08 W/m<sup>2</sup>h and 874.52 W/m<sup>2</sup>h, respectively, while it is 806.89 W/m<sup>2</sup>h and 869.70 W/m<sup>2</sup>h on surfaces with a 40-degree roof slope (Table 4). Consequently, the research results indicate that, during the summer season, the increase in roof slope angle leads to a decrease in the total solar radiation on these surfaces, as the sunlight comes at a steeper angle.

**Table 3.** The amount of solar radiation on the roof surfaces of grain warehouses in January, February and March

Roof Slope Angle (°)	Amount of solar radiation (W/m <sup>2</sup> h)		
	January	February	March
7	333,19	449,84	579,37
40	452,14	578,33	680,99

**Table 4.** The amount of solar radiation on the roof surfaces of grain warehouses in June, July and August

Roof Slope Angle (°)	Amount of solar radiation (W/m <sup>2</sup> h)		
	June	July	August
23	848,22	842,08	874,52
40	805,79	806,89	869,70

According to the research findings, the solar radiation on vertical (wall) and sloped (roof) structural elements causes an average heating of 17732 kcal/h and 15664 kcal/h, respectively. The total solar radiation affecting storage structures results in an average heat gain of 32704 kcal/h inside the storage facility.

#### 4. CONCLUSION

Radiative heat gain is a crucial factor in providing suitable indoor conditions for grain storage facilities based on the type of product. However, achieving proper indoor climate control requires considering other heat losses and gains to ensure storage without any qualitative or quantitative losses throughout the storage period. Due to climate change and global warming, the detection of net heat gain through radiation, which is a major source of overheating in grain storage facilities, requires consideration not only of the location of the warehouse but also its construction, insulation status, surface areas of structural elements, and thermal properties. In the silos in the Konya region, the optimum roof slope angle for minimizing heat gain due to solar radiation on roof surfaces should be 30 degrees.

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**AN EXPLICIT SURVEY ON THE EFFICACY OF DIGITAL SIGNATURE  
VERIFICATION SYSTEM (DSVS) AND ITS IMPORTANCE TO BANKING  
INDUSTRY**

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**ABSTRACT**

Today the quest for fast money has driven many people to carry out different illegal acts and signature counterfeiting is identifiable among this acts. Financial institutions including banks also fall victim because of lack of effective technology to verify signatures. Digital signature has been used over the past years in several industries to ensure authentication, non-repudiation, data integrity and reduce the risk of fraudulent transaction. The term digital signature is synonymic to electronic signature (e-signature). According to Sur & Roy (2011), digital signature has the potential that can safeguard valuable information over differing types of networks. This paper presents digital signature verification system as a means to enhance customers' information security in banking industry. The paper discussed the basic concept and characteristic features of digital signature. Some of the advantage and challenges of using digital signature in the banking sector were also highlighted in the paper work. In order to collect important information for the paper write-up, online Google form questionnaire instrument was used to collect vital information from respondents. The data retrieved were collated and subjected to reliability analysis. Conclusively, the paper inferred that digital signature is based on encryption methods that create a unique signature for each user. The technology ensures the security of the documents in the digital environment, guaranteeing their authenticity and integrity.

**Keywords:** Digital Signature Verification System, DSVS, Banking Industry.

**INTRODUCTION**

Financial institutions including banks are facing a lot of challenges in fighting numerous malicious acts within its spectrum including signature counterfeiting. Signature has been accepted worldwide as a means of official verification or authentication for legal documents, tellers, bank drafts, deposit slips, withdrawal slips, receipts, cheques and other valuable

documents. The traditional modes for attesting signature in banks have been abused thereby causing lots of damages and losses to individuals as well as banks, times without number; and have therefore been queried, especially in cases such as forgery, impersonation and identity manipulation. Today, the use of digital signatures have been introduced into banks to ensure authentication, non-repudiation, data integrity and limit of the risk of fraudulent transaction. This paper presents digital signatures as means of enhancing customers' information security and improving staff- customer relationship within banking domain.

### **RELATED LITERATURE**

The study of Schukat & Cortijo (2015) pointed that there are enormous problem of information insecurity and therefore suggest the enforcement of E-Governance security using digital signature schemes. According to Daniel (2000), the introduction of electronic document in Global and National Commerce Act (ESIGN) validates the use of electronic signatures. Erfaneh, et al. (2011) proposes simple and fast algorithms for generating digital signature. Rebecca (2004) reveals that the implementation of electronic signature offer greater security with the use of password. Imem (2015) emphasize that digital signatures algorithms are characterized by their high level of security and fast speed for encrypting and decrypting of data. Ravneet & Amandeep (2012) noted that digital Signatures ensure privacy, authentication, integrity and non-repudiation. Chang, (2007) observed that the use of electronic signature is increasingly becoming important as banking is transiting from geographic commerce to electronic commerce.

### **Applications of Digital signature in banking sectors**

Many banks are implementing digital signature solutions as a way to secure financial transaction. The major uses of digital signature in banking sectors include:-

#### **1. Account Opening:**

Signing paperless document when opening new account with banks involve the use of digital signature. Banks use digital signature to implement an end-to-end digital process whereby customers are able to choose where and when they transact with the bank.

#### **2. Lending:**

Digital signature is used online for signing finance contracts or loan applications as well as delivering the paper work electronically. This has helped eliminate the risks associated with errors of documentation. It has also helped remove the painful effort and poor customer experiences.

#### **3. Treasury Management:**

The use of digital signature has made it easier to seal up business contracts with customers far away from the banking branch. Digital signature are used to reduce the time it takes for customers to sign up for treasury management services.

#### **4. Wealth Management:**

Using Digital signature is increasingly becoming an excellent strategy for wealth management in banking sector. The goal is to help shorten the long processes involving multiple meetings where paperwork is processed.

#### **5. Residential Mortgage:**

Using Digital signature to seal up agreement on mortgage business is gaining momentum in banks. Digital signature has become the ideal solution that is bringing convenient, secured and compliant experiences into the home of customers.



### **Benefits of using Digital signature in banking sector**



The benefits of digital signature in banking sector include:-

1. **Easy Accessibility:**

Regardless of the location of the signees, they can attest their signature whenever there is a need for it.

2. **Security:**

Digital signature is very secure when correctly implemented.

3. **Enable process automation:**

Digital signature has become part of a streamlined digital process for many banks. Once the signature is available, it can be attested automatically.

4. **Improved records management:**

Once a document is signed, parties involved can save a local copy in their records which can readily be referenced and used when need be.

5. **Fast and easy to use:**

Digital signature is very fast and easy to use. When a document is received by parties required to sign, it is easy for they to attest their signature electronically.

### **Challenges of using Digital signature in banking sector**

There are a number of challenges using digital signature in banking sector. Viz:-

1. **May require advanced technology:**

Digital signature technology is wide spread. Using digital signature tools require the signees to have a fore knowledge of the skill which may not even address every scenario.

2. **Trust:**

Many individuals and banks are not fully convinced of the technology, so they feel reluctant to accommodate and implement its usage.

3. **Resistance to change:**

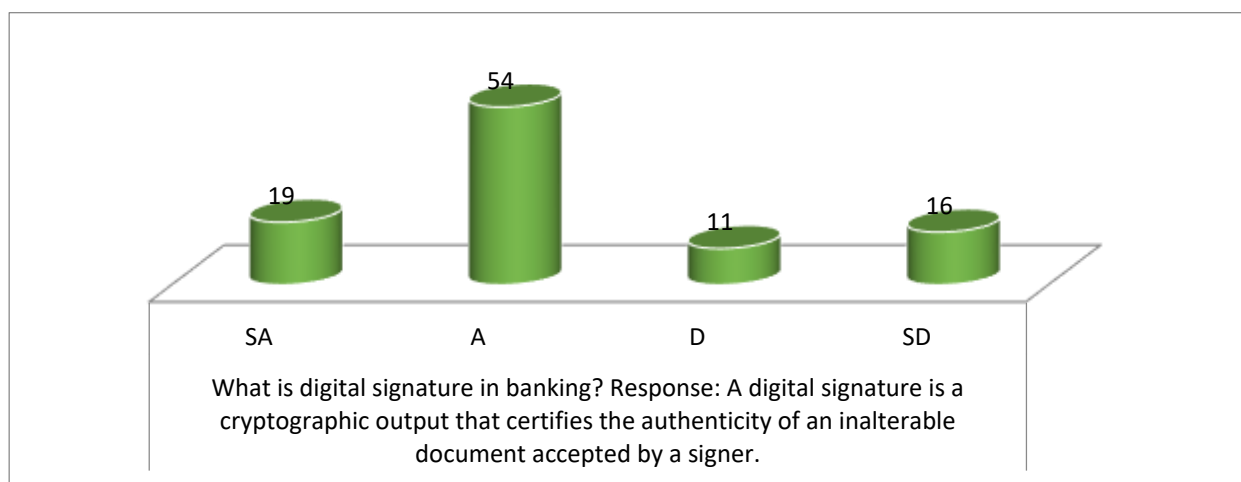
A lot of people are fully aware of the technology but still resist using it. Many individuals and banks still seek to reestablish the old process of manual signing.

## MATERIALS AND METHODS

This paper is a descriptive review on the basic concept of digital signature verification system (DSVS). The paper adopted simple random techniques for selecting IT professionals and bank workers that were interviewed. Relevant and reliable information were gathered through carefully formulated questionnaire. In order to collect information centered on digital signature, drafted copies of questionnaires were administered to respondents using online Google form questionnaire instrument. The responses gathered were collated and subjected to Cronbach's alpha reliability analysis. The result of 0.87 gave a good reliability index of the instrument. The entire exercise took place within two and half weeks before completion.

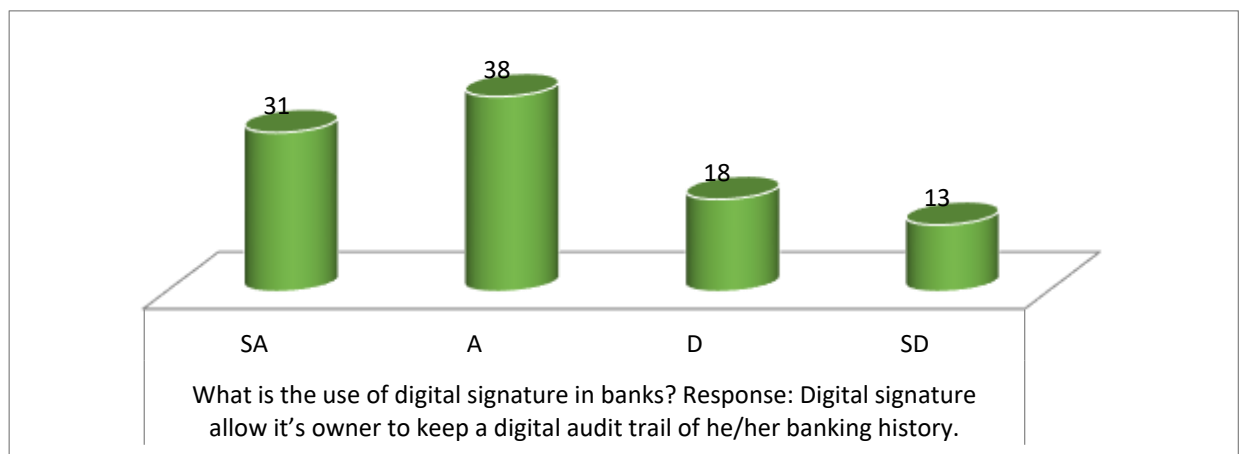
## RESULT AND DISCUSSION

**Fig.1: Chat Analysis**



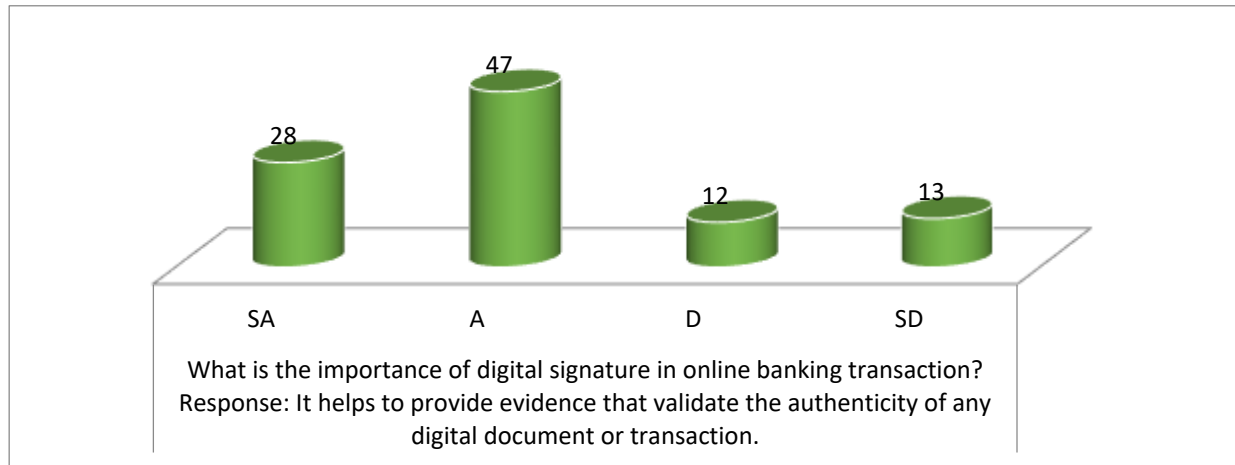
The graph plotted in figure 1 signifies that the respondents have a clear knowledge of what digital signature means. Majority of the respondents see digital signature as a cryptographic output (scripted with algorithms) accepted by a signer that certifies the authenticity of a document. The respondents further clarifies that digital signature is mainly an encrypted, electronic stamp of authentication on digital information which may include macros, email messages or electronic documents. The respondents inherently noted that the digital signature confirms that the information that originates from the signer is invariably unaltered.

**Fig.2: Chat Analysis**



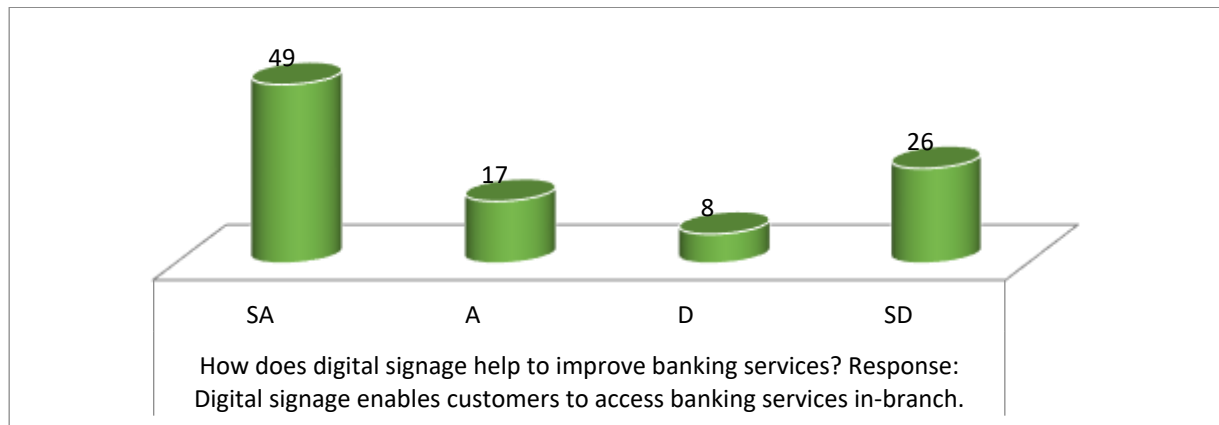
The chat analysis shown in figure 2 explains the respondents' perception of the use of digital signature. A greater number of the respondents outlined that digital signature allow its owner to keep a digital audit trail of he/her banking history. According to the respondents, the digitally signed agreements or documents are ultimately kept unalterable and ultimately secured.

**Fig.3: Chat Analysis**



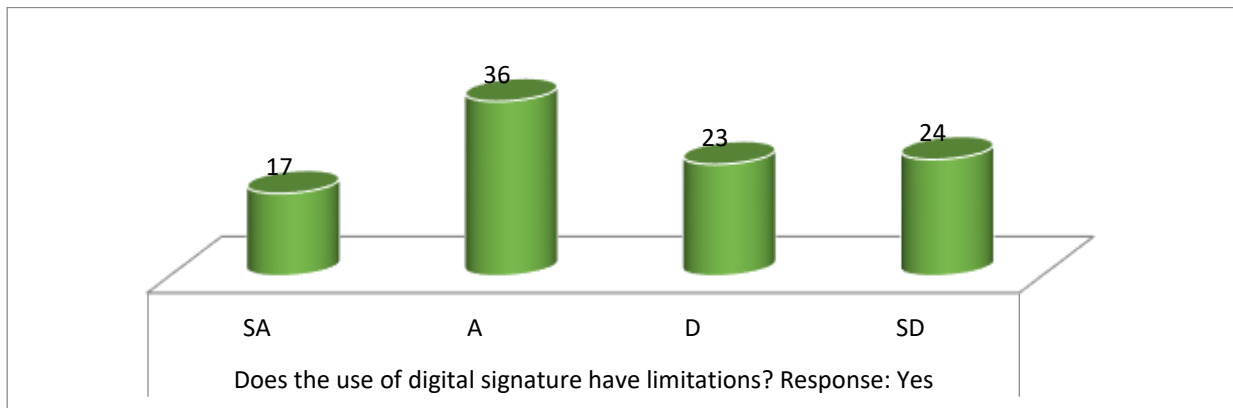
The chat analysis seen in figure 3 depicts that most of the respondents concur that the use of digital signature is very essential in banking industry. According to the respondents, digital signature helps to provide evidence that validate the authenticity of any digital document or financial transaction. The respondents further explain that in e-banking, digital signature is significantly useful in ensuring the security of the online transaction.

**Fig.4: Chat Analysis**



The graph plotted in figure 4 indicates that a greater number of the respondents agree with the statement that digital signage enables customers to access banking services in-branch. According to the respondents, many bank customers are able to access the banking your services online, and therefore the customers deploy self-service kiosks in branch to allow them to independently carry out transactions. This is kudos to digital signature verification system (DSVS) as it allow for the verification of the authentic of the online banking transactions.

Fig.5: Chat Analysis



The graph plotted in figure 5 shows that there are a number of challenges that comes with the use of digital signature verification system. The respondents stated that the primary drawback of digital signature is that it is limited to a single digital document. According to the respondents, each digital signature is bided to specific online document. The respondents further highlighted other challenges to include: high cost of implementation, lots of effort required and the legality involved sing digital Signatures.

## CONCLUSION

This paper is focused on digital signature verification system. The basic concept and feature of digital signatures were discussed in the paper work. The paper highlighted some of the advantage and challenges of using digital signatures in banking sector. The paper write-up queried the traditional methods of appending signatures as being abusive and disadvantageous to individuals and also to banks. The paper write-up also asserts that the introductions of digital signatures have help to ensure authentication, non-repudiation, data integrity and reduce the risk of fraudulent transaction. The paper write-up therefore presents digital signatures as effective means of enhancing information security and improved staff-customer relationship. Finally, the paper write-up affirmed that digital signature technology has the potentials that guarantee the authentication and integrity of transactions between customers and their banks.

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**OPERANDO X-RAY SCATTERING STUDIES OF INJECTION MOULDING OF  
BIOPLASTICS**

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**ABSTRACT**

Just over 40 years ago, the world's first second generation synchrotron light source, the Synchrotron Radiation Source (SRS) at Daresbury in England started operations. This ground-breaking source was built around a lattice of bending magnets which were the principle source of radiation. Since then many new synchrotron facilities have been design, constructed and developed. There are now about 70 such facilities worldwide. The more recent synchrotrons have been designed to enable insertion devices such as undulators to be inserted in the straight sections of the main synchrotron ring. An undulator consists of a periodic array of magnets and the characteristics of this array largely determines the energy and the wavelength of the intense radiation produced. An undulator is a harmonic device and the radiation produced is very intense and is highly collimated in the plane of the orbit of the electrons. The works included here were performed at the ALBA synchrotron light source in Barcelona, Spain. This is a third generation 3.0GeV machine in which six of the ten operational beamlines have an insertion device as the source of radiation. Undulator sources at a third-generation synchrotron light source are a billion times brighter than a conventional laboratory based X-Ray.

Researchers were quick to identify the advantages of combining small-angle X-Ray scattering (SAXS) and wide-angle X-Ray scattering (WAXS) in to a single experiment and to follow in real-time the variation and modifications in the structure and morphology of polymers. The processing of polymers to fabricate parts with a well defined shape usually involves heating the polymer in to the molten state, where a complex shape can be formed and then cooling to the solid state at room temperature, the development of structure and morphology which develops on cooling is critical in determining the properties of the part or product.

The most common fabrication technology used to fabricate parts made from polymers is injection moulding. Injection moulding appears to be a quite simple process in which molten polymer is injected at high pressure in to a shaped mould with the negative of the product required. The mould cools the polymer until it is solid, either as a consequence of passing through a glass transition in the case of amorphous thermoplastics or crystallises as in the case of semi-crystalline polymers. In 2022, researchers at CDRSP, developed an injection moulding system in which it was possible to use x-ray scattering as a quantitative tool for the time-resolving study of the injection moulding of semi-crystalline polymers.



Biopolymers derived from sustainable resources have come to the foreground in the search to enhance the sustainability of the plastics industry, in order to reduce the carbon footprint and solve the crisis of plastic pollution in the oceans. The challenge of replacing polyolefins in the plastics industry arising as they are exceptional materials and easy to process to achieve high quality products and excellent properties. Biopolymers are produced from natural resources, for example bacteria produce polyhydroxyalkanoates from biological waste. Another promising material polybutylenesuccinate can be synthesised from both petroleum-based raw materials and bio-based materials. In this work we explore the use of operando x-ray scattering to optimise the process of injection moulding to produce high quality products from biopolymers for which the processing window is narrower. We see the development of operando X-Ray measurements of injection moulding as the first step in the development of a multiscale digital twin for injection moulding.

**Keywords:** Injection moulding, biopolymers, operando SAXS and WAXS, crystallisation, orientation

## 1. INTRODUCTION

There are growing demands on the plastics industry to find solutions to the growing pollution of the oceans by poor management of plastics waste [1] and to increase the volume of plastic parts which are reused or recycled. The most popular technology for shaping plastics in to products is injection moulding. This is apparently a simple technology in which liquid plastic is injected in to a metal mould at high pressure as shown in Figure 1. The plastic cools and solidifies and retains the shape of the mould and it is ejected from the mould. This fabrication system is ideally suited to automation and this cycle can be automated to provide a cycle over a period of a few 10s. It is particularly suited to mass production and although the fabrication of the metal mould is an expensive tool, plastics parts can be produced in this manner quite cheaply.

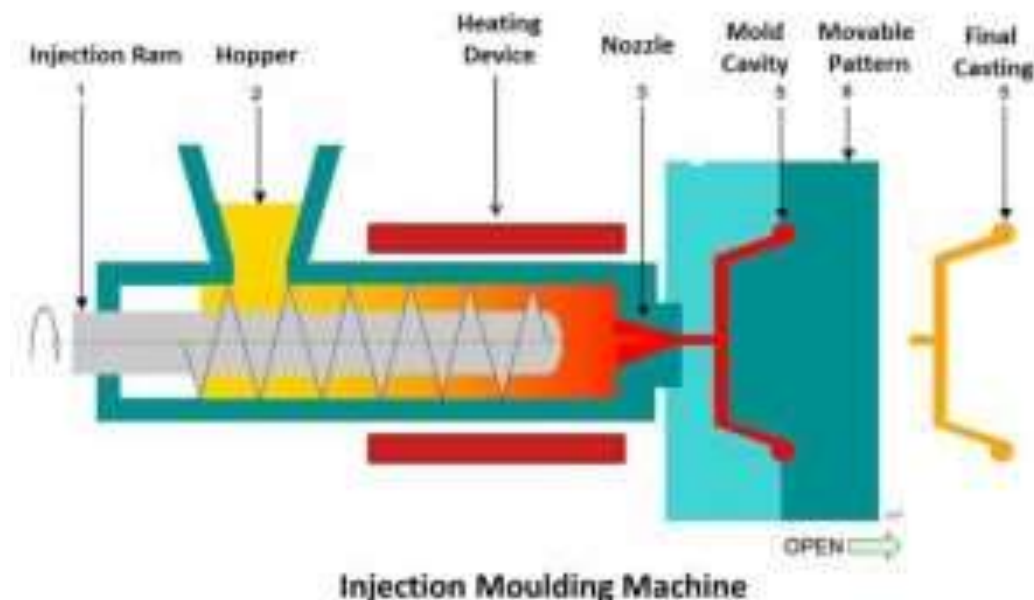


Figure 1 A schematic diagram of an injection moulding system

Late in the 20<sup>th</sup> century society realized that the properties of plastics that make them so attractive, such as durability, typically hydrophobic and tough, results in a long life time of the part, probably much greater than the use placed on it by society [2]. The recycling of plastic

waste is either non-existent or in its infancy in many countries, but in others the technology is quite advanced with automatic sorting in to specific waste streams. There are facilities which recycle PET products to produce food grade PET which is suitable for food packing or bottle production.

Collection, sorting and cleaning are amongst the major challenge for recycling and in some cases the recycled material may have a higher cost than the virgin material. Recently the EU has issued a Waste Framework Directive [3] providing a hierarchy for processing waste. Currently, the majority of plastic waste is not recycled but may end up in energy recovery or landfill. There is growing demand for a more effective circular economy, in which plastic parts which have reached their end of life are reused as raw material for a new product. Some other material systems, such as steel, glass and paper have a much higher level of circularity. This is because with these materials, it is more straightforward to reduce these materials to a more elemental form, which can then be used to prepare new materials with properties as good as the first cycle. At present this is not widely available with polymers as selectively breaking the chemical bonds inherent in a molecular material is much more challenging. This approach, often referred to as chemical recycling has been developed from specific materials [4].



Figure 2 The waste hierarchy which is embodied in the EU Waste Framework Directive

Part of our current work is focused on mechanical recycling and understanding how the processing cycle can be redefined so as to limit property degradation. Another approach is bioplastics which are prepared from biomaterials and which can undergo biodegradation so as to complete the circle through the natural world. An example of such materials are polyhydroxybutyrate [5] and polybutylene succinate [6]. Although bioplastics are an attractive option, they can be challenging materials to process as their thermal degradation temperatures is somewhat lower than their synthetic counterparts and hence the processing window is narrower.

We are setting out to further develop experimental X-ray scattering techniques to probe the multiscale structure of synthetic polymers and bioplastics as relevant to injection moulding. X-ray scattering is a highly quantitative techniques which can access the multiple scales of structure and morphology present in a plastic part. We set ourselves the task to develop an operando system with which X-ray Scattering can be performed in-situ during an injection moulding cycle on a time-resolving basis. Synchrotron light Sources have rapidly developed from the 1<sup>st</sup> so-called 2<sup>nd</sup> generation machines, which was the Daresbury Synchrotron Radiation Source in the UK and which opened in the early 1980s [7]. In such facilities high energy electrons travelling close to the speed of light, move around a storage ring which consists of a lattice of bending magnets in the form of a polygon. As the electron is redirected in the bending

magnet from one edge of the polygon to another, the electron is accelerated and so emits radiation. In this early system the radiation was broad band and ranged from the UV to hard X-rays. Over the intervening years, third generation machines has been design and developed and new lattice structures for the storage ring have been introduced, greatly increasing the brightness of the source.

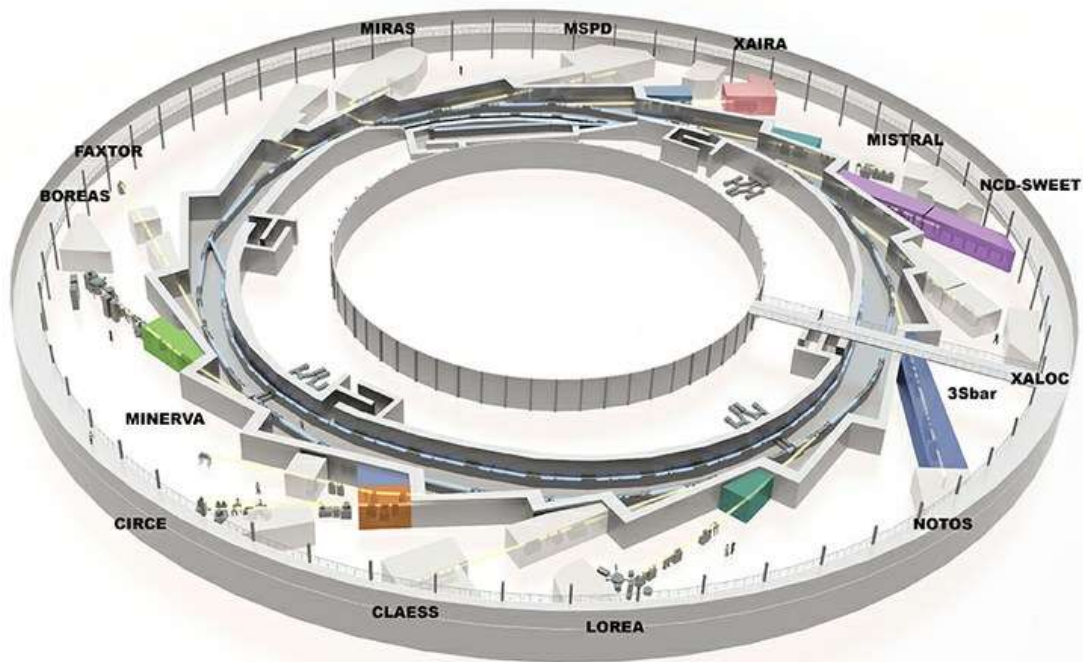


Figure 3 The layout of the ALBA Synchrotron Light Sourc. Reproduced from [8]

The Alba synchrotron light source shown in Figure 3 is an example of such a facility which opened in 2012 [8]. An important step was the introduction of undulator insertion devices which could be placed in the straight sections between the bending magnets.

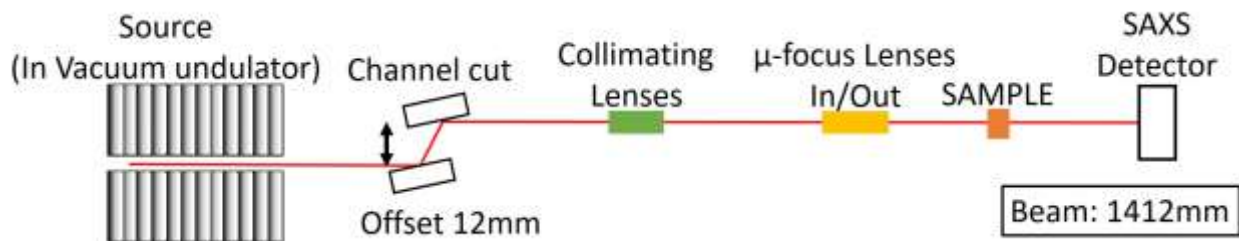


Figure 4 A schematic of the NCD-SWEET Beamline Reproduced from [9].

In this work we have exploited the capabilities of the NCD-SWEET SAXS/WAXS beamline shown in Figure 4 [9]. The undulator which is the source of the X-rays is shown schematically on the left. This array of Samarium Cobalt magnets mounted in a vacuum further accelerates the electrons. The static magnetic field varies along the length of the undulator with a wavelength  $\lambda_u$ , which for this undulator is 21.6 mm with 92 periods. Electrons traversing this periodic structure undergo oscillations and radiate energy. The radiation emitted is very intense and is concentrated in narrow energy bands [10]. The radiation is highly collimated in the orbit plane of the electrons. The radiation produced in this way enters the beamline. An undulator is

a harmonic device and on the NCD-SWEET beamline the first harmonic is the most intense. The energy is rather low at 2 keV and instead we utilize the 7<sup>th</sup> harmonic which has an energy of 12.4 keV corresponding to a wavelength of 1 Å. This selection of wavelength is a balance between the intensity of the harmonic produced in the undulator and its absorption by the aluminium alloy in the mould insert windows.



Figure 5 A photograph of the operando X-Ray Scattering Injection Moulding Stage mounted on the NCD-SWEET beamline at the ALBA synchrotron light source.

Figure 5 shows the injection moulding stage mounted on the NCD-SWEET beamline at the ALBA synchrotron light source. This photograph does not show the injection unit control system, the industrial recirculators used to control the mould temperature nor the remote control unit of this equipment. This stage was designed and developed by researchers at CDRSP and its design is described elsewhere [11-14]. It is emphasized that this is a fully functioning industrially relevant injection moulding system. Table 1 shows the parameters used to mould the parts prepared in this work.

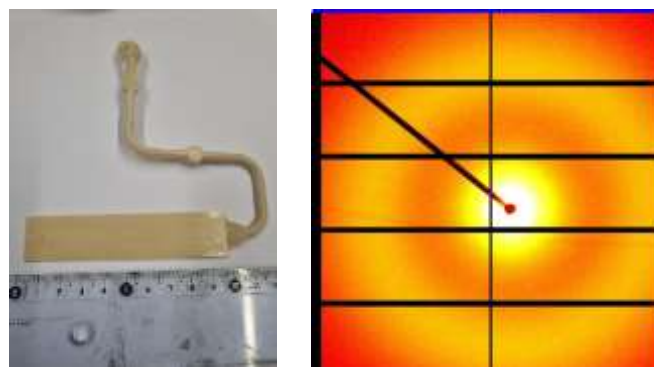


Figure 6(a left) shows a part prepared from PHB still with the cold runner attached which has been fabricated using the equipment shown in Figure 5, 6 (b right) shows a small-angle X-ray pattern

The first example shown is based on Polyhydroxybutyrate, a biopolymer produced by bacteria from waste streams. It is a semi-crystalline polymer with a melting point of ~172°C, often seen as reasonable direct replacement for isotactic polypropylene. In this work we used a PHB grade P304 obtained from Biomer in Germany. It exhibits a melt flow index of MFI of 8 g/10 min at 180C rising to 57.6 at 210 with 2.31Kg.



**Table 1.** Parameters used in these operando experiments

Parameter	Value	Units
Part weight	5	G
Shot size	13.0	cm <sup>3</sup>
1 <sup>st</sup> Injection Pressure	40	Bar
1 <sup>st</sup> Injection Time	2	S
2 <sup>nd</sup> Injection Pressure	30	Bar
2 <sup>nd</sup> Injection Time	6	S
1 <sup>st</sup> Injection speed	55	% <sup>a</sup>
2 <sup>nd</sup> Injection speed	45	% <sup>a</sup>
Cooling time	2	S
Cycle time	22.30	S

<sup>a</sup> The injection speed is set as a % of the maximum speed possible for the particular injection moulding system. For the system used in this work the maximum injection speed was 50mm/s.

The major advantage of the use of this operando equipment is the ability to record in a time-resolving manner small-angle X-ray scattering data from the transformation of the host plastic in the mould cavity to a solid part. Figure 6b shows the small-angle X-ray scattering (SAXS) pattern recorded for the part shown in Figure 6a at the end of the injection moulding cycle. This peak is typical for a semi-crystalline polymer and provides information on the scale and distribution of lamellae within the stack of alternating layers of crystalline and amorphous materials [15]. The uniform distribution of intensity around the circle indicates a random distribution of the orientation of those lamellar crystal stacks. The position of the peak intensity is at a modulus of the scattering vector of  $0.07\text{\AA}^{-1}$ .

In contrast Figure 7 shows a time-resolved series of SAXS patterns recorded during the injection moulding cycle of an isotactic polypropylene material, produced by Repsol as the grade ISPLEN PR595C2M with MFI of 45 g/10 min at 230°C with 2.31Kg. This polymer contains a small level of a clarifying agent. In this sequence time runs from left to right, each pattern is separated by 1s. Each pattern has had subtracted from the digital data, the background recorded for an empty cavity. The flow direction in the cavity is horizontal. The first pattern on the left corresponds to the first point in time where the molten polypropylene enters the mould cavity and we can observe a weak streak of intensity (white) in the vertical direction on either side of the central point which is the position of the zero-angle beam. There is also a weak horizontal streak. Moving from left to right, these weak features become more intense and by the 4<sup>th</sup> frame, we can clearly see two intense lobes on either side of the zero-angle position but very much intense on the horizontal or flow axis. This corresponds to the crystallization process of the hot plastic while cooling in the mould cavity. This is the same feature shown in figure 6b and the localization of the intensity indicates a high level of preferred orientation of the chain folded lamellar crystals normal to the flow direction. In the second line, the radial average of each of the SAXS patterns shown in the first line can be observed and we can see the growth of the peak corresponding to the lamellar peak. It is observed that this reaches a maximum after 9 seconds when we can deduce that the lamellar crystal volume fraction is 50% and so yields a maximum in the diffraction intensity. After that temperature, the intensity reduced as the electron density of the crystals moves closer to the electron density of the amorphous material. This is well known effect in the SAXS patterns of semi-crystalline polymers.

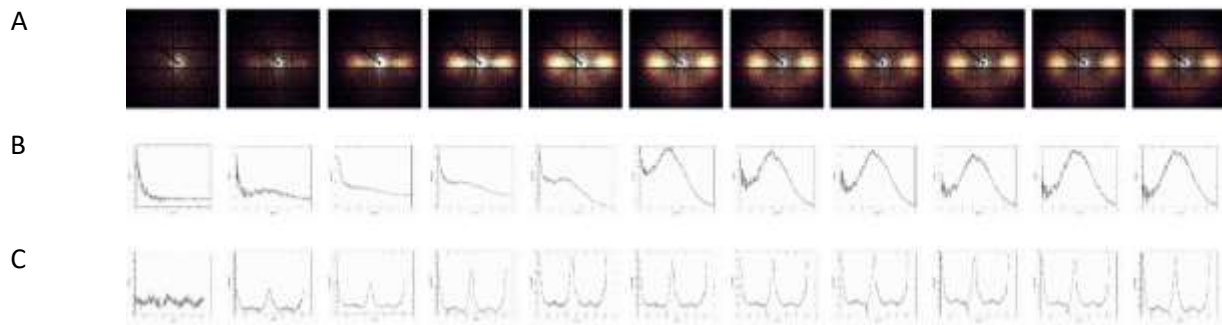


Figure 7 A time-resolved sequence of SAXS patterns taken using the equipment shown in Figure 5. Reproduced from [13]

The third line in Figure 7 shows a plot of the azimuthal variation in intensity for a fixed value of  $1Q1$ . The figures show an intensification of the anisotropy. Close inspection of these curves shows two small maxima corresponding to  $\alpha=90^\circ$  and  $270^\circ$  which are attributed to the fibrillar structures which are formed by the clarifying agent in polypropylene [16] which we can see are already present in the material at the start of the injection moulding cycle.

## REFERENCES

- 1) We have successfully developed and tested operando X-ray scattering measurements during injection moulding.
- 2) We are able to obtain useful quantitative data on the rate of crystallisation, local temperature variations, and the pattern of preferred orientation of the lamellar crystals.
- 3) We are able to operate on a 1 s data cycle time, and the possibilities of reducing this to 0.5 s are promising.
- 4) The design of the injection moulding unit enables modifications to be made easily and controls the processing parameters.
- 5) These validation experiments have confirmed that the microscopic characteristics in the process of transforming molten plastic to solid plastic are reproducible with successive moulding cycles, and this opens up the possibility of exploring spatial variations within the mould cavity using the predetermined window locations.
- 6) We have been able to obtain quantitative time-resolving data that can be compared with the predictions of computer simulations.
- 7) We now have a quantitative test bed able to explore new avenues and new procedures in the injection moulding of bioplastics;
- 8) The opportunities for multiscale active feedback are exciting and move us closer to the realisation of a multiscale digital twin for injection moulding.

We anticipate that this equipment will provide a valuable tool in the study of the development of injection moulding technology in order to increase the use of bioplastics and to increase the level of plastic waste which can be recycled to fabricate high quality products

## Acknowledgements

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**SLEEP TROUBLES IN THE CARDIAC WORLD: A LOOK INTO LIFESTYLE-  
INDUCED INSOMNIA**

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**ABSTRACT**

**Background:**

With advances in research in the context of cardiovascular health; sleep disorders, particularly insomnia and sleepiness have drawn more and more attention. Recently, research has brought light on the potential effects of sleep disorder in the risk of cardiovascular disease (CVD).

**Aims and Objectives:**

The main objective of the study is to investigate the association between sleep disorder (insomnia and sleepiness) with CVD. Furthermore, we aimed to explore the impact of lifestyle factors such as caffeine intake, dietary intake, and smoking, as an aggravating factor in sleep disturbance in CVD patients.

**Methodology:**

The pilot study design is a cross-sectional analysis; the sample size was selected using z-test on current population of city. The guidelines followed were Epworth Sleepiness Scale (EPSS) and Insomnia Severity Index (ISI) for evaluation of sleep disturbances. Statistical analysis was performed using Fischer Test to develop a potential link between CVD patients and sleep disturbances.

**Results:**

The study found a strong association between sleep disorder (insomnia and sleepiness) and CVD. Smoking and caffeine consumption were also associated with insomnia. CVD patients had a significantly higher prevalence of sleep disturbance than non-CVD patients ( $p < 0.05$ ).

**Conclusion:**

This study highlights the importance of understanding the relationship between sleep disorder, lifestyle factors, and cardiovascular health. Early intervention and preventive measures, as well as comprehensive strategies that address both lifestyle and sleep factors, can improve the quality of life of CVD patients.

**Keywords:** Cardiovascular disease, Insomnia Severity Index (ISI), Epworth Sleepiness Scale (EPSS), and Lifestyle factor.

## INTRODUCTION

A key component of human existence, sleep plays an essential role for general health and wellbeing. Sleep is a dynamic process during which the body heals, regenerates, and maintains essential bodily processes. It is not only a passive condition of rest. When this mechanism is harmed, it can have serious effects on both mental and physical health. However, a growing number of people are having trouble sleeping as a result of a variety of circumstances, including stress, lifestyle choices, and medical issues.

*Insomnia, sleep apnea, restless legs syndrome* and *narcolepsy* are just a few of the problems that fall under the category of "sleep disorders," which include a wide range of ailments that affect both the quality and amount of sleep.

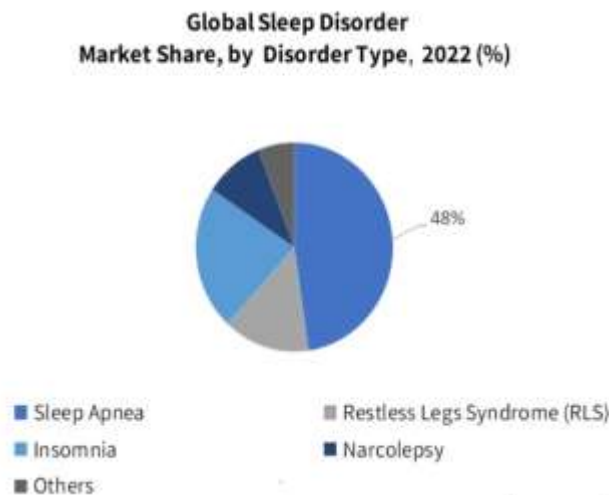


Figure 1: Global prevalence of Sleep Disorder

## CARDIOVASCULAR HEALTH IN RELATION TO SLEEP DISORDERS

It has become increasingly clear that sleep and cardiovascular health are related. This association is not just a coincidence; rather, it has its roots in the complex physiology of the human body. Our bodies go through a complicated sequence of physiological activities when we sleep that are essential for preserving cardiovascular health. These include controlling blood pressure, controlling heart rate, and releasing hormones that are essential for protecting vascular integrity.

In addition, long-term sleep deprivation and disturbed sleep patterns can cause metabolic problems, such as insulin resistance and obesity, both of which are risk factors for cardiovascular diseases. Atherosclerosis, a condition marked by the accumulation of plaque in the arteries, which may eventually result in heart disease, can also be brought on by sleep problems.

**Obstructive sleep apnea (OSA)**, which involves repeated disruptions in breathing during sleep owing to the partial or total collapse of the upper airway, is one of the most alarming sleep disorders in this setting. OSA has been closely linked to a number of cardiovascular conditions, including atherosclerosis, left ventricular hypertrophy, and hypertension. Recurrent hypoxia- and hypercapnia-induced episodes in OSA can result in oxidative stress, inflammation, and endothelial dysfunction, all of which help to promote the onset and progression of cardiovascular diseases.[1]

***Insomnia and Cardiovascular Health***

**Chronic Insomnia** has been associated with an increased risk of various heart diseases including coronary artery disease, heart attacks, and stroke. Chronic insomnia can lead to increased levels of stress hormones and inflammation in the body, which in turn can raise the risk of cardiovascular conditions such as hypertension, atherosclerosis, and heart disease. Furthermore, poor sleep quality may disrupt the body's natural circadian rhythms, affecting blood pressure and heart rate regulation [2]

**Lifestyle factors** can significantly influence the risk of having sleep disorders. These factors include:

- 1. Dietary Choices:** Sleep difficulties have been related to unhealthy eating patterns, such as an excessive intake of sugar and processed foods.
- 2. Physical Activity:** Lack of physical exercise and sedentary lifestyles have been linked to an elevated risk of insomnia.
- 3. Anxiety and Stress:** It is widely recognised that long-term stress and worry can interfere with sleep cycles and aggravate insomnia.[3]
- 4. Substance Use (Alcohol and Nicotine):** Nicotine and alcohol can both interfere with the design of sleep. Alcohol might cause sleepiness at first, but it can also cause disturbed sleep, and nicotine is a stimulant that makes it difficult to fall asleep.
- 5. Consumption of Coffee:** Excessive caffeine use can shorten the amount of time that people sleep at night and interfere with the initiation of sleep. [4]

**LITERATURE REVIEW:**

*Table 1: Literature review of the study*

<b>S. No</b>	<b>TITLE OF ARTICLE</b>	<b>YEAR</b>	<b>STATEMENT</b>
1.	Prevalence and associated factors of poor sleep quality among Chinese older adults living in a rural area: a population-based study	2020	In Elder of rural areas, sleep quality is found to be poor than in urban areas elder population and prevalence of sleep disorder is found to be more profound in female population than in male population.
2.	Association between daytime sleepiness and risk of cardiovascular disease and all-cause mortality: A systemic review and meta-analysis of longitudinal cohort studies	2020	Study shows that Excessive daytime sleepiness (EDS) can predict the occurrence of CVD events, CHD, stroke and all- cause mortality as it is directly associated with them.
3.	Insomnia in patients with coronary heart disease: prevalence and correlates	2021	In CHD outpatient, insomnia is highly prevalent. It shows strong association with anxiety. Also diabetes, type D personality, low fish intake and subclinical inflammation have large effect on insomnia.

<b>S. No</b>	<b>TITLE OF ARTICLE</b>	<b>YEAR</b>	<b>STATEMENT</b>
4.	Accumulated unhealthy behaviors and insomnia in Japanese dwellers with and without cardiovascular risk factors: a cross-sectional study	2022	Unhealthy behavior factors like smoking, drinking, skipping breakfast, no exercising and obesity is largely associated with increased insomnia. Also, an individual having one or more cardiovascular risk factors (Diabetes, hypertension and dyslipidemia) have profound effect on unhealthy behavior and insomnia.
5.	Cardiovascular Diseases And Sleep Disorders In South Asians: A Scoping Review	2022	In SOUTH ASIA, Obstructive sleep apnea and short sleep duration were more common in early age which is greatly associated with cardiovascular morbidity and mortality.
6.	Association Of Sleep Duration And Quality With Cardiovascular Risk Factors In Pakistani Adults	2023	In observational study, conducted in public hospitals of Pakistan, reported that participant with >6 hour sleep duration has CHD in higher percentage than in comparison to those that slept more than 6 hours.

**MEHODOLOGY**

**Study Design:**

For this pilot study design we select cross sectional survey approach for investigating the potential link between sleep disorder and cardiovascular disease (CVD). This design allows the initial understanding of the relationship between these two factors within our study population.

**Study Guideline and Setup:**

This study was done under the supervision of Jinnah University for Women, Karachi, Pakistan. The study was carried out by generating comprehensive online survey questionnaire, encompassing questions related to sleep pattern, lifestyle factors, cardiovascular health, knowledge and awareness and demographic information.

Epworth Sleepiness Scale and Insomnia Severity Index (ISI) were used for evaluation of sleep disorder. The survey was designed to obtain both qualitative and quantitative data including close-ended, multiple choice questions and Likert scale.

**Inclusion Criteria:**

- o Participant under the age 18-60.
- o Participant with no cognitive impairment or language barriers that would hinder their accurate self assessment.
- o Participant that provide consent to participate in this study.

**Exclusion Criteria:**

- o Participant with cognitive impairment or language barrier.
- o Participant who do not provide informed consent.

**Sampling Consideration:**



On the population of Karachi, the single-sample Z-test was conducted, resulting in sample size of 206 participants for our pilot study. Participant in this survey were chosen at random from Karachi's diverse population to guarantee the sample's representativeness.

***Ethical Consideration:***

Ethical rules and regulation were strictly followed throughout the study and sample selection. Prior to participating all participant were provided with clear and concise information about study purpose, data collection process and their right. Anonymity was considered and participant responses were kept strictly confidential.

***Section I:***

This section of survey is composed of three appendices each focusing on different aspects of participant information.

Appendices-1: This appendix includes information related to demographic feature of participants which specifically includes data on age and gender of the participants. This information allows the necessary understanding of characteristic of the study population.

Appendices-2: This appendix is comprised of questions that assess lifestyle factor of participants like their exercising habit, smoking habit, dietary intake and caffeine consumption.

Appendices-3: This appendix focuses on participant's cardiovascular health and their family history. It includes information on family medical history of participant, including any history of heart disease or other cardiovascular condition, as well as any preexisting cardiovascular condition.

***Section II:***

This section is designed to evaluated sleep habits of participant of survey. It contains of two appendices, each with specific purpose:

Appendices-1: This appendix contains a set of questions that evaluate daytime sleepiness in participant by using Epworth Sleepiness Scale(ESS). The question in this appendix help to evaluate the sleepiness of participant during daytime activities.

Appendices-2: This appendix includes set of questions that evaluate insomnia among participant by using insomnia severity index (ISI). The question in this appendix addresses various aspects of participant sleep pattern and insomnia-related experiences.

***Section III:***

This section is designed to evaluate the awareness and knowledge of participants regarding the association of sleep disorder and cardiovascular health as well as the role of healthcare professional play on disseminating information on this topic.

***Statistical Analysis:***

Using SPSS 20.2, all the obtained data was processed and Fisher's test was chosen for evaluation. To distinguish categorical data, a significance level of  $p\text{-value} < 0.05$  was employed. The results obtained were represented in terms of frequency (N), percentage and their associated p-value.

**RESULT**

**SECTION I:**

Total 206 responses were collected, out of which 65.05% were female and 30.10% were male. High amount of respondent were fall under the age group of 18-30 and some come under the age group of under 18 & 31-45. This obtained demographic data is represented in table 1.

Table 2: Demographic data of the participants

Demographic features		Frequency (N)	Percentages (%)
<b>Age</b>	under 18	32	15.53
	18-30	122	59.22
	31-45	36	17.48
	46-60	14	6.80
<b>Gender</b>	male	62	30.10
	female	134	65.05
	prefer not say	7	3.40

From total obtained responses, majority of participant (more than 60%) are found to be physically active and have no smoking habits. In terms of their dietary intake, about 54.85% showed that their intake somewhat health & balanced, whereas about 20.87% have unhealthy diet. However, approximately 30% of respondents have high caffeine consumption and around 45.63% have normal daily caffeine consumption. This data on lifestyle factors of respondents is represented in table 2.

Table 3: Lifestyle factors of respondents (n=206)

Lifestyle factors		Frequency (N)	Percentage (%)
<b>Physical activity</b>	Daily	38	18.4466
	3-5 time a week	40	19.41748
	1-2 time a week	47	22.81553
	Rarely	43	20.87379
	Never	37	17.96117
<b>Smoking</b>	Yes	48	23.30097
	No	154	74.75728
<b>Dietary factors</b>	Healthy & balanced	47	22.81553
	Somewhat healthy	113	54.85437
	Unhealthy	43	20.87379
<b>Caffeine consumption</b>	None	50	24.27184
	1-2 serving	94	45.63107
	3-4 serving	37	17.96117
	More than 4 serving	24	11.65049

Out of 206 participants about 59.22% have no cardiovascular condition and the ratio of participant that do have cardiovascular condition or not sure about it are about 18.93% and 20.87% respectively. However, about 51.45% do have family history of cardiovascular condition. The table 3 below represent overall cardiovascular health of participant.

Table 4: Cardiovascular health of respondents

Cardiovascular Health		Frequency (N)	Percentage (%)
<b>Cardiovascular Disease Condition</b>	Yes	39	18.93204
	No	122	59.2233
	Not sure	43	20.87379
<b>Family history</b>	Yes	106	51.45631
	No	96	46.60194

### **SECTION II: SLEEP EVALUATION**

From total 206 collected responses; about 46.60% of respondents have sub threshold insomnia and approximately about 20% have clinical insomnia. Whereas, about 29% of our survey population have sleepiness problem. The table 4 & 5 below shows the data of their insomnia and sleepiness evaluation.

Table 5: Insomnia evaluation data of respondents (n=206)

Insomnia Severity Index (ISI)		Frequency (N)	Percentage (%)
<b>No clinically significant insomnia</b>	0-7	69	33.49515
<b>Sub threshold insomnia</b>	14-18	96	46.60194
<b>Clinical insomnia(moderate severity)</b>	15-21	40	19.41748
<b>Clinical insomnia(Severe)</b>	22-28	2	0.970874

Table 6: Sleepiness evaluation data of respondents (n=206)

Epworth Sleepiness Scale		Frequency (N)	Percentage (%)
<b>Unlikely that you are abnormally sleepy</b>	0-7	121	58.73786
<b>Average amount of daytime sleepiness</b>	8--9	25	12.13592
<b>May be excessive sleepy, should consider seeking help</b>	10--15	49	23.78641
<b>Excessive sleep, should consider seeking medical attention</b>	16-24	11	5.339806

### **SECTION III:**

Regarding the awareness related to sleep disorder on CVD, about 32.52% of our study population is not at all aware however; about 29.12% have slight awareness. In terms of their concern, high ratio of population has neutral views about it. But more than 60% showed negative response in terms of seeking medical professional help & advice. The table 6 below represents the data related to awareness & knowledge.

Table 7: Awareness & knowledge of respondents(n=206)

Awareness & Knowledge		Frequency (N)	Percentage (%)
<b>Awareness</b>	Slightly aware	60	29.12621
	Moderately aware	47	22.81553
	Extremely aware	28	13.59223
	Not at all aware	67	32.52427
<b>Concern</b>	Concerned	44	21.35922
	Very concerned	21	10.19417
	Neutral	90	43.68932
	Not concerned	48	23.30097
<b>Seeking help from professional</b>	Yes	68	33.00971
	No	132	64.07767

**STATISTICAL ANALYSIS:**

Fisher's test performed on different variables of study, showed that insomnia and sleepiness are correlated to cardiovascular disease as their p-value is found to be significant ( $p < 0.05$ ). Along with that insomnia and participant with insomnia & CVD show significant correlation ( $p < 0.05$ ) with lifestyle factors (smoking and caffeine consumption). Whereas, sleepiness and participants with sleepiness and CVD show significant correlation ( $p < 0.05$ ) only with smoking. There was no significant co-relation between dietary consumption and insomnia, sleepiness & CVD.

Table 8: Co-relating Cardiovascular disorder to sleep disorders

Factors	CVD	Non-CVD	P-value	Significant difference
Insomnia	70	68	P-value $< 0.05$	Significant
Sleepiness	21	39		

Table 9: co-relating Smoking with cardiovascular disorder and sleep disorder

Factors	Smoker	Non Smoker	P-Value	Significant difference
Insomnia	11	55	P-value $< 0.05$	Significant
Insomnia + CVD	34	35		
Sleepiness	12	48	P-value $< 0.05$	Significant
Sleepiness + CVD	9	12		

Table 10: co-relating Caffeine intake with cardiovascular disorder and sleep disorder

Factors	Caffeine	No Caffeine	P-value	Significant difference
Insomnia	13	54	P-value $< 0.05$	Significant
CVD + Insomnia	30	41		
Sleepiness	12	18	P-value $> 0.05$	Not significant
Sleepiness + CVD	8	7		

Table 11: co-relating Dietary habits intake with cardiovascular disorder and sleep disorder

Factors	Somewhat Healthy	Unhealthy	P-value	Significant difference
Sleepiness	39	11	P-value >0.05	Not significant
CVD	40	20		
Insomnia	71	34	P-value >0.05	Not significant
CVD	40	20		

Table 12: : co-relating Dietary habits intake with cardiovascular disorder and sleep disorder

Factors	Healthy	Unhealthy	P-value	Significant difference
Sleepiness	10	11	P-value >0.05	Not significant
CVD	21	20		
Insomnia	31	34	P-value >0.05	Not significant
CVD	21	9		

## DISCUSSION

In the world of cardiac health, the impact of sleep troubles, specifically lifestyle-induced insomnia, has become a subject of significant interest and concern. This examination delves into the relationship between sleep disturbances originates from lifestyle factors and their implications for individuals with heart-related conditions. As we navigate this exploration, we unravel the complex interplay between lifestyle choices, insomnia, and their far-reaching consequences within the context of cardiac health.

A cross sectional survey was designed to collect different opinions of people regarding the link between sleep disorder & cardiovascular diseases. An audience was targeted at random responses to this survey, encompassing questions related to their sleep pattern, lifestyle factors, cardiovascular health, knowledge and awareness and demographic information, which helped us to determine the level of knowledge of respondents when it comes to health and diagnostic field. The age group of 18-60 was targeted and about 206 respondents take part in this pilot study.

Our study is divided into three main sections in which the 1<sup>st</sup> section includes the demographic data in table no 1 & includes lifestyle factors of respondents in table no 2 & it also includes cardiovascular health of overall respondents in table no 3. In 2<sup>nd</sup> section it includes Sleep Evaluation which consist of insomnia evaluation data in table no 4, sleepiness evaluation data in table no 5. In 3<sup>rd</sup> section it includes Awareness & knowledge of respondents in table no 6.

In the first Section of the study demographic information, lifestyle factors, cardiovascular health has been explored. In terms of gender, the majority of responses were from female (65.05%) and most of the responses we obtained laid in the category of age group 18-30 (59.22%) in table no 1. This section also includes the lifestyle factors (table no 3) which showed (60%) of the respondents are found to be physically healthy or in a good shape and (74.75%) respondents showed no smoking habits. About (54.85%) of the respondents claimed that they take somewhat healthy or balanced diet and the (45%) of the respondents claimed to have normal daily consumption of caffeine. As in table no 3, the information regarding their cardiovascular health was collected, which showed that the most of the participants (59.22%) have no cardiovascular conditions or disease whereas, (51.45%) do have a family history of the cardiovascular condition.

The section 2 was aimed to evaluate the sleepiness and insomniac conditions of the respondents. In table no 4 By using Insomnia severity index (ISI), we found that majority of the respondents of the survey have a sub threshold insomnia (46.60%), which means they showed few signs of insomnia, that can also be called initial stage, can be treated or could be improved. However, about (20%) participant found to be clinically insomniac that need immediate medical help for insomnia management. In table no 5 the respondents (29%) found to have a sleepiness problem which was determined by the help of Epworth Sleepiness Scale which revealed that they respondents should seek help for their condition. Furthermore, to identify the correlation of insomnia and sleepiness with cardiovascular disease we apply fisher's test, the result revealed a significant difference as the p value was found to be  $p < 0.005$ . This declared that this sleep disorder may aggravate the CVD conditions of the respondents and increasing the risk or chances of cardiovascular conditions in those who are not CVD patients but are suffering from sleep disorders. Other correlation was found to be with the lifestyle factors, as the respondents having insomnia and insomnia with CVD both showed significant correlation ( $p\text{-value} < 0.05$ ) with lifestyle factors such as smoking & caffeine consumption, which revealed that these factors play role in aggravating the CVD and insomnia conditions and found to be the potential risk factor for insomnia and CVD. Other correlation showed that sleepiness and sleepiness with CVD condition are correlated to lifestyle factor (smoking), as their p-value is found to be significant ( $P < 0.05$ ) which showed that the respondents having sleep disorder or with CVD conditions may get suffered more due to the smoking habits as it is found to be one of the risk factor of sleepiness and CVD. We also apply fisher's test to determine the correlation between other lifestyle factors but we found no significant co-relation between dietary consumption and insomnia, sleepiness & CVD.

The 3<sup>rd</sup> section of our study, targets the awareness, knowledge and concern of the respondents in table no 6, (32%) of the respondents claimed to have no awareness regarding the effect of sleep disorders on CVD as they need proper counseling and awareness. When it comes to the concern of the respondents the response we got is neutral and medical professional help ratio is bit lower as more than (60%) respondents claimed to not seeking any medical help or not getting any professional advice. Increased knowledge and proactive steps in this domain will be necessary to guarantee that people with sleep problems receive the required medical care and lower the risks to their cardiovascular health.

Our study exclusively showed potential link between sleep disorder and cardiovascular disease (CVD) and examined the respondents review on this topic as they concealed their complete knowledge regarding their awareness to CV health and identified their sleep disorder in addition with lifestyle factors which can be troubling with their Cardiac health.

### **Conclusion**

Sleep play very huge role in development and advancement of cardiovascular disease. The study of lifestyle-related insomnia in relation to cardiac health highlights the critical importance of taking sleep problems into consideration and treating them as a part of cardiac care. It is critical to understand how lifestyle decisions affect insomnia and how it affects people with cardiac disorders. We may make great progress in improving the general health and cardiovascular wellness of those who require it by diagnosing and treating lifestyle-induced insomnia.

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## 360 DEGREE IMAGE NOISE PROCESSING AND APPLICATION

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### ABSTRACT

Image noise can appear for many reasons, such as the quality of the camera, lighting conditions, or the process of stitching images together. 360-degree image noise can reduce image quality, lose important details, making it difficult to observe and analyze images. 360-degree image noise processing plays an important role in improving image quality. photos, making them sharper. This article conducts an overview of research works related to 360 Image Noise Processing. The results of the research will help give an overview of 360 Image Noise Processing. From there, it can be applied in various fields such as healthcare, tourism, industries and many more to eliminate noise and create enjoyable user experiences. 360-degree image noise processing is an important tool in the digital world, it brings an interesting feeling to help enhance the experience and effectively manage information.

**Key word:**Image noise, noise processing, 360 images, image digitization, enhanced experience

### Introduction

Due to the influence of the environment, camera quality and other factors, images are inevitably disturbed during the recording, compression and transmission process, leading to distortion and loss of image information. In the presence of noise, further image processing tasks can occur, image denoising, one of the basic and important problems in image processing. This article introduces the causes of noise, mathematical models of noise and noise reduction methods from classical to modern. The article also presents experimental results and evaluates the performance of denoising methods on standard data sets. Finally, the article offers some conclusions and future research directions in this field. Therefore, image denoising plays an important role in image processing systems.

Image denoising is important in image processing, to remove noise and restore realistic images. Noise can occur due to environmental factors, transmission channels or image compression processes. Noise reduces image quality and affects other image processing tasks. Denoising methods are classified into three main groups: classical methods, transformational techniques, and convolutional neural network (CNN) based methods. These methods have different advantages and disadvantages and are compared on standard data sets. The problem of image denoising is still a challenging and open task and needs more extensive research in the future.

In reality, 360-degree image noise processing is a difficult and new problem in the field of image processing. 360-degree photos are a type of photo that can show a panoramic view of a space by using special photography equipment or stitching multiple photos together. 360-degree photos can bring a vivid and realistic experience to viewers, but can also be noisy due to factors such as lighting, resolution, stitching errors, etc. Noise in 360-degree photos can cause reduces image quality and affects other applications such as virtual reality, travel, and real estate. The main reason for this is that from a mathematical perspective, image denoising is an

inverse problem and its solution is not unique. In recent decades, great achievements have been achieved in the field of image denoising [2,3,4] and we will consider it in the following sections.

### Types of image noise

Image noise refers to random variations in the brightness or color information of pixels in a digital image. It can reduce the quality of the image and make it grainy or distorted. There are several types of image noise, including:

- **Gaussian noise:** Gaussian noise is a type of random noise that follows a normal distribution. It is commonly used in signal processing, communications, and image processing to model the effects of various noise sources, such as thermal noise, sensor noise, or channel noise. Gaussian noise can also be added to the input data during training to improve the model's reliability and generalization ability. This is called data augmentation [5].
- **Salt & Pepper noise:** Salt & Pepper noise, also known as impulse noise, is a type of noise that affects digital images by randomly changing some pixels to black or white. It can be caused by many different factors, such as errors during image acquisition, transmission, or storage. Salt & Pepper noise can reduce image quality and make interpretation or processing difficult [Salt & paper say]. [18]
- **Shot noise or Poisson noise:** This noise is caused because during the reception process, a large number of photons are concentrated at one point and they create noise at that point. Noise is characterized by the Poisson probability distribution density function, so it is called Poisson noise.

Shot noise or Poisson noise is a type of noise caused by the random appearance of discrete particles or events, such as photons or electrons. It follows a Poisson distribution, which means that the variance of the noise is equal to the mean value of the signal. Image noise predominates in situations where the number of particles or events is low, such as in low-light photography or in electronic circuits. Image noise can be reduced by increasing signal strength or averaging multiple measurements [15].

- **Speckle noise or speckle noise:** Is a type of noise that arises due to the influence of environmental conditions on the image sensor during the image acquisition process. Speckle noise is mostly detected in the case of medical images, Operational Radar images and Synthetic Aperture Radar (SAR) images. [8]

Noise occurs in images for many reasons. Perhaps the most frequently occurring noise is sub-Gaussian noise. [9]

Image noise processing is the process of removing or reducing false or unwanted pixels in an image. To improve image quality and clarity. There are a number of image noise treatment methods that have been proposed and researched in scientific works. Some of the main methods and popular programs are as follows:

Spatial domain based method:

This method handles image noise using operators in the spatial domain of the image, such as median filters. Median filter Gauss filter Wiener filter Bilateral filter Non-local method filters, etc. This method has the advantage of being simple and easy to use. But there is a downside: it can blur the details and edges of the image.

Linwei Fan Synthesize and compare existing methods. Divide noise reduction methods into three main groups: spatial domain methods, transformation domain methods and methods based on convolutional neural networks. Hang Fu New band selection and spatial noise reduction method for hyperspectral image classification proposes a new unsupervised dimensionality

reduction framework that integrates band selection and spatial noise reduction for hyperspectral image classification. It uses a new neighbor group normalization matching filter for band selection and advanced 2-D single spectrum analysis to reduce spatial noise. Shuying Li & Wei Liu During the process of image processing, acquisition, reception and transmission, images are often affected by noise, leading to "distortion" at different levels. Image denoising is a very important graphics processing method, which can effectively improve the quality of scattered images and solve the problem of image quality deterioration after noise pollution in practice. spatial denoising methods, including mean filter, Wiener filter, and median filter, and analyze these methods. By using MATLAB software, **Image denoising methods in the spatial domain are researched and tested and the results are analyzed. Keya Huang : talks about an improved image processing algorithm for non-local mean noise reduction (NLM). This algorithm combines the adaptive median filtering (AMF) algorithm with the traditional NLM algorithm, first adaptively adjusting the image window size, selecting corresponding pixel weights, and then reducing image noise. , which can have good filtering effect for mixing noise. Experimental results show that, compared to the traditional NLM algorithm, the algorithm proposed in this paper has better results in terms of image quality and signal-to-noise ratio (PSNR) of complex noisy images.**

Method based on frequency domain:

This method handles image noise using transformations in the image frequency domain, such as the Fourier transform. Cosine transform wavelet transform, etc. This method has the advantage of being able to separate signal and noise components in the frequency domain. But there is a disadvantage that it can cause edge phenomenon. and difficulty handling non-linear noise.

Yadav and public history Adaptation-based frequency domain filter to reduce periodic noise in images: This method adaptively defines a threshold function to identify noisy regions in the frequency domain and replaces pixels in noisy regions by applying Use a minimum filter that uses their neighbors to determine the new frequency value

Espinosa-Bernal The reduction of periodic or quasi/periodic noise present in the image arises because the image can be obtained digitally. However, it was not until the sources of such contamination were analyzed, as well as how they were represented digitally, that work began to remove the contamination contained in corrupted images.

Machine learning methods:

Digital photography equipment is widely used in many fields. including personal identification (Lei et al., 2016, Wen, Xu et al., 2020, Wen, Zhang et al., 2020) and remote sensing (Du, Wei, and Liu, 2019) Figs. Captured as a degraded image of the hidden observation. In particular, the decomposition process is affected by factors such as light and sound (Zha et al., 2018, Zhang and Zuo, 2017). Noise will occur during transmission and compression due to unknown potential observations (Xu, Zhang, & Zhang, 2018c). It is essential to use image noise reduction techniques to remove noise and restore it. Observations may arise from degraded images

image denoising using machine learning techniques such as regression and classification. deep learning, etc. This method has the advantage of being able to learn the patterns and relationships between pixels in the original image and the image without noise. But it has the disadvantage of requiring sufficiently large and high-quality training data. And it can be difficult to deal with new types of interference. [2]

Chunwei Tian and public history 2020 We use a convolutional neural network (CNN), a type of deep learning technique, to reduce noise in images. CNN is a network capable of automatically

learning image features from data. We train a CNN model to learn the mapping from noisy images to noiseless images, using a dataset of noisy and noiseless image pairs [twelfth].

### **Research results**

In this paper, we study the problem of noise in 360-degree images, a type of image created by combining images from many different perspectives. Image noise can appear due to many reasons, such as due to the quality of the camera, due to lighting conditions, due to the process of stitching together images, etc.

Image noise can reduce image quality, lose important details, and make it difficult to observe and analyze images. We tested and compared the effectiveness of three popular image noise processing methods: spatial domain based methods, frequency domain based methods and machine learning methods. We used a 360-degree image dataset containing different types of noise, such as Gaussian noise, salt-pepper noise, Poisson noise, and Speckle noise. We evaluated the effectiveness of image noise processing methods using image quality metrics.

Experimental results show that the machine learning method has the highest performance in denoising 360-degree images, followed by the frequency domain-based method and the spatial domain-based method. Machine learning methods can not only remove false or unwanted pixels in images, but can also restore details and edges of images. Frequency domain-based methods can separate signal and noise components in the frequency domain, but may cause edge phenomena. Spatial domain-based methods can handle simple types of noise, but can blur image details and edges.

The significance of this research result is: This research is significant in improving the quality of 360-degree images, a type of image created by combining images from many different perspectives. 360-degree images can be used in many fields such as tourism, education, entertainment, etc. However, 360-degree images are often noisy due to various reasons, reducing the clarity and details of the images. By comparing and evaluating popular image noise processing methods, this research can help choose the most suitable method to denoise and restore 360-degree images. This can contribute to increased user experience and expanded applications of 360-degree images.

### **Conclusion**

This research has provided an overview of image denoising. It is one of the crucial and prevalent issues in the field of image processing. In numerous applications, it can adversely affect the image quality and lead to the loss of vital information. The study of image denoising has continuously evolved to effectively reduce or eliminate noise, thereby enhancing image quality. In our research, we focused on presenting an exploration of image denoising and analyzing the technique involving the combination of deep neural networks and traditional image processing methods to minimize noise. Specifically, the deep convolutional neural network (CNN) model combined with advanced image processing algorithms to reconstruct images from noisy ones. The potential applicability of this model in practical applications is substantial. Fields such as medicine, information technology, and industry can all benefit from employing advanced image denoising techniques. High-quality image reconstruction can support medical diagnosis and pharmaceutical research. The fusion of deep neural networks with traditional image processing methods has yielded positive results and potential applications in real-world scenarios. However, there are still ample opportunities for future research to explore and improve the performance of image denoising models. This exploration is necessary to apply them in image denoising effectively and further enhance their real-world applicability.



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**EFFECT OF MAGNETIC FIELD ON REMOVAL OF DENSE NON AQUEOUS  
PHASE LIQUID FROM UNSATURATED ZONE USING STEAM INJECTION**

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**ABSTRACT**

Unsaturated zone is of great importance in providing water and nutrients that are vital to the biosphere and the main factor controlling water movement from the land surface to the aquifer. Contamination of unsaturated zone by Dense Non-Aqueous Phase Liquids (NAPLs) has become a major threat to human environment as a result of increasing concern with industrialization. The use of steam injection for remediation of porous media which are contaminated by DNAPLs has not given the desired recovery efficiency, hence the need for improvement in recovery efficiency has been a subject of continuous study. This study investigated the effect of magnetic field on the removal of DNAPL from unsaturated zone using steam injection.

An unsaturated zone of a sand box of interior dimensions 110 x 74 x 8.5 cm was polluted at different periods with 200 ml of Carbon tetrachloride. Steam injection experiment with flow rate of 0.01 m<sup>3</sup>/s was performed to determine the recovery efficiencies of Carbon tetrachloride in an unsaturated zone containing sand of porosity 0.42 and permeability of 0.001163779 cm/s. Magnetic field in steps of 1 Tesla (T) was introduced from 1-3 Tesla (T) into the experiment. The effects of magnetic field on removal of DNAPL from unsaturated zone using steam injection only and steam injection with magnetic field were compared using descriptive statistics.

The recovery efficiency of Carbon tetrachloride using steam injection only was 82.05 %, while that with varying magnetic field at 1T, 2T and 3T were 89.45%, 94.95% and 95.35% respectively. The recovery efficiency of steam injection with varying magnetic field at 1T, 2T and 3T were 9.02, 15.72, 16.21% higher than the result of steam injection only for Carbon tetrachloride.

The result demonstrated the ability of steam injection to recover contaminants from the subsurface. A combined application of steam injection with magnetic field appreciably enhances the removal of Non Aqueous phase liquids from Unsaturated Zone.

**Keywords:** Magnetic Field, Dense Non Aqueous Phase Liquid, Unsaturated Zone, Steam Injection

**Introduction**

Groundwater is one of the most important natural resources to man. It provides thirty-six percent (36%) portable water for domestic, forty-two percent (42%) for industrial use, and twenty-four percent (24%) for agriculture/irrigation especially in a place where there is no surface water like an arid region. It is found below the surface of the earth in the soil pore space and cracks of rock formation and this unit of rock is called an aquifer (Doell and Scanlon, 2011).

The groundwater can be contaminated in different ways by the different sources which natural sources, septic systems, improper disposal of hazardous waste, landfill and. impoundments, sewers, and other are pipelines, pesticides/fertilizers use, drainage wells, injection wells/floor drains, improperly constructed wells, improperly abandoned wells, active drinking water supply wells, poorly constructed irrigation wells, mining activities, and spills from stored chemicals and petroleum product such as Non-Aqueous Phase Liquids (Krishna 2008).

Non-Aqueous Phase Liquids (NAPLs) are liquids contaminants solution that does not dissolve in or easily mix with water, they contaminate soil and groundwater. It is classified into Dense Non-Aqueous Phase Liquids (DNAPLs) and Light Non-Aqueous Phase Liquids (Uwe 2013). Effects of groundwater contamination results range from reduced drinking, agriculture, industrial water qualities, loss of water supply, degraded surface water system, destruction of aquatic habitats, higher cleanup costs, high costs for alternative water supplies, and health problems such as kidney failure and cancer which are life-threatening disease (Ortiz-Hernandez *et al.* 2014; Wesseling *et al.* 2001).

Groundwater remediation is the process that is used to treat polluted soil and groundwater by removing the pollutants or converting them into harmless substances. During the past few years, several in situ techniques have been developed for clean up of soils contaminated by NAPLs. Existing remediation technologies include vapour extraction, radio frequency heating steam, stripping (steam injection) and biological/chemical/physical methods. Thermal technology, which make use the application of heat to the groundwater via soil to increase the recovery efficiency of volatile and semi-volatile contaminants from the aquifer. Thermal treatment includes the use of electrical resistivity heating, steam enhanced extraction, conductive heating, radio-frequency heating, and vitrification technologies (SEPA 2014).

Among these various in situ technologies, steam injection is being investigated as a potential method for remediation of NAPL contaminated soils. Some for the knowledge and techniques developed in petroleum engineering for enhanced oil recovery by steam injection are useful to the problem of steam stripping for remediation of NAPL contaminated soils. In enhanced oil recovery, the objective is to remove the maximum amount of oil from the reservoir as long as it is economically feasible while small amounts of oil left in the formation are usually ignored. In contrast, the purpose of remediation efforts is to remove as much of the contaminants as possible until clean up levels are achieved.

Magnetic field is a region or space or a vector around a bar magnet where the effect of magnetic force can be experienced or felt. Several researches has proved that, the magnetic force is capable of improve remediation of NAPLs from both saturated and unsaturated zone using steam injection by reducing the rate of migration of NAPL in a porous media. Imposition of an external magnetic field appreciably decrease pollutant spread in an aquifer. Subsequently cut down on remediation processes (Dare and Sasaki 2012).

Many remediation technologies can be used to remediates groundwater but appropriate remediation technology to be selected on-site depends on certain factors such as soil condition, properties of contaminants, the method, and types of soil contaminants and more so, there is no best particular method suitable for remediate all types of soil and groundwater contaminants (Humby, 2000). Sometimes more than one remediation technology may be used which may be combined or arranged in parallel or series purposely to increase the remediation efficiency of contaminated soil and groundwater (treatment train). Since most of the remediation technology yields good results, but there is need to improve their efficiency, reducing contaminants in the soil and groundwater quality is highly important to bring improvement to economic efficiency to the soil remediation and environment for the benefit of man. Therefore, the aim of this

research was to experiment Effects of Magnetic fields on the Removal of Dense Non-aqueous Phase Liquid from an Unsaturated Zone using Steam Injection.

### Methodology

This research work involved the experimental investigation of the removal of Dense Non-aqueous phase liquid (DNAPL) from Unsaturated Zone using Steam Injection with Magnetic Effect. The pollutants used for the experiment was Carbon tetrachloride (DNAPL). The experiment was carried out at the New Fluid Mechanic Laboratory of the Mechanical Engineering department, LAUTECH, Ogbomoso, Oyo State.

### Geo-technical Test

Geo-technical test was performed on the soil sample (obtained in front of chemical engineering laboratory, LAUTECH premises) in order to determine the identity of the soil samples used in the experiment. This test was carried out in Geotechnical Engineering Laboratory in Civil Engineering Department of Ladoke Akintola University, Ogbomoso, Oyo state.

### Soil Porosity

Porosity is the amount of empty space in a soil and rocks. Porosity was calculated using equation 1 to 3.

$$\text{Macro-porosity} = \frac{\text{Pore space volume of gravel}}{\text{Total volume}} \times 100 \quad (1)$$

$$\text{Micro-porosity} = \frac{\text{Pore space volume of sand}}{\text{Total volume}} \times 100 \quad (2)$$

$$\text{Total porosity} = \text{Macro-porosity} + \text{Micro porosity} \quad (3)$$

### Soil Permeability

The process was repeated until constant value was obtained and hydraulic conductivity was calculated using the equation (4): Soil Permeability was calculated using equation 4

$$K_T = \frac{QL}{Ath} \quad (4)$$

Where:  $K_T$  = Hydraulic conductivity (cm/min)     $L$  = length of specimen in centimeters

$t$  = time for discharge in minutes     $Q$  = volume of discharge in  $\text{cm}^3$  (assume 1 mL = 1  $\text{cm}^3$ )

$A$  = cross-sectional area of permeameter (soil core) ( $A = \frac{\pi}{4} D^2$ ,  $D$  is the inside diameter of the permeameter (soil core)     $h$  = hydraulic head difference across length  $L$ , in cm of water

### Moisture Content

Muhammed (2014) used oven- drying method of English Standard Institution (E.S.I) part II-1973, to determine the moisture content of the soil sample. The moisture content was determined using Equation 5

$$M_{\text{content}} = \frac{M_2 - M_3}{M_3 - M_1} \times 100 \quad (5)$$

Where:  $M_1$  = Weight of an empty clean container with lid (g)  $M_2$  = Weight of clean container with lid + wet soil (g)  $M_3$  = Weight of clean container with lid+ dry soil (g)

### Soil Texture

Soil textural determination was done using hydrometer method described by Bouyoucos method as described by Andres *et al*(2014).

$$\% \text{Sand} = \frac{\text{Sample mass} - 40 \text{ seconds reading}}{\text{Sample mass}} \times 100 \quad (6)$$

$$\% \text{Clay} = \frac{\text{Two hours reading}}{\text{Sample mass}} \times 100 \quad (7)$$

$$\% \text{Silt} = (100\% - \% \text{ sand} - \% \text{ clay}) \quad (8)$$

### Tools and Equipments

The followings are description of some of major tools and equipment that was used for the experiments:

#### Steam Boiler

Steam boiler consists of an enclosed pressure vessel where water is being heated to produce steam through heat energy source. This steam boiler designed in such a way that, it is capable of using either charcoal, cooking gas or electricity by 2KW electric heater as source of heat energy but gas was used of the work. The steam boiler is equip with digital temperature measuring device, pressure gauge, thermostat and pressure safety valve which are use for measuring steam temperature, pressure and control the internal pressure of the boiler respectively. It is also provided with fluid flow-meter to control and measure the flow rate of the steam leaving the steam boiler to the sand box. Plate 3.1 shows the picture of steam boiler that was used for the research.

#### Sand Box

The experiment was conducted in a sand box. The sand box had the interior dimension of 110 X 74 X 8.5 cm (figure 3.3). The sand box was constructed from galvanized steel and a front glass panel. The glass panel was to allow for taking photographs, visual inspection and access to the sand packing. The sand box was lagged in order to minimized heat loss and loss of pollutant. Steam was injected into the sand box through the injection port. The steam from the steam boiler was super heated to 110 °C in order to ensure that the steam is a dry steam. The sand box was equipped with temperature sensor, pressure transducer and variable electromagnetic induction device to measure temperature, pressure and varies the magnetic field strength in the sand box respectively. Effluent gas (steam and pollutant) leave the sand box through the extraction port located at the opposite side inlet port of the sand box and was pass to the condenser.

#### Condenser

This is a device that was used to condense effluent vapour (steam and contaminant vapour) into a liquid state through cooling. The vapour was pass through a condenser which is made up of series of copper pipe coiled and submerged in a melting ice so that the latent heat of the vapor from the sand box is released and transferred to melt the ice. The condenser is also capable of using refrigerator system to condense the vapor when electricity is available but ice pack was used. It is fixed to the outlet (extraction port) port of the sand box. The condensate was collected and transfer to the phase separator.

#### Phase Separator

Separating funnel was used as phase separator. It is a glassware use to separate the components of a mixture of two immiscible solvent phases (water and the contaminant) of different densities. This apparatus is like a funnel with a tap at the bottom of the funnel to drain a less dense liquid at the bottom of the funnel out while the denser one will remains and drain out later.

### Electromagnetic Device

An electromagnetic device was made up of coils of wires wound round a bar of iron or other ferromagnetic material. The principle of work is when electric current flows through the conductor (wire), it causes coils to generate magnetic field which has both magnetic north and south poles. This electromagnetic device was made up of 1.32 W DC electric motor from power sources of 0.32 A with frequency ranging between 3.75- 6.75 HZ, rotational speed of 202.5 – 405 rpm. It is capable of generating variable magnetic field strength of 1-3 T which can be selected accordingly with help of switch and is capable of producing 3.63 Ncm torque.

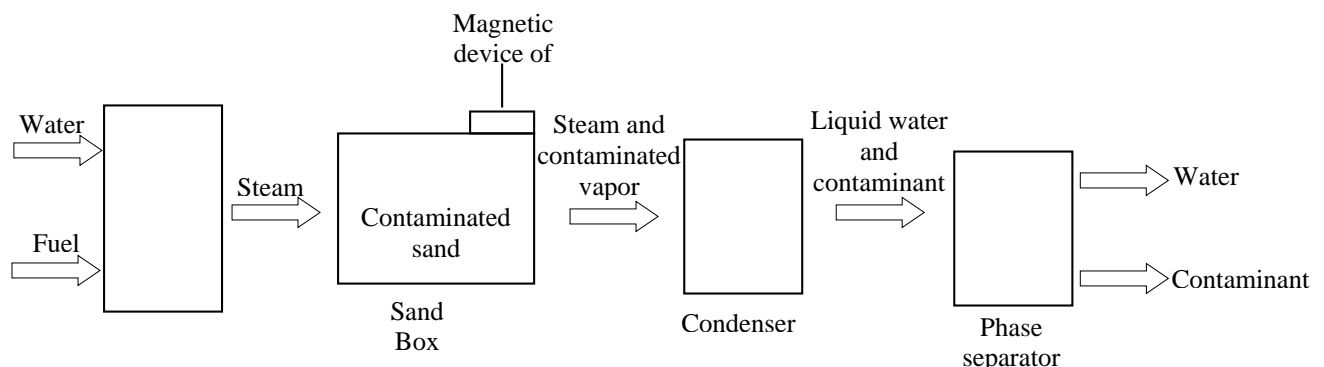
### Experimental Procedure for Removal NAPL from Unsaturated Zone Using Steam

#### Injection

The sand box was filled up with sand to height level of 50 cm of which granite stone was filled up to 10cm from the bottom of the sand box. 200 mL of contaminant (Toluene and Carbon tetrachloride) was measured using measuring cylinder while the temperature of contaminant was cooled to 0 °C with ice parked around the container. This is to reduce the contaminant loss due to evaporation while pouring into the sand in the box. To make the experiments to be uniform, the same volume of contaminant was used throughout the experiment. Prior to the commencement of the experiments, the ambient temperature and original temperature of the sand in a sand box was measured using digital thermometer.

Steam at 1.2 bar pressure and temperature 120 °C was injected into the sand box from the injection port located at the 40 cm from the bottom side directly opposite to extraction port located at the side of the other side of the sand box at a constant steam flow rate of 0.01m<sup>3</sup>/s measure using flow meter which was control manually by flow valve as used by Adegbola *et al* (2014). With the help of automatic temperature control of the boiler and pressure relieve valve coupled with the expected high permeability of the soil, the injection pressure was a little bit above atmospheric pressure which was measured by pressure gauge on the sand box. Steam injected into the sand box and vapor of the contaminants leaves the box through the outlet port and conveyed to the condenser via a metal pipe.

Figure 1 and Plate 1 show the block diagram of experimental set up and schematic diagram of the experimental set up of steam injection respectively.



**Figure 1: Block Diagram of Experimental Set up of Steam Injection**



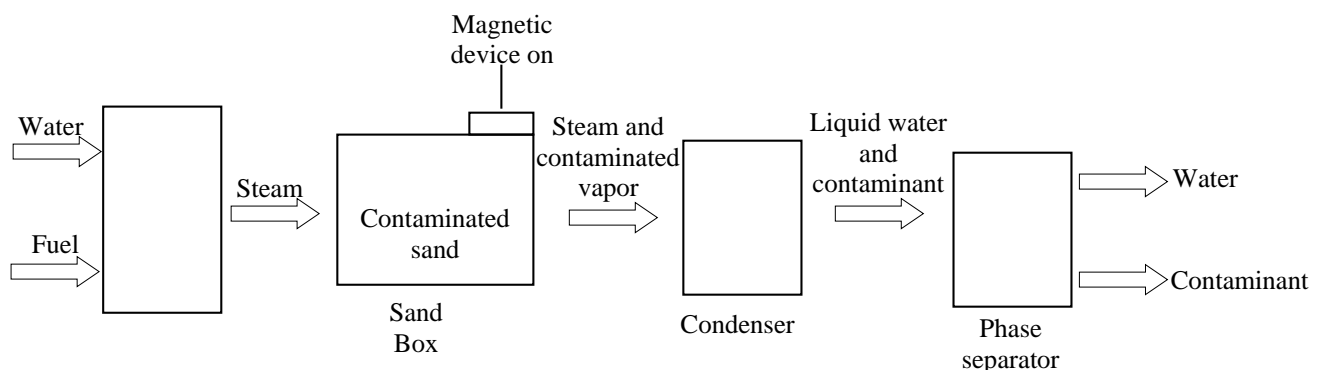


**Plate 1: Steam Boiler, Sand Box and Condenser Set-Up for the Experiment**

**Experimental Set-up for Removal of NAPL from Unsaturated Zone Using Steam Injection**

**with Magnetic Effect**

The experiment was conducted in a galvanized steel box (Sand box) of dimension 110cmx74cmx8.5cm with a plain glass panel which will allow visual access of the sand packing in the sand box to observe the behaviors of contaminant (DNAPL). Steam was generated from steam boiler which operating on gas as its fuel and injected in to the sand box through the inlet port located at the middle edge of the sand box. The steam flow rate was adjusted using a flow control valve and monitored with flow meter and pressure gauges. Magnetic field was generated by electromagnetic inductor which induced magnetic field on to the metal rod perpendicularly positioned in the Sand box to the direction of flow of injecting steam. This electromagnetic device is capable of producing magnetic flux of varying values ranging from 1-3T (Adegbola and Dare 2018). Steam injected into the sand box and vapor of the contaminants leaves the box through the outlet port and conveyed to the condenser via a metal pipe.



**Figure 2: Block Diagram of Experimental Set up of Steam Injection with Magnetic Effect**

**Determination of Recovery Efficiency**  
Recovery efficiency was determined for each experiments performed on using steam injection only (0 T) and steam injection with magnetic field (1-3 T) for recovery of Carbon tetrachloride (contaminant) from the groundwater. The result from both methods was compared to each other to determine the most efficient method out of the two. And also, graph of cumulative volume

of recovered contaminant (DNAPL) was plot against time for each of the experiments performed.

$$\text{Recovery efficiency} = \frac{\text{Recovery volume of NAPL (Contaminant)}}{\text{Initial volume of NAPL (contaminant) in sand box}} \times 100 \quad (9)$$

### Comparative Study between Experimental Result of Steam Injection Only and Steam Injection with Magnetic Field

The experimental result of Effect of Magnetic Field on Removal of Non-aqueous Phase Liquid from Unsaturated Zone Using Steam Injection Only and Steam Injection with Magnetic Field was compared using descriptive and inferential statistics. The descriptive method used includes percentage while the inferential analysis used was correlation and Chi-square at 0.05 level of significant. The deviation of results was calculated with the equation 10.

$$\% \text{ Deviation} = \frac{\text{Value of steam injection by author} - \text{value of steam injection}}{\text{value of steam injection only by an author}} \times 100 \quad (10)$$

### Results and Discussions

#### Results of Soil Geophysical Test

The result of the soil geophysical test of the soil sample collected at in front of chemical engineering laboratory, Ladoke Akintola University of Technology, Ogbomosho, Oyo state to determine the Effects of Magnetic Field on Removal of Non Aqueous Phase Liquid from Unsaturated Zone using Steam Injection. The results of the soil moisture content, permeability, soil texture, porosity, soil grain size are as follows. Table 1 shows the result of soil moisture content of the soil used for the experiment.

**Table 1: Result of Soil Moisture Content Test**

S/N	Description	1 <sup>st</sup> Result	2 <sup>nd</sup> Result
1	Container No (cup no)	243	345
2	Mass of cup (g)	29.40	30.70
3	Mass of dry soil (g)	15.60	42.70
4	Mass of cup + wet soil (g)	46.30	77.50
5	Mass of cup + dry soil (g)	45.00	73.40
6	Mass of water (g)	1.30	4.10
7	Water content (%)	8.33	9.60
	<b>Average water content (%)</b>	<b>9.0</b>	

Table 2 and 3 show the summary of all result of soil properties test of soil sample used for the experimental investigation of effect of magnetic field on removal of non aqueous phase liquid from unsaturated zone using steam injection.

**Table 2: Result of Soil Permeability Test**

S/N	Time (s)	Height (cm)
1	0.0	2.0
2	30.0	6.5
3	60.0	9.7
4	90.0	12.5
5	120.0	15.0
6	150.0	17.4
7	180.0	19.0
8	210.0	20.1
9	240.0	21.0
10	270.0	21.8
11	300.0	22.4
<b>K=0.001163779 cm/s</b>		

**Table 3: Properties of Soil Sample used for Experiment**

S/N	Parameter	Value of the Result
1	Sand color	Light brown
2	Sample area (cm <sup>3</sup> )	86.6250
3	Sample length (cm)	12.5000
4	Bulk Density (g/cm <sup>3</sup> )	1.7600
5	Moisture content (%)	9.000
6	Dry density (g/cm <sup>3</sup> )	1.6200
7	Specific Gravity	2.6000
8	Void ratio	0.0044
9	Porosity	0.42
10	Manometer Area	1.0000
11	Soil texture: sand, clay, silt (%)	64.5, 11.4, 24.1
12	Hydraulic constant (cm/s)	0.001163779

**Effect of Magnetic Field on Removal of Dense Non Aqueous Phase Liquid (Carbon tetrachloride) from Unsaturated Zone using Steam Injection**

The result of total cumulative volume and recovery efficiency of Light Non Aqueous Phase Liquid (Carbon tetrachloride) from unsaturated zone (sand box) after remediation of the contaminated soil with steam injection and combination of steam injection and magnetic field strength (1-3 T) at steam injection flow rate of 0.01 m<sup>3</sup>/s for 120 minutes are as follows:

**Removal of Dense Non Aqueous Phase Liquid (Carbon tetrachloride) from Unsaturated Zone using Steam Injection only**

Table 4 show the cumulative recovered volume of contaminant (Carbon tetrachloride) after treating with steam injection only for another 30, 60, 90 and 120 minutes of remediation process were 25.6, 82.6, 155.4, and 160.6 mL respectively out of 200mL total initial volume of contaminant (Carbon tetrachloride) was recovered.

**Table 4: Recovered Volume/ Recovery efficiency of Removal of NAPL (Carbon tetrachloride) from Sand Box using Steam Injection only**

S/N	Time (minute)	Cumulative (mL)	Recovered volume	Recovery Efficient (%)
1	0	0		0
2	30	39.4		19.70
3	60	99.7		49.85
4	90	163.5		81.75
5	120	164.1		82.05

**Removal of Dense Non Aqueous Phase Liquid (Carbon tetrachloride) from Unsaturated Zone using Steam Injection and Magnetic Field (1 T)**

From table 4 and figure 4.5, the recovered volumes were 61.2, 130.6, 177.8, and 178.45 mL when used steam injection with magnetic field strength (1 T) at 30, 60, 90, and 120 minutes. The recovery efficiency calculated for each of the recovered volumes were 30.60, 65.30, 88.90 and 89.45 %.

**Table 5: Recovered Volume/ Recovery efficiency of Removal of NAPL (Carbon tetrachloride) from Sand Box using Steam Injection and Magnetic Field Strength of 1 T**

S/N	Time (minute)	Cumulative (mL)	Recovered volume	Recovery Efficient (%)
1	0	0		0
2	30	61.2		30.60
3	60	130.6		65.30
4	90	177.8		88.90
5	120	178.9		89.45

The calculated recovery efficiency for the same respective treatment time was 12.80, 41.30, 77.70 and 80.30% respectively. Within the first thirty minutes of commencement of the process, it was observed that the recovery rate was very small so as also the recovery efficiency too when comparing it with that of thirty to ninety minutes. This was because the injected steam losses its latent heat to raise the temperature of the sand box from room temperature to temperature enough to vaporize the water and the DNAPL and there was an increase in recovery volume of DNAPL (Carbon tetrachloride) between thirty minute to ninety minute of steaming which also increase the recovery efficiency, because the temperature of the sand box at this period was sufficient to vaporize the DNAPL (Carbon tetrachloride). But there was a reduction in recovery volume of DNAPL between ninety minute and one-twenty minute of the process. This might be as a result of reduction in the concentration of DNAPL (Carbon tetrachloride) in the sand box or some of the DNAPLs was lost through evaporation to the surrounding and was unable be recovered .

**Removal of Dense Non Aqueous Phase Liquid (Carbon tetrachloride) from Unsaturated Zone using Steam Injection and Magnetic Field (2 T)**

Table 6 shows the cumulative recovered volume of contaminant (Carbon tetrachloride) recovered when treated with steam injection with magnetic field (2 T) at 30, 60, 90 and 120 minutes were 70.8, 143.9, 189.1, and 189.9 mL respectively and the recovered efficiency for this treatment were 35.40, 71.95, 94.55 and 94.95 %.

**Table 6: Recovered Volume/ Recovery efficiency of Removal of NAPL (Carbon tetrachloride) from Sand Box using Steam Injection and Magnetic Field Strength of 2 T**

S/N	Time (minute)	Cumulative Recovered volume (mL)	Recovery Efficiency (%)
1	0	0	0
2	30	70.8	35.40
3	60	143.9	71.95
4	90	189.1	94.55
5	120	189.9	94.95

**Result of Removal of Dense Non Aqueous Phase Liquid (Carbon tetrachloride) from Unsaturated Zone using Steam Injection and Magnetic Field (3 T)**

Table 7 shows the recovered volume and recovery efficiency, when treated the contaminated soil in the sand box with steam injection with magnetic field of 3 T to removed contaminant (Carbon tetrachloride) from the sand box for 30, 60, 90, and 120 minutes, the cumulative volume of Carbon tetrachloride recovered were 70.6, 144.9, 189.7, and 190.7 mL respectively of the total Carbon tetrachloride content initially injected in to the soil in the sand box (200mL) and the recovery efficiency were 35.3, 72.45, 94.85, and 95.35 % respectively.

**Table 7: Recovered Volume/ Recovery efficiency of Removal of NAPL (Carbon tetrachloride) from Sand Box using Steam Injection and Magnetic Field Strength of 3 T**

S/N	Time (minute)	Cumulative Recovered volume (mL)	Recovery Efficiency (%)
1	0	0	0
2	30	70.6	35.3
3	60	144.9	72.45
4	90	181.7	94.85
5	120	190.7	95.35

**Comparing the Experimental Result of Removal of NAPL from Unsaturated Zone using Steam Injection Only and Steam Injection with Magnetic Fields**

The method for data analysis was descriptive and inferential statistics. The inferential analysis used was Chi-square method to test the result of comparative study between experimental result of steam injection only and steam injection with magnetic fields on removal of non aqueous phase liquids from unsaturated zone using steam injection. The recovery efficient steam injection with magnet (RESIM) on the remediation non aqueous phase liquid from unsaturated zone at different time of 30, 60, 90, and 120 minutes respectively for steam injection only and steam injection with magnetic field 1 T- 3 T) were evaluated as follows:

**Comparing the Experimental Result on Removal of DNAPL (Carbon tetrachloride) from Unsaturated Zone using Steam Injection Only and Steam Injection with Magnetic Fields**

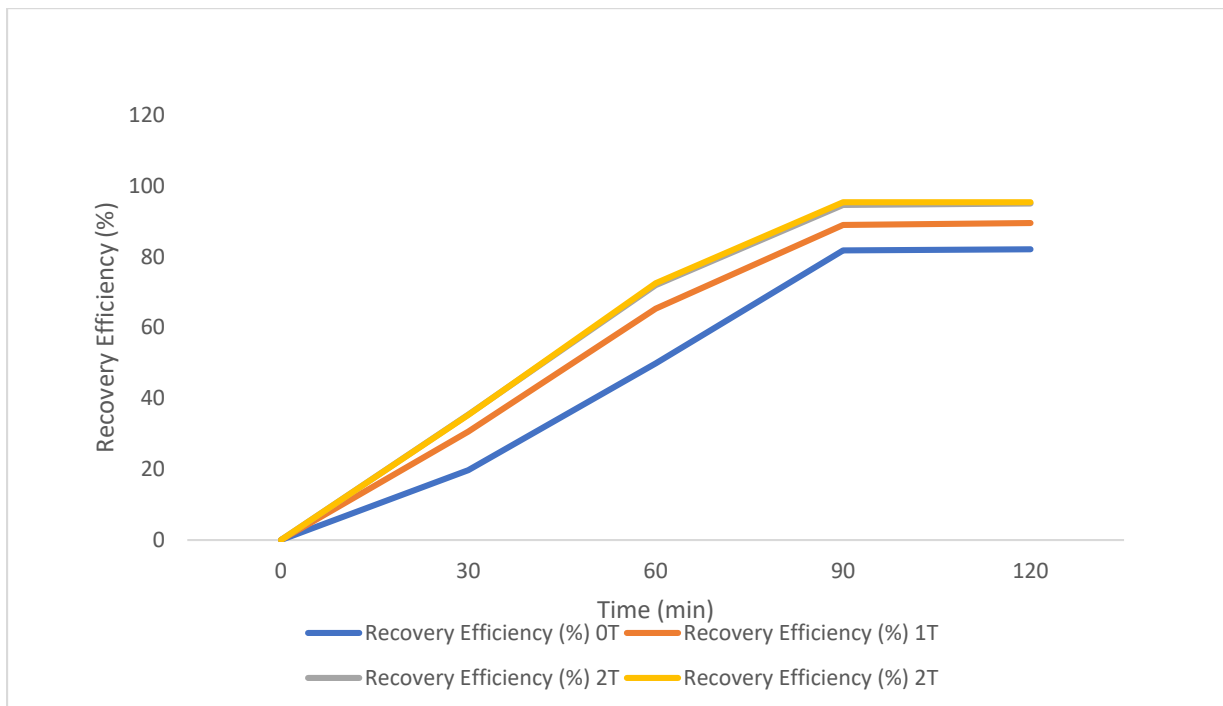
Figure 3 and Table 8 show the Recovery Efficient of Steam Injection only and steam injection with Magnet field 1-3T on the removal of Dense Non Aqueous Phase Liquid from Unsaturated Zone at different time (30, 60, 90, and 120 minutes). From the figure, on treating the Carbon tetrachloride in the sand box with Steam Injection only, the recovery.

**Table 8: Observed Recovered Volume of Toluene for Steam Injection with Magnetic Field 1-3 T**

Time (minute)	Volume Recovered at 0 T	Volume Recovered at 1 T	Volume Recovered at 2 T	Volume Recovered at 3 T	Total
0.0	0	0	0	0	0
30.0	25.6	25.7	29.6	30.2	111.1
60.0	57	62.2	65.3	67.4	251.9
90.0	72.8	76.3	74.7	74.1	297.9
120.0	5.2	3.2	2.1	1.5	12
Total	160.6	167.4	171.7	173.2	672.9

efficiency obtained for the steaming time of 120 minutes was 82.05 % which was similar with the work done by USEPA (2007) with deviation of 3.47 %. While treating the contaminant (Carbon tetrachloride) for the same period with steam injection with magnetic field 1-3 T, the recovery efficiency was 89.45-95.35 %.

This shows that the more the steaming time and magnetic field the more the recovery efficiency of the remediation process at constant steam injection flow rate of 0.01m<sup>3</sup>/s. The surge in recovery efficiency of the remediation process was attributed to the decrease in amount of contaminant (Carbon tetrachloride) in the sand box after the remediation process. The soil type may influence the process of exit of Carbon tetrachloride considering the porosity of the soil which allows the persistence penetration of steam into the soil. This in-turn, will aid Carbon tetrachloride to vaporize and desorb from the soil particles. The more the steam is injected into the soil in the sand box the more the Carbon tetrachloride vaporize from it because of its nature of volatility and this led to the reduction in Carbon tetrachloride and which eventually increases the recovery efficiency



**Figure 3: Recovery Efficiency of NAPL (Carbon tetrachloride) from Sand Box using Steam**



**Injection only and Steam Injection with Magnetic Field (1 -3 T)**

of the remediation process. It was also observed that recovery efficiency of Carbon tetrachloride in the sand box when treated with steam injection with magnetic field 1-3T is higher than the one treated with steam injection only by 9.02-16.21%. This was because the magnetic field increases the rate of evaporation of NAPLs (Carbon tetrachloride) by reducing the strength of Van der Waals force which resulted to reduction in viscosity of Carbon tetrachloride, eventually increasing the recovery rate of NAPL (Carbon tetrachloride) in the sand box.

Table 9 and 10 shows observed and expected recovered volume of carbon tetrachloride for steam injection with magnetic field 1-3 T and the calculated value of the result from the Tables showed observed and expected recovered volume of Carbon tetrachloride for steam injection with magnetic field 1-3 T. The calculated value of Chi-square (0.0557) was less than the critical value (16.92) at nine degree of freedom at 0.05 level of significance. This result implied that, there is a significant relationship between recovered volume of Carbon tetrachloride when treated with steam injection only and steam injection with magnetic field of 1-3 T.

**Table 9: Observed Recovered Volume of Carbon tetrachloride for Steam Injection Only (0 T) and Steam Injection with Magnetic Field 1- 3 T**

Time (minute)	Volume Recovered at 0 T	Volume Recovered at 1 T	Volume Recovered at 2 T	Volume Recovered at 3 T	Total
0.0	0	0	0	0	0
30.0	39.4	61.2	70.8	70.6	242
60.0	60.3	69.4	73.1	74.3	277.1
90.0	63.8	47.2	45.2	45.8	202
120.0	0.6	1.1	0.8	0	2.5
150.0	0	0	0	0	
Total		164.1	178.9	189.9	190.7 723.6

**Table 10: Expected Recovered Volume of Carbon tetrachloride for Steam Injection Only (0 T) and Steam Injection with Magnetic Field 1- 3 T**

Time (minute)	Volume Recovered at 0 T	Volume Recovered at 1 T	Volume Recovered at 2 T	Volume Recovered at 3 T	Total
0.0	0	0	0	0	0
30.0	54.8814262	59.8311222	63.5099502	63.7775014	242
60.0	62.8415008	68.5091072	72.7215174	73.0278745	277.1
90.0	45.8101161	49.9416805	53.0124378	53.2357656	202
120.0	0.56695688	0.61809011	0.65609453	0.65885849	2.5
150.0					0
Total		164.1	178.9	189.9	190.7 723.6

X<sup>2</sup> value

P=	<b>0.05577048</b>	Table value=	<b>16.92</b>
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## CONCLUSION

The study therefore, has been able to determine the effect of magnetic field on removal of Dense Non Aqueous Phase Liquid (DNAPL) from unsaturated zone using steam injection only and steam injection with magnetic field 1-3 T. And also to compare the remediation processes. The following conclusions were drawn from the research work:

1. The experimental result for the recovery efficiency of dense non aqueous phase liquid (Carbon tetrachloride) using steam injection only at  $0.01\text{m}^3/\text{s}$  was 82.05%.. Steam injection for remediation of porous media contaminated by DNAPL has been shown to be an efficient technology.
2. The experimental result for the recovery efficiency of light non aqueous phase liquid (Carbon tetrachloride) while steam injection of  $0.01\text{m}^3/\text{s}$  and magnetic field 1-3 T yielded 89.45-95.35%. Better recovery efficiency of Carbon tetrachloride was obtained from Steam injection with magnetic field than steam injection only.
3. The recovery efficiency of DNAPL (Carbon tetrachloride) in the sand box treated with steam injection and magnetic field 1-3 T is higher than the one treated with steam injection only by 9.01-16.21% respectively.

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## MicroRNAs IN TAKOTSUBO SYNDROME

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### ABSTRACT

Takotsubo syndrome, another name for stress cardiomyopathy, is a primary cardiomyopathy characterized by aberrant ventricular wall motion that is reversible. Acute myocardial infarction-like symptoms are present in its clinical manifestations. Postmenopausal women frequently develop stress cardiomyopathy, which is commonly brought on by emotional or physical stress. Although the pathophysiology is still unclear, cardiac damage caused by catecholamines is generally accepted. MicroRNA(miRNA)-specific binding to the target messenger RNA in cells may control how genes are expressed. At the same time, several cardiovascular illnesses are intimately associated with the stable expression of miRNA in body fluids. Peripheral blood miRNAs have been discovered to be promising indicators for the early identification of cardiovascular disease in recent years.

**Keywords:** Takotsubo Syndrome; microRNAs; miRNAs; myocardial infarction; biomarkers; emotional stressors; catecholamines

### Abbreviations

Takotsubo Syndrome (TTS), MicroRNAs (miRNAs or miR), Myocardial Infarction (MI), Coronary Artery Disease (CAD), Left Ventricle (LV), Sarcoplasmic Reticulum (SR), Sarcoplasmic reticulum Ca<sup>2+</sup>-ATPase (SERCA), Na<sup>+</sup>/Ca<sup>2+</sup> exchanger (NCX), Default mode network (DMN), Serum Creatine Phosphokinase (CK or CPK), Cardiac Troponin T (cTnT).

### Aim of the Study

To review the current literature on Takotsubo syndrome, with a focus on its diagnosis via microRNAs.

### Methodology

This review article analyzed relevant literature from reputable sources, including scientific journals and online databases such as Pubmed, Google Scholar, Elsevier, and Wiley Online Library. A total of 20 papers were initially collected and reviewed. The selection criteria included studies focusing on microRNA's role in diagnosing Takotsubo Syndrome.

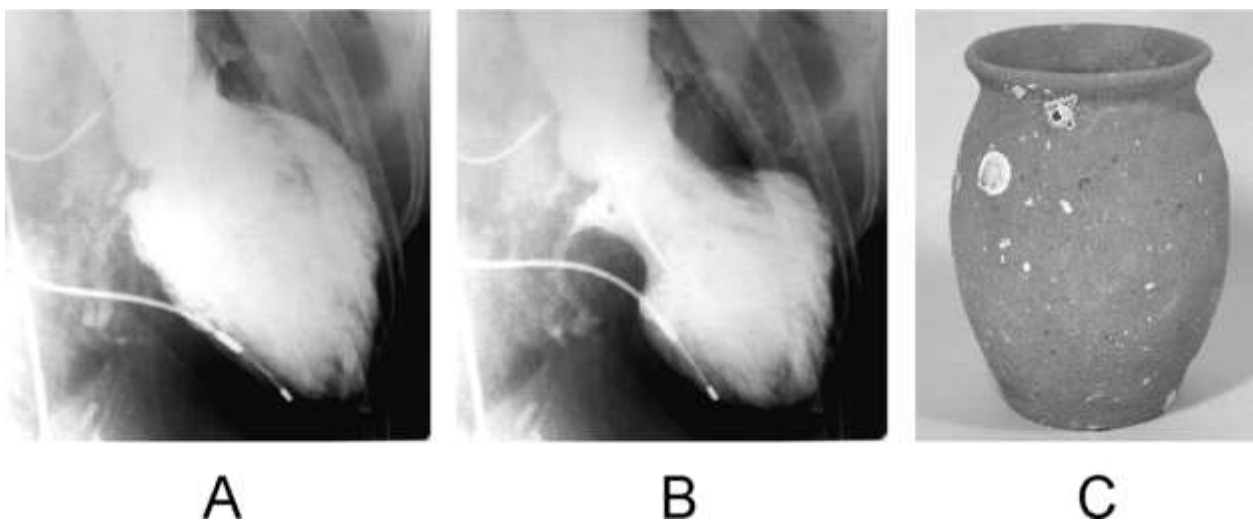
### Results:

Overall, from the collection of literature that was analyzed, it is evident that microRNAs have a diverse range of roles, particularly with regards to the cardiovascular system and its anomalies. Certain biomarkers, such as miR-16 and miR-26a affect the baseline contraction of cardiomyocytes. In the sarcoplasmic reticulum TTS miRNAs reduce the amount of Calcium that is stored. Furthermore, although varying in pathology, both TTS and MI share microRNAs as a common baseline.

## 1.Introduction & Background

MicroRNAs (miRNAs), since their discovery in the early 2000s, have been shown to play pivotal roles in a wide array of medical conditions. MiRNA belongs to a class of non-coding RNAs, which are found in both cells, as well as the bloodstream. These particular molecules are highly involved in gene regulation. MiRNAs control gene expression primarily by binding to messenger RNAs (mRNAs) in the cytoplasm, thereby becoming "marked mRNAs." Subsequently, the "marked mRNAs" are either destroyed and their components recycled or preserved and translated later [1].

MiRNAs are closely associated with a disorder known as Takotsubo cardiomyopathy. This type of cardiomyopathy is reversible and is characterized by apical ballooning of the left ventricle, resembling the appearance of a myocardial infarction in the absence of coronary artery disease (CAD). The name "Takotsubo" originates from Japanese, referring to the resemblance of the affected heart to a container used by the Japanese to catch octopuses with a circular bottom and a narrow neck. The prevalence of Takotsubo cardiomyopathy ranges from 1.0-2.5%. Although the precise pathophysiology of Takotsubo cardiomyopathy is not yet fully understood, several conditions have been linked to it, such as over-stimulation of the sympathetic system, abnormalities in microvascular and myocardial tissue metabolism, and coronary artery vasospasm [1]. The most notable hypothesis regarding the etiology of ventricular dysfunction in Takotsubo syndrome (TTS) is the theory of catecholamines. This hypothesis states that acute stressors can cause a sudden surge in the levels of catecholamines, such as dopamine, epinephrine, and norepinephrine, which can lead to left ventricle (LV) dysfunction. High levels of catecholamines can also contribute to myocardial infarction (MI), increasing the workload on the heart and leading to a supply-demand mismatch. This can cause ischemic TTS, which is often misdiagnosed. However, in recent years, our understanding of TTS has rapidly improved, particularly in terms of the clinical relevance and typical apical ballooning of the LV. The clinical manifestations of TTS include chest pain, dyspnea, cardiac arrest, and cardiogenic shock. One way to distinguish TTS from ST-elevation myocardial infarction (STEMI) is to look at the NT-proBNP/troponin T ratio. In TTS, this ratio is often high, with a sensitivity of 91% and a specificity of 95%. TTS is also distinctive because it is associated with a nonischemic etiology of acute, but transiently diminished, systolic function with wall movement abnormalities that advance in a single vascular domain [2].



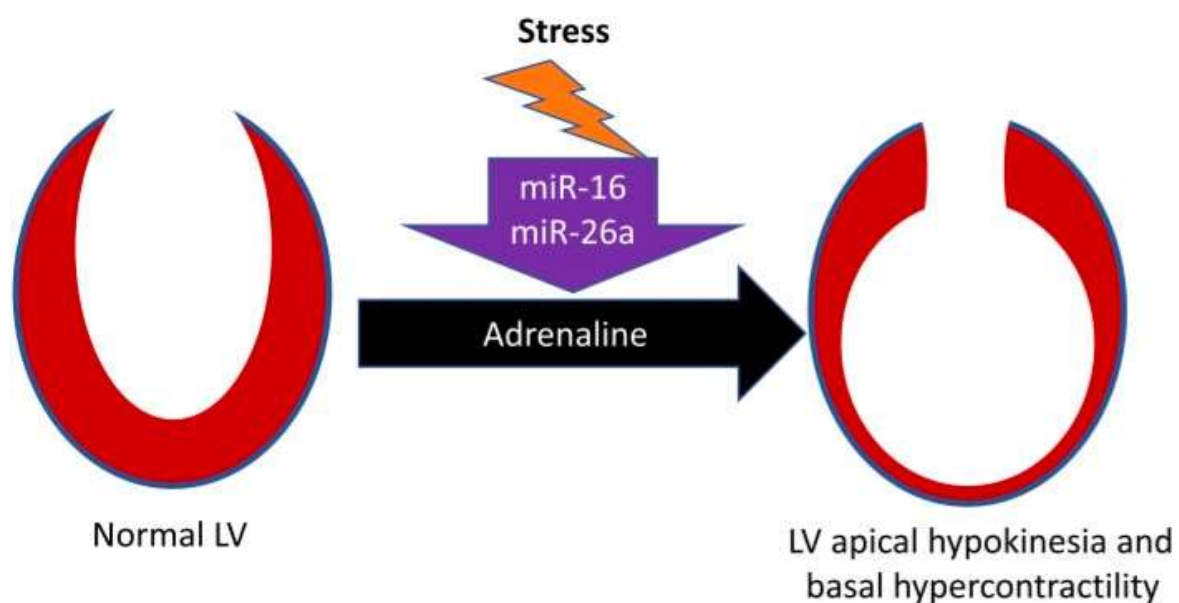
**Figure1:** Left ventriculogram (A, end-diastolic phase; B, end-systolic phase) in the right anterior oblique projection. The extensive area around the apex shows akinesis, and the basal segments display hypercontraction, especially in the end-diastolic phase. C, A picture of a

*real takotsubo, which has a round bottom and narrow neck to capture octopuses and has been used for a long time in Japan.*

## 2. Discussion

### 2.1 MiRNA's Role in Contractility

Research on specific biomarkers, miR-16 and miR-26a, which are elevated in TTS, was conducted, and their impact on cardiomyocyte contractility was studied. In in-vitro transfection experiments, it was observed that elevated levels of miR-16 and miR-26a significantly reduced the baseline contraction of isolated apical cardiomyocytes. Interestingly, this reduction in contractility was not mirrored in paired basal cardiomyocytes, and they remained largely unaffected. However, when miR-16 and miR-26a were transfected together, the maximal amplitude of basal cardiomyocytes significantly increased. This finding emphasizes the complex interplay between these microRNAs in controlling contractility [3].



**Figure 2:** *miR-16 & miR-26a effect on apical and basal cardiomyocytes contractility.*

### 2.2 Impaired Calcium Cycling by miRNAs

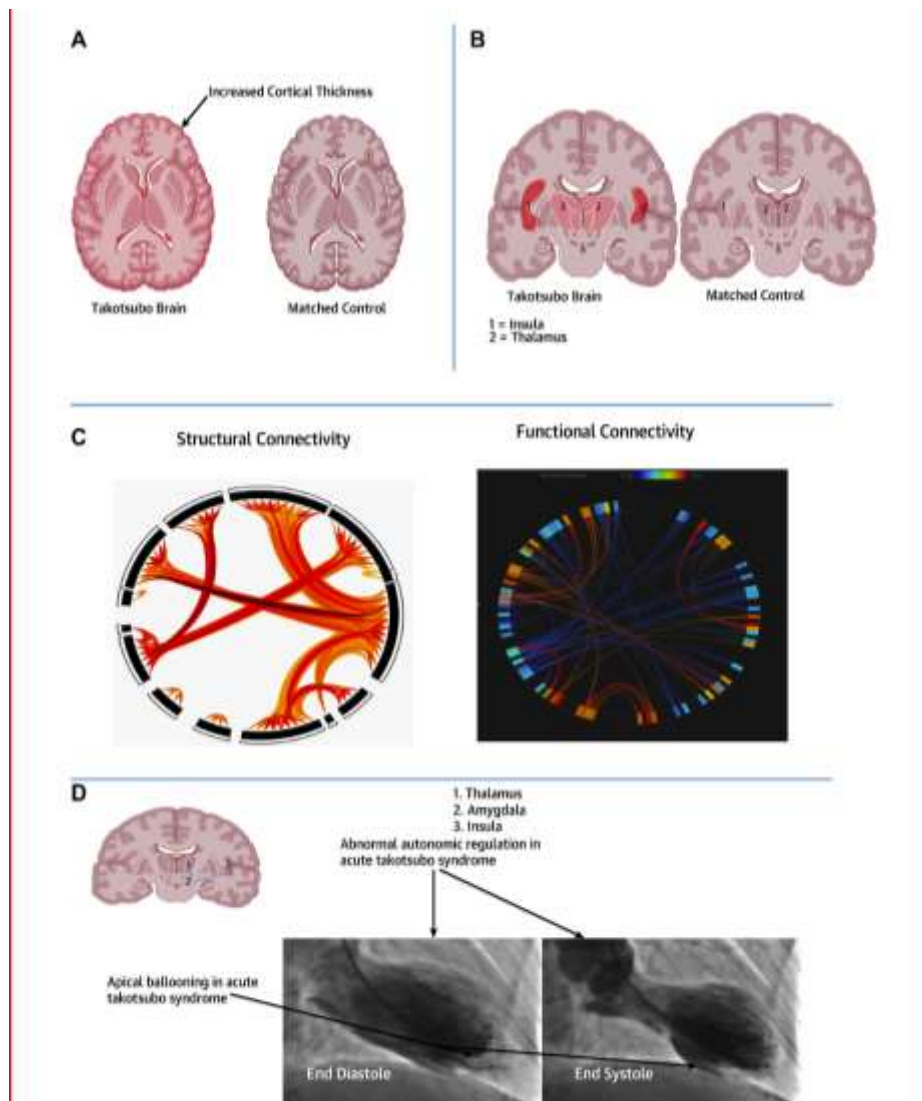
TTS miRNAs reduce the amount of calcium stored in the sarcoplasmic reticulum (SR). This decrease in calcium content leads to a smaller amplitude of caffeine-induced calcium transients. Caffeine-induced calcium transients are often used as a research tool to study the mechanisms of calcium handling in muscle cells. The amplitude of a calcium transient is a measure of the amount of calcium that is released from the SR into the cytoplasm of the cell. Fractional release measures how much of the calcium stored in the SR is released into the cytoplasm during a contraction. It is important to note that fractional release was unchanged in the presence of TTS miRNAs. SR Ca<sup>2+</sup>-ATPase (SERCA) and Na<sup>+</sup>/Ca<sup>2+</sup> exchanger (NCX) are two proteins involved in calcium transport across the SR membrane. SERCA pumps calcium into the SR, while NCX exchanges calcium for sodium across the SR membrane. SERCA and NCX-mediated contributions to calcium decay were unaltered in the presence of TTS miRNAs, suggesting that the miRNAs are not targeting these proteins. This indicates that the miRNAs are explicitly targeting the calcium content of the SR and not the mechanism by which calcium is released from the SR [3].



### 2.3 Brain-Heart Interaction in TTS

TTS patients often have psychiatric comorbidities such as depression, anxiety, and stress [4,5]. TTS can also cause serious cardiac arrhythmias and autonomic dysfunction. This emotional regulation, fear conditioning, and heart regulation are core functions of the insula and the amygdala, which thus seems to provide a link between the limbic system and TTS.

A recent resting-state functional magnetic resonance imaging (rsfMRI) study found that TTS patients have increased connectivity in the praecuneus and decreased connectivity in the ventromedial prefrontal cortex compared to healthy controls. The praecuneus is a part of the default mode network (DMN), a network of brain regions active when we are at rest and daydreaming. The ventromedial prefrontal cortex is involved in emotional regulation and decision-making. These findings suggest that the DMN may be more involved in TTS [6]. This is supported by previous research showing that a history of neurological and mental conditions can cause anatomical and functional changes in the brain that lead to sympathetic hyperactivation, excessive catecholamine release, and, subsequently, TTS. In other words, pre-existing changes in specific brain regions may be a risk factor for TTS as they would be more sensitive to stress and, thus, more likely to overreact to stressful stimuli [7].



**Figure3: Brain- Heart Axis in Takotsubo Syndrome**

## 2.4 *MiRNA in MI vs TTS*

Myocardial infarction (MI) and TTS share similarities and can be difficult to distinguish from each other, especially in the early stages, leading to numerous misdiagnoses. MiRNAs play roles in both MI and TTS. In MI, the heart muscle is damaged due to a lack of blood flow. This can happen when a blood clot blocks a coronary artery. MiRNAs can play a role in MI by regulating the genes involved in inflammation, cell death, and tissue repair. In TTS, the heart muscle is temporarily weakened, but the coronary arteries are not blocked. TTS is often triggered by emotional or physical stress. MiRNAs may play a role in TTS by regulating the genes involved in stress response, heart function, and autonomic nervous system function. Researchers are still investigating the role of miRNAs in MI and TTS. However, early studies suggest that miRNAs may be useful biomarkers for diagnosing and monitoring these conditions [8].

One prominent miRNA in the heart, miR-133a, has significant involvement in cardiovascular disorders and can serve as a diagnostic biomarker for acute MI. In a 2011 study by Kimura et al., circulating miR-1 and miR-133a levels were found to increase early after chest pain onset, even before serum creatine phosphokinase (CK or CPK) or cardiac Troponin T (cTnT) up-regulation. MiR-133a was more sensitive to myocardial injury than miR-1, suggesting that exosomes from live myocardium may be the source [9].

Conversely, various research studies have shown that different miRNAs influence Takotsubo cardiomyopathy. For example, a study involving 36 TTS patients from the international TTS registry revealed variations in miRNA expression between TTS and ST-elevation myocardial infarction (STEMI) patients. MiRNAs associated with emotional stress and depression (miR-16 and miR-26a), as well as cardiac-enriched miR-1 and miR-133a, which indicate myocardial injury when released into the bloodstream, were found to be up-regulated in acute TTS compared to control patients [10].

Additionally, another study showed that the miRNA biomarkers associated with Takotsubo cardiomyopathy were also linked to stress and depression, while those related to STEMI were much lower. Thus, miR-16 and miR-26a appear particularly important in the context of TTS and sensitize the heart to TTS-like changes induced by adrenaline [11].

## 3. Conclusion

The intricate role of microRNAs in myocardial injury and cardiac conditions like Takotsubo syndrome and myocardial infarction is a complex yet revealing field of study. MiRNAs, such as miR-1 and miR-133a, exhibit high sensitivity to myocardial injury, showing elevation in circulation even before conventional diagnostic biomarkers like serum creatine phosphokinase and cardiac troponin T. This heightened sensitivity suggests their potential as early diagnostic biomarkers not only for MI but also for TTS. TTS, often misdiagnosed as MI due to shared biomarkers and cytological manifestations, presents distinct elevations in specific miRNAs, particularly miR-16 and miR-26a, in conjunction with psychological stressors like stress and sadness. However, the overlapping TTS and MI diagnostic markers sometimes lead to misdiagnosis, highlighting the need for precise clinical differentiation. TTS, often associated with emotional stressors, not only shares common miRNA profiles with MI but also presents similar cytological manifestations. Understanding these differences in miRNA expression and psychological factors is crucial for accurate diagnosis and appropriate management. Continued research in this area holds promise for improved diagnostic precision and targeted therapeutic strategies for both MI and TTS, ultimately benefiting individuals at risk of or affected by these cardiac conditions.

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**ANALYSIS OF THE REQUIREMENTS OF PHARMACOPEIAS FOR THE  
PREPARATION INFUSION AND DECOCTION IN PHARMACIES**

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**ABSTRACT**

The study of the current state of the regulatory framework, which regulates the production activity of pharmacies, showed that Ukraine has a high level of legislative regulation of all branches of pharmaceutical activity. However, there are not enough scientific and methodical publications to solve more specific issues. For example, methodological recommendations on certain technological issues of extemporaneous formulation are extremely necessary for the daily work of pharmacists. In addition, issues regarding the approximation of the pharmacopoeia of Ukraine for pharmacy workers remain relevant, in particular, the updating of existing general monographs.

The work presents an analytical review of the pharmacopoeial aspects of the preparation of extemporaneous dosage forms, namely infusions and decoctions in pharmacies.

It was found that in many pharmacopoeias ( European, British, Italian, French, Czech, Kazakh) there are no instructions regarding the pharmacy technology of these dosage forms at all. Only the pharmacopoeias of Japan, Austria contain separate monographs on the extemporaneous preparation of infusions and decoctions. Taking into account the data of the conducted analysis and the existing national requirements, a generalized approach to the preparation of infusions and decoctions in the conditions of pharmacies is proposed.

**Key words:** pharmacopoeias, infusions, decoctions, extemporaneous technology, quality indicators

**SLEEP DURATION, SOCIAL SUPPORT AND LIFE SATISFACTION AMONG  
HOSTILITIES AND NON-HOSTILITIES UNIVERSITY STUDENTS**

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**ABSTRACT**

The aim of the research was to investigate the relationship between sleep duration, social support and life satisfaction among hostilities and non-hostilities. The purpose of this study was to check which students are more satisfied in life, hostilities or non-hostilities. Scales used in this research were Social support, sleep duration and life satisfaction. Quantitative research was conducted on the university students where 200 students participated in this research and the results were drawn using the SPSS. Findings suggested that sleep duration and life satisfaction displayed as negative indicators between one another. Social support demonstrated the positive relationship with life satisfaction. Social support, sleep duration and life satisfaction were indicated high in hostilities as compared to non-hostilities. Females scored high in sleep duration and males essentially scored high in social support and life satisfaction. Limitations and recommendations for further research were discussed further.

**Key words:** Relationship, sleep duration, non-hostilities, life-satisfaction.

GENELLEŞTİRİLMİŞ İKİ DEĞİŞKENLİ BİHIPERBOLİK POLİNOMLARIN BAZI  
ÖZELLİKLERİ  
SOME PROPERTIES OF GENERALIZED BIVARIATE BIHYPERBOLIC  
POLYNOMIALS

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**ÖZET**

Bihiperbolik polinomların özelliklerinin ve uygulamalarının anlaşılması pek çok matematik problemlerine ışık tutmaktadır. Bu nedenle bihiperbolik polinomlar matematiğin çeşitli alanlarında önemli bir rol oynamaktadır. Dolayısıyla son zamanlarda bihiperbolik polinomlar ile alakalı çalışmalarda bir artış söz konusudur. Öte yandan, iki değişken arasındaki ilişkileri temsil etmek için kullanılan iki değişkenli polinomlar çeşitli biçimlerde karşımıza çıkabilirler ve birçok bilimsel disiplinde kullanılmaktadırlar. Bu çalışmada, bazı genelleştirilmiş iki değişkenli bihiperbolik polinomlar ele alınacaktır. İlk olarak, bu bihiperbolik polinomları tanımlarken literatürde var olan tanımlar, teoremler ve özelliklerden faydalanılacaktır. Yeni tanımlar elde edildikten sonra, genelleştirilmiş iki değişkenli bihiperbolik polinomların üreteç fonksiyonları farklı yollarla elde edilecektir. Daha sonra, bu polinomlar ile ilgili özelliklere yer verilecektir. Elde edilen tüm bu sonuçlar, genelleştirilmiş iki değişkenli bihiperbolik polinomların matematiksel literatürdeki yerini daha da güçlendirmekte ve bu alandaki gelecekteki araştırmalara katkıda bulunacağı düşünülmektedir.

**Anahtar Kelimeler:** Bihiperbolik polinomlar, İki değişkenli polinomlar, Genelleştirilmiş Fibonacci polinomları, Genelleştirilmiş Lucas polinomları, Üreteç fonksiyonlar.

**ABSTRACT**

Understanding the properties and applications of bihyperbolic polynomials sheds light on many mathematical problems. For this reason, bihyperbolic polynomials can play an important role in various fields of mathematics. Therefore, there has been an increase in studies on bihyperbolic polynomials recently. On the other hand, bivariate polynomials, used to represent relationships between two variables, can appear in a variety of forms and are used in many scientific disciplines. In this study, some generalized bivariate bihyperbolic polynomials will be discussed. First, when defining these bihyperbolic polynomials, definitions, theorems and properties existing in the literature will be utilized. After new definitions are obtained, the generating functions of generalized bivariate bihyperbolic polynomials will be obtained in different methods. Subsequently, properties related to these polynomials will be discussed. All these results are expected to further solidify the position of generalized bivariate bihyperbolic polynomials in t



he mathematical literature and contribute to future research in this field.

**Keywords:** Bihyperbolic polynomials, Bivariate polynomials, Generalized Fibonacci polynomials, Generalized Lucas polynomials, Generating functions.

CHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITIES OF THE  
MEDICINAL PLANT *ERINACEA PUNGENS*

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**ABSTRACT**

The genus *Erinacea* of the family Fabaceae is represented by a single species named *Erinacea pungens*. This plant is called also blue broom, hedgehog plant or rush kidney vetch. *E. pungens* is a dwarf, thorny shrub that reaches less than 30 cm in height and whose erect branches end in sharp thorns. The leaves are inconspicuous and the flowers are blue. It is native to Spain and Algeria. *E. pungens* is used in Algerian folk medicine to treat rheumatic diseases and as a source of honey in the Siroua region of Morocco. The aim of this work is the isolation and structural identification of secondary metabolites of the species *Erinacea pungens* and the evaluation of biological activities. Indeed, two new prenylated isoflavonoids, namely: Erinasone A (**1**) and Erinasone B (**2**), as well as ten known compounds were isolated from the EtOAc extract of *E. pungens*. Structures of the isolated metabolites **1-12** were established mainly by spectroscopic analysis, measurement of optical rotation  $[\alpha]_D$  and by comparison with the literature data. The total phenolic and flavonoid contents were quantified by Folin-Ciocalteu and trichloroaluminum methods respectively. The antioxidant activity of the EtOAc extract and the isolated compounds was determined by three different methods. The results of the antioxidant activity revealed that the EtOAc extract and the isolated compounds possess moderate antioxidant activity for all the tested methods. Consequently, *E. pungens* is a rich source of polyphenolic compounds particularly isoflavonoids used as chemotaxonomic markers for the subfamily Papilionoideae.

**Keywords:** *Erinacea pungens*, Isoflavonoids, Bioactive contents, Antioxidant activity, Antibacterial activity.

NANOMATERIALS FOR CANCER THERAPY

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**ABSTRACT**

Cancer remains one of the most formidable challenges in modern medicine, necessitating innovative approaches to improve treatment efficacy while minimizing side effects. nanomaterial's have emerged as promising candidates for revolutionizing cancer therapy due to their unique properties and versatility. This abstract provides an overview of the key developments and applications of nanomaterial in cancer therapy. Nanomaterials, with their tuneable physicochemical properties, offer a multitude of advantages for cancer treatment. They can be designed to enhance drug delivery, enabling targeted therapy and minimizing systemic toxicity. Furthermore, the small size of nanoparticles facilitates their accumulation in tumour tissues via the enhanced permeability and retention effect, improving therapeutic outcomes. Several types of nanomaterial have gained attention in cancer therapy. Lipid-based nanoparticles, polymer nanoparticles, and inorganic nanoparticles (such as gold and iron oxide) have been engineered to encapsulate chemotherapeutic agents, nucleic acids, and imaging contrast agents. These multifunctional Nano carriers not only improve drug solubility but also allow for controlled release, thereby increasing treatment efficacy. Drug delivery, nanomaterial have been instrumental in the development of humanistic platforms. These integrated systems combine therapy and diagnostics, enabling real-time monitoring of treatment responses and adjustments as needed. Humanistic nanomaterial, often functionalized with targeting ligands, offer the potential for personalized cancer therapy.

**Key Words:** Nanomaterial's, Cancer, Drug Delivery

A SHORT REVIEW ON POLYMERIC NANOPARTICLES FOR DRUG DELIVERY

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**ABSTRACT**

polymeric nanoparticles have become a viable drug delivery platform, because of their special qualities and wide range of uses. The development of polymeric nanoparticles for drug delivery is examined in this review along with its design, production, and uses. These nanoparticles have several important benefits, including targeted delivery of medicinal substances, enhanced bio availability, and controlled release. Tailoring their performance is largely dependent on the selection of polymer materials, nanoparticles size, and surface changes. A number of encapsulation methods are covered, including solvent evaporation, emulsion, and nano precipitation. The review also explores the distinct modes of administration and targeted uses of polymeric nanoparticles, such as personalized medicine, cancer treatments, and the treatment of infectious diseases. These nanoparticles' safety and bio compatibility are also discussed, emphasizing their potential to transform drug delivery and improve treatment results.

**Keywords:** Polymeric nanoparticles, Targeted delivery, Bioavailability, Controlled release, Improve treatment results.

**TOXICITY OPTIMIZATION OF GREEN ZINC OXIDE QUANTUM DOTS IN  
ZEBRAFISH USING BOX-BEHNKEN DESIGN: A NOVEL APPROACH FOR  
SAFER NANOPARTICLE SYNTHESIS**

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**ABSTRACT**

Zinc oxide quantum dots (ZnO QDs) possess a versatile range of beneficial characteristics, including impressive photoluminescence, water solubility, and robust photostability. These attributes position them as promising candidates for applications in drug delivery, bioimaging, and other biomedical fields. Nonetheless, prior to their potential human use, a comprehensive exploration of their in-vivo toxicity is imperative. Zebrafish (*Danio rerio*), due to their cost-effectiveness, rapid development, and genetic similarity to humans, serve as a prevalent in-vivo model for assessing nanomaterial toxicity. This study delves into the assessment of concentration-dependent toxicity of ZnO QDs and Zinc oxide bionanocomposite (ZnO BC) in zebrafish, with a concurrent optimization of methodologies using Box-Behnken design. To ensure judicious toxicity assessment in zebrafish, preliminary investigations encompassed cell line and hemocompatibility analyses, establishing appropriate dosages. Intriguingly, neither ZnO QDs nor ZnO BC exhibited discernible embryonic toxicity or adverse effects during hatching or developmental stages at a dosage of 2.5  $\mu\text{l}$  for ZnO BC and 2  $\mu\text{l}$  for ZnO QDs. Meanwhile, behavioral assays on larval zebrafish under visible light unveiled a dose-dependent decrease in total swimming distance and speed. However, noticeable effects materialized only at elevated concentrations (>250  $\mu\text{l}$  for ZnO BC and >200  $\mu\text{l}$  for ZnO QDs) in zebrafish embryos. Consequently, it is apparent that lower concentrations of ZnO BC and ZnO QDs remain substantially non-toxic. This pioneering research significantly contributes to the arsenal of future investigators in the realm of in-vivo imaging studies, offering valuable insights into the potential toxic ramifications of nanomaterials. These insights are pivotal in guaranteeing the safety of nanomaterials in various bio-applications, thereby facilitating the responsible advancement of cutting-edge biomedical technologies.

**Key words:** Quantum dots; Zebrafish; Embryo; *In-vivo*, Toxicity study

**EFFECTIVE USE OF NANOCARRIERS AS DRUG DELIVERY SYSTEM FOR THE  
TREATMENT OF SELECTIVE TUMOURS**

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**ABSTRACT**

Nanocarriers have emerged as a promising strategy for the targeted delivery of anticancer drugs to selective tumors. This paper reviews the principles, advantages, and challenges associated with nanocarrier-based drug delivery systems for cancer treatment. Nanocarriers, including liposomes, nanoparticles, and micelles, can enhance drug solubility, improve pharmacokinetics, and reduce systemic toxicity. Selective tumor targeting is achieved through passive and active targeting mechanisms, exploiting the enhanced permeability and retention (EPR) effect and specific ligand-receptor interactions. The potential of nanocarriers to encapsulate a variety of chemotherapeutic agents, including small molecules and nucleic acids, is discussed. Moreover, the review addresses the hurdles, such as drug release kinetics, biocompatibility, and clinical translation. A comprehensive analysis of recent preclinical and clinical studies showcases the potential of nanocarriers as effective tools for precision oncology. Further research is essential to optimize nanocarrier design, scalability, and regulatory approval, advancing the field of targeted cancer therapy.

**Keywords:** Nano-carrier, Liposomes, Specific Ligand-receptor, Biocompatibility and Scalability.



**PHARMACY SERVICES FOR PATIENTS WITH GENERALIZED ANXIETY  
DISORDER**

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**ABSTRACT**

Anxiety disorders represent the group of the most prevalent mental diseases which may have serious negative consequences for mental and social health. Anxiety is generally treated with a combination of the psychotherapeutic treatment and pharmacotherapy. Pharmacotherapy of anxiety implies the use of antidepressants, which are used as basic drugs, and an additional therapy with anxiolytics. This therapeutic approach in the treatment of anxiety disorders is accompanied by significant limitations. Adherence of anxiety patients is often insufficient due to the late onset of the effects of antidepressants, the appearance of adverse effects, the stigmatization of psychiatric patients in society and other reasons. Certain exogenous factors, such as an excessive use of coffee, smoking of marijuana, sleep disorders and personal problems, such as family problems or financial problems, can exacerbate anxiety and make it more difficult to treat it. Prolonged use of benzodiazepines, as an adjunct therapy in the treatment of anxiety, may be accompanied by the development of psycho-physical dependence. Finally, the drugs used to treat anxiety have a serious potential for the drug-drug interactions. All of these limitations may be completely or partially overcome through the active participation of Pharmacists as equal members of collaborative medical teams for the treatment of anxiety disorders.

**Keywords:** Anxiety, Antidepressants, Benzodiazepines, Pregabalin, Pharmacist.

AN EFFECTIVE COMPUTATIONAL METHOD FOR THE MATHEMATICAL  
ANALYSIS OF THE FRACTIONAL DIABETES MODEL

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**ABSTRACT**

Diabetes is referred to a chronic metabolic disease signalized by elevated levels of blood glucose (also known as blood sugar level), which results over time in serious damage to the heart, blood vessels, eyes, kidneys, and nerves in the body. A mathematical assessment of the diabetes model using the Caputo fractional order derivative operator is given in this research paper. The concept of a Caputo fractional order derivative is a novel class of non-integer order derivative that has many applications in real-life scenarios. The proposed model is represented by a set of fractional ordinary differential equations. The authors employed the Sumudu Transform Homotopy Perturbation Method (STHPM) for finding the series solutions of the model being studied. By giving various numerical values to the respective model parameters, graphical analysis is also performed. It is observed in the numerical discussion that a decrease in both fractional order  $\alpha$  and  $\beta$  leads to decrease in the number of diabetic people.

**Keywords:** Sumudu transform; Fractional calculus, Fractional Diabetes Model; Homotopy perturbation method.

**ACUTE TOXICITY STUDIES OF MEDICINAL PLANTS: A SHORT REVIEW**

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**ABSTRACT**

Since ancient times, medicinal plants have been a crucial part of both conventional and complementary medical systems, providing a wide range of organic substances with possible medical uses. Their toxicity and safety profiles, however, are still crucial factors to take into account prior to their clinical application. An overview of studies on acute toxicity carried out on several medicinal herbs is given in this abstract. In order to ascertain whether these plants are safe to consume, acute toxicity studies are essential since they assist identify any possible dangers. Plant extracts or chemicals are administered at different doses to experimental animals, usually rats, in acute toxicity studies. The possible negative consequences are evaluated by recording observations of alterations in behaviour, physiology, and histopathology. It is common practice to estimate toxicity using parameters like LD50, or lethal dose for 50% of the population. The plant type chosen, the portion of the plant used, the extraction techniques used, and the animal models used are some of the elements that affect the results of these investigations. Chemical standardisation is crucial because variations in acute toxicity profiles can also depend on the chemical makeup of the plant. Since acute toxicity studies help determine safe dosages, direct regulatory choices, and aid in the creation of safe and effective herbal medicines, this abstract emphasises the significance of these studies in the assessment of medicinal plants. In addition, it emphasises the necessity of additional study and standardisation to improve the security and effectiveness of medicinal plants in medical and therapeutic settings.

**Keywords:** Acute toxicity, Medicinal herbs, LD50, Safe dosages, Histopathology.

TOXICITY ASSESSMENT OF 7 ANTICANCER COMPOUNDS IN ZEBRAFISH

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**ABSTRACT**

Anticancer compounds hold significant promise for cancer treatment; however, their potential toxic effects on non-target organisms are of growing concern. This study aimed to assess the toxicity of seven commonly used anticancer compounds in zebrafish (*Danio rerio*), a widely accepted model organism for toxicity studies. The selected anticancer compounds included both traditional chemotherapeutic agents and targeted therapies, such as doxorubicin, paclitaxel, cisplatin, imatinib, sorafenib, tamoxifen, and trastuzumab. Zebrafish embryos were exposed to varying concentrations of these compounds, and various toxicity endpoints, including embryo viability, developmental abnormalities, and gene expression profiles, were evaluated. The results showed dose-dependent toxic effects of all seven anticancer compounds on zebrafish embryos, with differences in sensitivity among the compounds. This comprehensive toxicity assessment provides essential insights into the potential risks associated with these anticancer drugs in aquatic ecosystems, contributing to the development of safer therapeutic options and better environmental management strategies.

**Keywords:** Toxicity assessment, Anticancer compounds, *Danio rerio*, Chemotherapeutic agents, Targeted therapies, Doxorubicin, Paclitaxel, Cisplatin, Imatinib, Sorafenib, Tamoxifen, Trastuzumab, Embryo viability, Developmental abnormalities, Gene expression, Environmental risk, Aquatic ecosystems, Therapeutic options, Environmental management strategies.

IMMUNOTHERAPY

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**ABSTRACT**

Utilising the immune system's ability to combat cancer cells, immunotherapy is one method of cancer treatment. Immunotherapy teaches the immune system to identify and eliminate cancer cells, in contrast to conventional cancer treatments like chemotherapy and radiation therapy, which directly target cancer cells. Immunotherapy comes in a variety of forms, each of which focuses on a particular aspect of the immune system. The most popular forms of immunotherapy are cancer vaccines, CAR T-cell treatment, and checkpoint inhibitors. In order to target cancer cells, immune cells from a patient's body are modified in a lab as part of CAR T-cell therapy. The altered cells are then reintroduced into the body of the patient, where they can fight cancer cells. The immune system is prompted by cancer vaccines to identify and target cancer cells. Cancer cells or cancer cell components are used in the creation of some cancer vaccines, whereas materials that resemble cancer cells are used in others. To combat cancer cells, the immune system is prompted to do so by immunotherapy. Depending on the type of treatment being employed, immunotherapy targets various immune system components to accomplish this. Utilising the immune system's ability to combat cancer cells, immunotherapy is a promising new method of cancer treatment. Immunotherapy may provide a number of advantages, but there are also some concerns.

**Key Words:** Immunotherapy, Cancer cells, Immune system

**MULTIDRUG RESISTANCE OF *ENTEROBACTERIACEA* FROM  
ASYMPTOMATIC CHILDREN CARRIERS IN KETU ADIE-OWE COMMUNITY  
OGUN STATE, NIGERIA**

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**ABSTRACT**

**Background:** Antibiotic resistance is a global problem affecting the populace including the people within ketu adie-owe community. The possibility of transference within the community is of public health challenge as the community which may serve as reservoir for easy transmission and maintenance.

**Objective:** This study aimed to isolate the enteric bacterial pathogens from stool samples of healthy children volunteers within ketu adie-owe community and screen for multidrug resistant strains.

**Methods:** One hundred and twenty stool samples were collected healthy children were collected ranging from one to twelve years of age from ketu adie-owe community in Ogun State, Nigeria. The samples were processed using standard microbiological techniques and these were identified using Identification kits (OXOID, England) and characterized using the MICROBACT 12A and 12B as well as 24E.

**Result:** A total of 242 isolates were collected, out of which *Escherichia coli* 82 (31%) was the highest prevalent species, followed by *Klebsiella sp* 75 (31%), while *Salmonella sp* had a prevalence of 60 (24.8%) and *Shigella sp* has the lowest prevalence of 25(10.3%). Antibiotic resistance profile revealed a highest drug resistance in *Shigella sp* strains to augmentin (92%), ampiclox (88%), gentamycin (56%), cefuroxime (56%).

**Conclusion:** This study revealed that *Shigella sp* has the highest antibiotic resistance profile strains in all antibiotic drugs tested for in this study. Severe multidrug resistance poses a great danger to members of the community as they can easily be infected with such organisms without showing any clinical symptoms.

**Keywords:** Stool samples, Enteric organisms, Multidrug resistant, Standard Microbiological Techniques (SMT)



**GOLD NANOPARTICLES APPLICATION IN WOUND HEALING**

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**ABSTRACT**

Gold nanoparticles have demonstrated potential in wound healing due to their unique properties, such as anti-inflammatory effects, antimicrobial activity, and their ability to enhance tissue regeneration. Here are some ways in which gold nanoparticles can be applied in wound healing: Enhanced Wound Dressings: Gold nanoparticles can be incorporated into wound dressings and gauzes to promote wound healing. They can help maintain a moist environment, reduce inflammation, and facilitate the healing process. Antimicrobial Properties: Gold nanoparticles exhibit antimicrobial activity, which can help prevent or treat infections in wounds. They can be used as an alternative or adjunct to traditional antimicrobial agents. Anti-Inflammatory Effects: Gold nanoparticles have anti-inflammatory properties that can reduce the inflammatory response at the wound site. This can help minimize pain, redness, and swelling associated with the healing process. Stimulating Cell Proliferation: Gold nanoparticles can enhance cell proliferation and tissue regeneration. They can stimulate the growth of fibroblasts, keratinocytes, and endothelial cells, which are essential for wound closure and tissue repair. Drug Delivery: Gold nanoparticles can serve as carriers for drugs or growth factors that aid in wound healing. By delivering therapeutic agents directly to the wound site, they can accelerate the healing process and improve outcomes. Photothermal Therapy: Gold nanoparticles can absorb near-infrared light and convert it into heat. This property can be used in photothermal therapy to selectively target and destroy bacteria or infected tissue in chronic wounds. Reducing Scarring: Gold nanoparticles may help reduce scar formation in the wound healing process by promoting tissue remodeling and reducing collagen deposition. Hemostasis: Gold nanoparticles can assist in achieving hemostasis by promoting blood clot formation. This property is particularly beneficial in the management of bleeding wounds. Topical Formulations: Gold nanoparticles can be incorporated into topical creams, ointments, or hydrogels designed for wound application. These formulations can provide sustained release of gold nanoparticles to the wound area. Pain Relief: Gold nanoparticles may help alleviate pain associated with wounds by reducing inflammation and promoting faster healing, leading to faster pain resolution. It's important to note that while gold nanoparticles show promise in wound healing, research is ongoing to better understand their mechanisms and optimize their use. Clinical trials and further studies are needed to evaluate their safety and efficacy in various wound types and conditions. The application of gold nanoparticles in wound healing should be conducted under the guidance of healthcare professionals and in compliance with regulatory standards.

**Keywords:** Antimicrobial activity, Drug Delivery, Gold nanoparticles, Antimicrobial Properties.

INVESTIGATING NOVEL Cyclohexane-1,3-dione DERIVATIVES AS POTENTIAL  
ANTI-NSCLC CANCER AGENTS THROUGH QSAR AND DOCKING STUDIES

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**ABSTRACT**

The C-met receptor tyrosine kinase holds promise as a target for anti-cancer therapies. This study initiates a theoretical exploration into the quantitative structure-activity relationship (QSAR) of compounds that inhibit the enzymatic activity of the C-met protein. Through the application of statistical approaches such as RLM, RNLM, and Y-randomization within the specified scope, a group of 38 molecules, derived from cyclohexane-1,3-dione and dimedon, were assessed for their potential as anti-cancer agents capable of impeding the C-met receptor tyrosine kinase. The analysis resulted in robust models that displayed impressive statistical performance in both multiple linear regression ( $R^2 = 0.913$ ;  $R^2_{CV}=0.85$ ;  $R^2_{test}=0.934$ ) and multiple nonlinear regression ( $R^2=0.991$ ;  $R^2_{CV}=0.82$ ;  $R^2_{test}=0.997$ ). These results highlight the effectiveness of multiple linear regression in accurately representing the inhibitory activity against the enzymatic function of the C-met protein, as well as its predictive capability. Encouraged by these findings, our future endeavors will focus on designing novel molecules tailored for the treatment of non-small cell lung cancer (NSCLC). These molecules will undergo in silico ADMET property assessment, complemented by molecular docking studies.

**Keywords:** QSAR, ADMET, Molecular Docking, NSCLC, C-met

IN SILICO DESIGN OF NEW QUINOLINE DERIVATIVES AGAINST BREAST  
CANCER

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**ABSTRACT**

In order to rationalize the cost of drug development, in silico drug design encompasses a wide range of theoretical and computational methodologies that play an essential role in the current state of drug discovery. This study presents and validates a bioinformatics approach for the identification of potential pharmaceutical agents targeting breast cancer. The main objective of this research was to evaluate the efficacy of quinoline derivatives as anti-tumor agents and to explore their potential in the development of new therapeutic approaches for breast cancer. A comprehensive study was carried out using quantitative three-dimensional structure-activity relationships (3D-QSAR) and molecular docking interactions with the aromatase enzyme (PDB: 3S7S). By applying comparative molecular similarity index analysis (CoMSIA), a robust 3D-QSAR model was established, producing statistically significant results for  $Q^2$ ,  $R^2$  and  $R^2_{pred}$ , indicating a high predictive ability. To validate the predictive power of this model, an external validation process was performed using an independent test dataset. The results highlighted the significant influence of electrostatic, hydrophobic, hydrogen bond donor and acceptor fields on breast cancer activity. Based on these results, a series of potent aromatase inhibitors were designed, and the most optimal model was used to predict their inhibitory effects. In addition, the efficacy of these new drug candidates was assessed on the basis of their properties of absorption, distribution, metabolism, excretion and toxicity (ADME-Tox).

**Keywords:** In silico; Breast cancer; Quinoline; QSAR; Molecular docking; ADME-Tox.

**THE 4-FIBONACCI SEQUENCES OF  $G_m$**

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**ABSTRACT**

For any given integer  $t \geq 2$ , the  $t$ -step Fibonacci sequence is  $F_n(t)$  defined by the following recurrence formula

$F_n(t) = F_{n-1}(t) + F_{n-t+1}(t) + \dots + F_{n-1}(t)$  with initial conditions with initial condition  $F_0(t) = 0, F_1(t) = 0, \dots, F_{t-2}(t) = 0$  and  $F_{t-1}(t) = 1$ . In this paper, we consider finite groups  $G_m$  as follows:

$$G_m = \langle x, y \mid x^m = y^m = 1, [x, y]^x = [x, y], [x, y]^y = [x, y] \rangle, m \geq 2.$$

Then by using the properties of  $G_m$  and 4-nacci sequences in finite groups, we show that

$$K(4, m) \mid \text{LEN}(G_m, 4), m > 2.$$

We use  $K(4, m)$  to denote the minimal length of the period of the sequence  $F_n(4)$  and call it Wall number of  $m$  with respect to 4-step Fibonacci sequence. Also  $\text{LEN}(G_m, 4)$  is the length of the period of the sequence  $G_m$  [1].

**Definition.** Let  $G = G_m$ . Then

- 1) Every element of  $G$  can be uniquely presented by  $x^r y^s [y, x]^t$  where  $0 \leq r, s, t \leq m-1$ .
- 2)  $|G_m| = m^3$ .
- 3)  $Z(G_m) = G'_m$ .

**Lemma.** For integers  $n, i$  and  $m \geq 2$ , we have

- 1)  $F_{K(4,m)+i} = F_i \pmod{m}$ ,
- 2)  $F_{nK(4,m)+i} = F_i \pmod{m}$ .

**Corollary.** For integers  $n$  and  $m \geq 2$ , if

$$\begin{cases} F_n = 0 \pmod{m}, \\ F_{n+1} = 0 \pmod{m}, \\ F_{n+2} = 0 \pmod{m}, \\ F_{n+3} = 1 \pmod{m}. \end{cases}$$

Then  $K(4, m) \mid n$ .

**Keywords**

Finite groups,  $t$ -step Fibonacci sequences, Wall number.

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DEVELOPMENT AND IN VIVO EVALUATION OF A COMMERCIALY VIABLE  
SPRAY BANDAGE FOR WOUND HEALING

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**ABSTRACT**

**Background:** Polyvinylpyrrolidone-Iodine or povidone-iodine (PVI) has been used to reduce the bacterial burden and wound healing for decades. Ideally, a conventional pharmaceutical product of PVI requires proper application either with fingers or with cotton gauze or by using an applicator which is a painful process for patients specifically for children. Further, it has lesser retention time and other associated risks. The present manuscript offers a film-forming spray product having the potential capability to augment the healing process with an enhanced holding period as the product is absorbed into the wounded area providing an effective and painless therapeutic outcome without touching it. **Objective:** The purpose of this investigation is to develop a film-forming spray bandage of PVI for wound healing. The development has been kept synchronized with applicable regulatory requirements to be commercially scalable and viable. **Materials and Methods:** Different concentrations of polymer Ethyl Cellulose (EC), Dibutyl Sebacate (DBS) and Isopropyl myristate (IPM) have been tried (using quality by design approaches), and finally, a composition that showed a desirable quality target product profile (QTPP) was selected for wound healing property. The formulation was optimized by 3<sup>3</sup> Box Behnkan Design design. Further, this study employed a splintered excisional wound murine model. Additionally, accelerated and long-term stability testing was also conducted as per ICH Q1 guidelines. **Results:** The optimized spray bandage was evaluated for instrumental analysis, in vitro permeation, skin irritation, and wound curative potential. Differences in wound healing potential were observed between the treatments and the control group. The group treated with optimized formulation showed around 99.34% healing whereas in the case untreated group (control) 55.78% healing was observed by the 14th day. Moreover, the control group showed inflammation and pus formation, whereas the treated group did not exhibit such changes. **Conclusion:** The product under development has a significant outcome on the process of wound healing which could further be taken up for commercial development.

**Keywords:** Polyvinylpyrrolidone-Iodine, Film-forming polymeric spray solution, Ethyl Cellulose, Dibutyl Sebacate, wound healing, spray bandage, topical plasticizers



$\mathcal{G}^{\ast\ast\beta}$ -CONTINUOUS AND  $\mathcal{G}^{\ast\ast\beta}$ -IRRESOLUTE  
MAPPINGS IN TOPOLOGICAL SPACES

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**ABSTRACT**

Analysis is one of the greatest achievements in the history of mathematics. The achievement opens a new era of mathematical progress and plays an important role in the development of physics, astronomy, signal processing and other disciplines. At the end of the 19th century, mathematicians deduced many properties of continuous functions on closed intervals, which undoubtedly promoted the development of analytical theory. Bolzano's Function Theory gives the earliest proofs of the Boundedness theorem and the Extreme value theorem and Weierstrass proved the Extreme value theorem in Berlin lecture. The Intermediate value theorem was first proved in 1817 by Bolzano, and then Cauchy gave a proof in 1821. The definition of uniform continuity is proposed by Heine, and he published a proof of the Uniform continuity theorem. There are some important properties of continuous functions on closed intervals including Weierstrass second theorem: Boundedness theorem, Weierstrass first theorem: Extreme value theorem, Bolzano-Cauchy second theorem: Intermediate value theorem, Cantor theorem: Uniform continuity theorem. Continuous functions have four fundamental properties on closed intervals: Boundedness theorem, Extreme value theorem, Intermediate value theorem, Uniform continuity theorem. These theorems are the basis of mathematical analysis and the direct expression of real number theory in functions. In 2014, Dr. T. Delcia and M.S. Thillai introduced a new class of sets called  $\mathcal{G}^{\ast\ast\beta}$ -closed and  $\mathcal{G}^{\ast\ast\beta}$ -open sets in topological spaces and studied their properties. We introduce  $\mathcal{G}^{\ast\ast\beta}$ -continuous function and  $\mathcal{G}^{\ast\ast\beta}$ -irresolute function and investigate several properties and characterizations of these new types of mappings in topological spaces.

Mathematics Subject Classification (2020): 54C05, 54C08, 54C10.

**Keywords and Phrases:** Topological space,  $\mathcal{G}^{\ast\ast\beta}$ -open set,  $\mathcal{G}^{\ast\ast\beta}$ -closed set,  $\mathcal{G}^{\ast\ast\beta}$ -interior set,  $\mathcal{G}^{\ast\ast\beta}$ -closure set,  $\mathcal{G}^{\ast\ast\beta}$ -continuous function,  $\mathcal{G}^{\ast\ast\beta}$ -irresolute function

$\mathcal{G}^{**\beta}$ -OPEN AND  $\mathcal{G}^{**\beta}$ -CLOSED MAPPINGS  
IN TOPOLOGICAL SPACES

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**ABSTRACT**

Analysis is one of the greatest achievements in the history of mathematics. The achievement opens a new era of mathematical progress and plays an important role in the development of physics, astronomy, signal processing and other disciplines. At the end of the 19th century, mathematicians deduced many properties of continuous functions on closed intervals, which undoubtedly promoted the development of analytical theory. Bolzano's Function Theory gives the earliest proofs of the Boundedness theorem and the Extreme value theorem and Weierstrass proved the Extreme value theorem in Berlin lecture. The Intermediate value theorem was first proved in 1817 by Bolzano, and then Cauchy gave a proof in 1821. The definition of uniform continuity is proposed by Heine, and he published a proof of the Uniform continuity theorem. There are some important properties of continuous functions on closed intervals including Weierstrass second theorem: Boundedness theorem, Weierstrass first theorem: Extreme value theorem, Bolzano-Cauchy second theorem: Intermediate value theorem, Cantor theorem: Uniform continuity theorem. Continuous functions have four fundamental properties on closed intervals: Boundedness theorem, Extreme value theorem, Intermediate value theorem, Uniform continuity theorem. These theorems are the basis of mathematical analysis and the direct expression of real number theory in functions. In 2014, Dr. T. Delcia and M.S. Thillai introduced a new class of sets called  $\mathcal{G}^{**\beta}$ -closed and  $\mathcal{G}^{**\beta}$ -open sets in topological spaces and studied their properties. We introduce  $\mathcal{G}^{**\beta}$ -open function,  $\mathcal{G}^{**\beta}$ -closed function, pre- $\mathcal{G}^{**\beta}$ -open function and pre- $\mathcal{G}^{**\beta}$ -closed function and investigate several properties and characterizations of these new types of mappings in topological spaces.

Mathematics Subject Classification (2020): 54C05, 54C08, 54C10.

**Keywords and Phrases:** Topological space,  $\mathcal{G}^{**\beta}$ -open set,  $\mathcal{G}^{**\beta}$ -closed set,  $\mathcal{G}^{**\beta}$ -interior set,  $\mathcal{G}^{**\beta}$ -closure set,  $\mathcal{G}^{**\beta}$ -open function,  $\mathcal{G}^{**\beta}$ -closed function, pre- $\mathcal{G}^{**\beta}$ -open function, pre- $\mathcal{G}^{**\beta}$ -closed function,

**THE NEGATIVE IMPACT OF ANOREXIA NERVOSA AND BULIMIA NERVOSA  
ON PREGNANCY**

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**ABSTRACT**

Over recent years the cases of eating disorders (ED) including anorexia nervosa and bulimia nervosa have uprisen in the western and non-western regions, with an 80-85% female preponderance. A trio of 1. Biological (genetics and neurohormonal changes), 2. Psychological (weight phobia), 3. Societal (influence of mass media) are known factors for ED. Both anorexia and bulimia result in dysregulated immune system, undernourishment and micronutrient deficiencies of cellular zinc, copper, selenium, vitamin D, vitamin B1, vitamin B12, vitamin B9 and manganese. We aim to develop a greater understanding of how this vicious cycle of calorie restriction and purging affects pregnancy.

Databases such as Google Scholar and PubMed were analysed using keywords such as “pregnancy”, “anorexia nervosa”, “bulimia nervosa” and “maternal nutrition”. According to the implemented research, sufficient evidence suggests the negative effects of ED on maternal-foetal health which are well-reasoned in this abstract.

Studies have proven that prolonged fasting, purging syndrome and low body mass index due to ED result in reproductive health issues like secondary amenorrhea, irregular ovulation and infertility. Generally pregnant women are nutritionally guided for a balanced diet without abstaining from fats and carbohydrates. However in women with ED, weight gain is a major stressor of pregnancy which provokes self-induced vomiting and high-intensity exercise post-meal, resulting in increased rate of miscarriage, premature labour, stillbirth and low-birth weight neonates.

Eating disorder remains unaltered during pregnancy, thus worsening pregnancy-related conditions such as hyperemesis gravidarum, hormonal fluctuations, gestational diabetes, weight gain and altered body shape. Women with anorexia or bulimia are prone to chronic laxative and appetite suppressants abuse in order to eliminate calories for their drive towards slimness, this triggers electrolyte and mineral imbalances, gastrointestinal infections, severe dehydration, lazy bowel syndrome, preeclampsia, breastfeeding problems and prenatal stroke. Additionally women with ED are vulnerable to depression during pregnancy and relapse of the disorder postpartum. Pre-pregnancy counselling, nutritional psychiatric supervision and antenatal monitoring can help managing pregnancy in mothers with an eating disorders.

FONKSİYONEL GIDA AĞIRLIKLIL BESLENMENİN DİYABET HASTALIĞININ  
GELİŞME VE ÖNLENMESİNDEKİ ÖNEMİ

THE IMPORTANCE OF FUNCTIONAL FOOD-BASED NUTRITION IN THE  
DEVELOPMENT AND PREVENTION OF DIABETES

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**ÖZET:**

Son yıllarda insan ömrünün artması ve değişen yaşam koşulları sebebiyle tüketicilerin günlük olarak tükettikleri yiyecekler ile sağlıkları arasındaki ilişkiye verdikleri önem artmakta ve buna bağlı olarak sağlık ile ilişkili olan gıdalara yönelik ilgi de artmaktadır. Fonksiyonel gıdalar; temel besin değerlerine ek olarak sağlık üzerine potansiyel olumlu etkileri olabilecek öğeleri de içeren veya bunlar ile zenginleştirilmiş olan, vücut için faydalı, belirli hastalıkların önlenmesinde ve hastalığa yakalanma riskinin azaltılmasında rol oynayan gıdalar olarak tanımlanmaktadır. Fonksiyonel gıdalar insan beslenmesinde temel besin ihtiyaçlarını karşılamaktan çok metabolik fonksiyonlar üzerinde etki göstererek insanları hastalıktan koruyucu, iyileştirici veya hastalık riskini azaltıcı etkiye sahiptir.

Diyabet pankreasın yeterli miktarda insülin hormonu üretmediği ya da vücudun üretilen insülinde yeterli miktarda yararlanamaması durumunda ortaya çıkan ciddi bir rahatsızlıktır. Diabetes Mellitus hastalığı gençlik diyabeti (İnsülin bağımlı diyabet, Tip 1) ve erişkin tipi diyabet (Tip 2), gebelik diyabeti ve kullanılan ilaçlar veya geçirilen hastalıklara bağlı gelişen sekonder diyabet olarak sınıflanabilmektedir. Yapılan çalışmalar özellikle Tip 2 diyabet üzerine genetik kökenlerin olduğu kadar beslenme tarzının ve kilo kontrolünün önemli etkileri olduğunu göstermektedir.

Fonksiyonel gıdalar, özellikle tip 2 diyabet (T2DM) gibi kronik hastalıkların önlenmesi ve yönetilmesi için fizyolojik sağlık yararlarıyla ilişkili biyolojik olarak aktif bileşenler içermektedir. Fonksiyonel gıdalar ve içerdikleri bioaktif bileşenler vücutta karbonhidrat ve yağ metabolizması üzerinde etki göstererek dislipidemi ve insülin duyarlılığı ve direncini düzenleyebilmektedir. Bu gıdaların antiinflamatuvar ve antioksidan özellikleri ile oksidatif stresi azaltarak uzun vadede diyabet oluşumunu ve diyabete bağlı komplikasyonların gelişimini önlemek ve yönetmek amacıyla kullanılmaktadır. Bunun yanı sıra fonksiyonel gıdaların glisemik kontrol, kan basıncının düzenlenmesi, antioksidan özellikteki enzimlerin aktivasyonu, bağırsak mikroflorası üzerine de olumlu etkileri bulunmaktadır.

Fonksiyonel gıdalarda bulunan vitamin C, vitamin D ve vitamin E, antioksidan bileşikler, polifenoller, flavonoidler, tokoferoller, terpenler, alkaloidler, sterollere ek olarak kalsiyum, magnezyum ve içerdikleri yağ asitleri (özellikle omega-3, EPA, DHA) ile sağlıklı yaşamı sürdürmeye yardımcı olmanın yanı sıra diyabete karşı koruyucu etki gösterebilmektedir. Karbonhidratların sindirim ve emilimini yavaşlatma özelliği gösteren diyet liflerinin tüketimini arttırmak ise tokluk glikoz seviyesini aşağıda tutabilmekte ve dolayısıyla vücuttaki insülin talebini azaltabilmektedir. Fonksiyonel gıdaların diyabet üzerindeki olası koruyucu-önleyici etkileri, onların insülin direncine ya da insülin salınımına olan etkilerine bağlı olduğu pek çok çalışma ile öne sürülmektedir.

**Anahtar kelimeler:** Fonksiyonel gıda, Beslenme, Diyabet, Tip 2 Diabetes Mellitus.

## ABSTRACT

In recent years, due to the increase in human lifespan and changing living conditions, the importance that consumers attach to the relationship between the foods they consume daily and their health is increasing, and accordingly, the interest in foods related to health is also increasing. Functional foods are defined as foods that, additionally to their basic nutritional values, contain or are enriched with elements that may have potential positive effects on health, are beneficial for the body, and play a role in preventing certain diseases and reducing the risk of contracting diseases. Functional foods, rather than meeting the basic nutritional needs of human nutrition, have an effect on metabolic functions, protecting people from diseases, healing them or reducing the risk of diseases.

Diabetes is a serious disorder that occurs when the pancreas can not produce enough insulin hormone or the body can not benefit from the insulin produced in sufficient amounts. Diabetes Mellitus disease can be classified as juvenile diabetes (Insulin-dependent diabetes, Type 1) and adult type diabetes (Type 2), gestational diabetes and secondary diabetes that develops due to drugs used or diseases experienced. Studies show that diet and weight control, as well as genetic origins, have important effects on Type 2 diabetes.

Functional foods contain biologically active ingredients associated with physiological health benefits, especially for the prevention and management of chronic diseases such as type 2 diabetes (T2DM). Functional foods and the bioactive components they contain can regulate dyslipidemia and insulin sensitivity and resistance by affecting carbohydrate and fat metabolism in the body. The anti-inflammatory and antioxidant properties of these foods are used to prevent and manage diabetes and the development of diabetes-related complications in the long term by reducing oxidative stress. In addition, functional foods also have positive effects on glycemic control, blood pressure regulation, activation of antioxidant enzymes, and intestinal microflora.

In addition to vitamin C, vitamin D and vitamin E, antioxidant compounds, polyphenols, flavonoids, tocopherols, terpenes, alkaloids and sterols found in functional foods, they help maintain a healthy life with calcium, magnesium and the fatty acids they contain (especially omega-3, EPA, DHA). In addition, it may have a protective effect against diabetes. Increasing the consumption of dietary fibers, which have the ability to slow down the digestion and absorption of carbohydrates, can keep the postprandial glucose level down and therefore reduce the insulin demand in the body. Many studies suggest that the possible protective-preventive effects of functional foods on diabetes depend on their effects on insulin resistance or insulin secretion.

**Keywords:** Functional food, Nutrition, Diabetes, Type 2 Diabetes Mellitus.

**SAĞLIKLI VE DENGELİ BESLENME AÇISINDAN SÜRDÜRÜLEBİLİR GIDA  
SİSTEMLERİNİN DEĞERLENDİRİLMESİ**  
**EVALUATION OF SUSTAINABLE FOOD SYSTEMS IN TERMS OF HEALTHY  
AND BALANCED NUTRITION**

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**ÖZET**

Beslenme insanın büyüme, gelişme ve yaşam faaliyetlerinin yapılması ve yaşamın sağlıklı ve üretken olarak devamı için, besin maddelerinin vücuda dışarıdan alınması, vücutta emilebilir hale getirilmesi, emilmesi ve kullanılmasıdır. Bununla birlikte Dünya Sağlık Örgütü'nün (WHO) tanımına göre sağlık bireylerin bedensel, ruhsal, zihinsel ve sosyal yönden tam bir iyilik ve uyum halinde olmasıdır. Bu iki tanıma göre sağlıklı beslenme; yenilen besinden zevk alarak, çeşitli ve dengeli beslenerek, tüm besin öğelerinin bireye özel gereksinim duyulan miktarlarda alınması ve ideal vücut ağırlığının sürdürülmesidir. Vücudun büyümesi, yenilenmesi ve çalışması için gerekli olan enerji ve besin öğelerinin her birinin vücudun ihtiyacını karşılayacak yeterli miktarlarda ve kalitede, düzenli, sürekli ve ekonomik olarak vücuda alınmasına ise yeterli ve dengeli beslenme denilmektedir.

Günümüzde halk ve toplum sağlığı açısından bakıldığında en önemli sorunlardan birisi özellikle düşük ve orta gelirli ülkelerde ekonomik kalkınma ve kentleşmeyle ilişkili demografik ve epidemiyolojik geçişler sonucunda meydana gelen beslenme geçişleri, ve buna bağlı olarak ortaya çıkan yetersiz beslenme sorunları, makro ve mikro besin eksiklikleri sonucunda beslenmeye bağlı ortaya çıkan sağlık sorunları (proteinin yanı sıra, enerji bakımından da yetersiz beslenme, malnütrisyon); ve yine dengesiz ve düzensiz beslenme kaynaklı bulaşıcı olmayan hastalıklarda meydana gelen artışın yanı sıra hem yetersiz hem de aşırı beslenme sorunlarının (obezite ve kronik rahatsızlıklar) giderek artmasıdır. Beslenme sebebi ile ortaya çıkan sorunlara ek olarak bir diğer sorun ise kentleşme ve sanayileşmenin artması ile giderek artan teknolojik gelişmeler sonucunda gıda üretim alanlarının daralması ve gıda üretimi sırasında mevcut olan kısıtlı kaynakların değerlendirilmesi ve çevre ile doğal kaynakların korunamaması sorunudur.

Bu mevcut sorunlara çözüm olarak sürdürülebilir gıda sistemleri öne çıkmaktadır. FAO, Gıda Sistemlerini tarım, ormancılık ve balıkçılıktan kaynaklanan gıda ürünlerinin üretimi, toplanması, dağıtımı, tüketimi ve bertarafına dahil olan tüm aktörler ve bunlarla bağlantılı katma değerli faaliyetleri ve içerdikleri daha geniş ekonomik, sosyal ve doğal ortamlara ait kısımları kapsayacak şekilde düzenlemiştir. Gıda sistemleri, tarım sistemi, atık yönetim sistemi, girdi tedarik sistemi vb. alt sistemlerden oluşmakla birlikte, enerji sistemi, ticaret sistemi, sağlık sistemi gibi diğer kilit sistemlerle etkileşim içerisinde. Sürdürülebilir Gıda Sistemleri Amerikan Halk Sağlığı Derneği (APHA), tarafından mevcut gıda ihtiyaçlarını karşılamak için



uygun fiyatlı, besleyici, güvenilir ve sağlıklı gıda sağlarken, gıdada kayıp ve israfı azaltmayı hedefleyen ve bunu sağlarken nesillere ve çevreye en az olumsuz etki yapacak şekilde gıda sağlayabilen ve sağlıklı ekosistemleri koruyan ve tarımsal ekosistemlerin bütünlüğü ve toplumsal refah arasındaki dengeyi ekonomik, sosyal ve çevresel bakımdan temel alan sistemler olarak tanımlamaktadır.

Bu çalışma kapsamında sürdürülebilir gıda sistemlerinin ekonomik, sosyal ve çevresel etkilerinin halk ve toplum sağlığı açısından değerlendirmesi yapılmaktadır. Bunun yanı sıra ülkemizde uygulanan veya uygulanabilecek olan gıda güvenliği ve sürdürülebilir gıda politikalarının ve politika önlemlerinin gıda üretimi, dağıtım, tüketimi ile halk ve toplum beslenmesi ile olan ilişkileri tartışılmaktadır. Buna ek olarak yapılan çalışmada toplumumuzun gıda tüketim ve beslenme alışkanlıklarının beslenme kalitesi üzerine etkilerini belirtmek, geçmiş ve mevcut durumumuzdaki değişimleri örnekler ile açıklamanın yanı sıra, gelişen zaman içerisinde oluşan mevcut durum ve gelecek nesillere bırakabileceğimiz sürdürülebilir gıda güvenliği emaneti ile yapılabilecek çalışmaları vurgulamayı amaçlamaktadır.

**Anahtar Kelimeler:** Dengeli beslenme, Sürdürülebilir gıda sistemleri, Gıda politikaları

## ABSTRACT

Nutrition is the intake of nutrients from outside into the body, making them absorbable in the body, absorption and use in order for human growth, development and life activities and for the continuation of life in a healthy and productive manner. The World Health Organization (WHO) defines health as the complete physical, spiritual, mental and social well-being and harmony of individuals. According to these two definitions, healthy nutrition is about enjoying the food you eat, eating a varied and balanced diet, taking all nutrients in amounts specifically needed for the individual, and maintaining your ideal body weight. Adequate and balanced nutrition is defined as the intake of each of the energy and nutrients required for the body's growth, renewal and functioning, in sufficient quantities and quality to meet the body's needs, regularly, continuously and economically.

Nowadays when we look at the issue from a public and community health perspective, the most important problems are nutritional transitions that occur as a result of demographic and epidemiological transitions associated with economic development and urbanization, especially in low- and middle-income countries, and the resulting malnutrition problems, which arise due to nutrition as a result of macro and micronutrient deficiencies. emerging health problems (insufficient nutrition in terms of energy as well as protein, malnutrition); and the increase in non-communicable diseases caused by unbalanced and irregular nutrition, as well as the increasing number of both undernutrition and overnutrition problems (obesity and chronic diseases). In addition to the problems arising from nutrition, another problem is the shrinkage of food production areas as a result of increasing technological developments with the increase of urbanization and industrialization, and the problem of utilizing the limited resources available during food production and not protecting the environment and natural resources.

Sustainable food systems steps forward as a solution to these current problems. FAO has organized food systems to include all actors involved in the production, collection, distribution, consumption and disposal of food products originating from agriculture, forestry and fisheries and their associated value-added activities, and the broader economic, social and natural environments they contain. Food systems include agricultural system, waste management system, input supply system, etc. It consists of subsystems and is in communication with other important systems such as the energy system, trade system, and health system. American Public Health Association (APHA) defines sustainable food systems as a system that aims to reduce

food loss and waste while providing affordable, nutritious, safe and healthy food to meet current food needs, and that can provide food in a way that has the least negative impact on generations and the environment and protects healthy ecosystems. It defines the balance between the integrity of agricultural ecosystems and social welfare as systems based on economic, social and environmental aspects.

In this study, the economic, social and environmental impacts of sustainable food systems are discussed in terms of public and community health. In addition, the relationship between food safety and sustainable food policies and policy measures implemented or to be implemented in our country and food production, distribution, consumption, and public and community nutrition is examined. In addition, in this research, the effects of our society's food consumption and nutrition habits on nutritional quality are stated, the changes in our past and current situation are explained with examples, the current situation that has developed over time is discussed, and it is aimed to give ideas for possible studies on the sustainable food safety legacy that we can leave to future generations.

**Keywords:** Balanced nutrition, Sustainable food systems, Food policies

FUNDAMENTAL RESULTS ON DISCONTINUOUS BOUNDARY VALUE  
PROBLEM WITH PERIODIC BOUNDARY CONDITIONS

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**ABSTRACT**

In this work we study certain properties of three-interval, differential equations together with periodic boundary conditions and additional impulsive conditions specified at two interior singular points. This work's primary objective is to investigate certain characteristics of the eigenvalues and eigenfunctions of a novel class of boundary value problems that comprise three-interval Sturm-Liouville equations. Namely we will consider a new type periodic Sturm-Liouville problems, consisting of the three-interval differential equation

$$-\nu''(x) + q(x)\nu = \lambda \nu, \quad x \in [a, \xi_1) \cup (\xi_1, \xi_2) \cup (\xi_2, b] \quad (1)$$

subject to periodic boundary conditions, given by

$$\nu(a) = \nu(b), \quad \nu'(a) = \nu'(b) \quad (2)$$

and additional impulsive conditions at the common endpoints  $\xi_1, \xi_2$  given by

$$\alpha\nu(\xi_1 - 0) + \beta\nu(\xi_1 + 0) = 0 \quad (3)$$

$$\delta\nu'(\xi_1 - 0) + \gamma\nu'(\xi_1 + 0) = 0 \quad (4)$$

$$\alpha\nu(\xi_2 - 0) + \beta\nu(\xi_2 + 0) = 0 \quad (5)$$

$$\delta\nu'(\xi_2 - 0) + \gamma\nu'(\xi_2 + 0) = 0 \quad (6)$$

where  $q(x)$  is real-valued functions which continuous on each of the intervals  $[a, \xi_1)$ ,  $(\xi_1, \xi_2)$  and  $(\xi_2, b]$  and has a finite one-hand limits,  $q(\xi_i \pm 0) = \lim_{x \rightarrow \xi_i \pm} q(x)$ ,  $\alpha, \beta, \delta, \gamma$  are nonzero real numbers,  $\lambda$  is a complex eigenvalue parameter, in the special case when  $\alpha = -\beta, \delta = -\gamma$ , under consideration is reduced to classical periodic Sturm-Liouville problems, so the results obtained in this paper extend and generalize the corresponding classical results. Note that the problem under consideration is not selfadjoint in the classical Hilbert space of square

integrable functions. By using a new approaches we obtained some important properties of eigenvalues and eigenfunctions.

**Keywords:** Sturm-Liouville problems, transmission conditions, eigenvalue.

## INTRODUCTION

The main goal of regular Sturmian theory is to analyze spectral properties of a differential equation of the form

$$-(p(x)v')' + q(x)v = \lambda r(x)v(x) \quad (7)$$

on a finite interval  $x \in [a, b]$  with two boundary conditions at the ends  $x = a$  and  $x = b$  given by

$$\alpha_a v(a) + \alpha'_a v'(a) = 0 \quad (8)$$

$$\alpha_b v(b) + \alpha'_b v'(b) = 0 \quad (9)$$

where  $\alpha_a, \alpha'_a, \alpha_b, \alpha'_b$  are real constants with  $|\alpha_a| + |\alpha'_a| \neq 0, |\alpha_b| + |\alpha'_b| \neq 0, \lambda \in \mathbb{C}, p(x), q(x), r(x)$  are continuous in  $[a, b]$   $p(x) > 0, r(x) > 0$ . A value of the complex parameter  $\lambda$  for which there is a nontrivial solution  $u \neq 0$  satisfying the given boundary conditions, is called an eigenvalue and the solution  $u = u(x)$  is the eigenfunction belonging to this eigenvalue. Such type of spectral problems arose first in the context of the separation of variables method for various type of partial differential equations which model physical processes such as the propagation of sonar in water stratified by varying density, the Earth's seismic behaviour, the stability and velocity of large-scale waves in the atmosphere, etc. In particular Sturm-Liouville differential equations with periodic boundary conditions.

$$v(a) = v(b), \quad v'(a) = v'(b)$$

arise, as a rule, in modeling of many phenomena in regions with circular boundaries. Although the regular Sturm-Liouville problem (7)-(9) has only simple eigenvalues, however Sturm-Liouville equation with periodic boundary conditions can have both simple or repeated eigenvalues. There are volumunous papers devoted to the investigation of periodic Sturm-Liouville problems and its applications (see, for example, [3], [5], [6], [7], [11] and references cited therein. In this study, the Sturm-Liouville equation will be examined, along with periodic boundary conditions and extra transmission conditions that are stated at the internal places of interaction. Sturm-Liouville problems with transmission conditions have been an important research in recent years [1], [2], [4], [8], [19], [10].

## MAIN RESULTS

**Theorem 1.** All eigenvalues of the problem (1)– (6) are real numbers.

**Proof.** Let  $\lambda = s + it$  is an eigenvalue with eigenfunction  $u(x, \lambda) = v(x, \lambda) - iw(x, \lambda)$ , where  $v$  and  $w$  are real-valued functions. Taking the complex conjugate of the eigenfunctions (4)– (6) we have that  $\bar{\lambda} = s - it$  is also an eigenvalue with eigenfunction  $\bar{u}(x, \lambda) = v(x, \lambda) - iw(x, \lambda)$ . Using the well-known Green's second identity we can derive the following identity:

$$2it \int_a^b (|v(x, \lambda)|^2 + |w(x, \lambda)|^2) dx = 0$$

which implies that  $t = 0$ .

**Theorem 2.** If  $\begin{vmatrix} \alpha & \beta \\ \delta & \gamma \end{vmatrix} = 0$ , then any eigenvalue has at least one real-valued eigenfunction.

**Proof.** Suppose the contrary that there is no real-valued eigenfunctions and that

$u(x) = y(x) + iz(x)$  is any complex-valued eigenfunction ( that is  $z(x)$  is not identically zero) corresponding to the eigenvalue  $\lambda$ . Since all coefficients of the three-interval Sturm-Liouville boundary value transmission problem (1)-(6) are real, the complex conjugate of the eigenfunction  $u(x)$  is also eigenfunction corresponding to the same eigenvalue  $\lambda$ . Then  $z(x) = \frac{1}{2i} (u(x) + \overline{u(x)})$  is also an eigenfunction corresponding to the same eigenvalue  $\lambda$ . Thus we have a contradiction. The proof is complete

**Remark.** From now on we can assume that all eigenfunctions of the problem (4)-(6) are real-valued functions.

**Definition 3.** Let  $u(x, \lambda)$  and  $v(x, \lambda)$  are real valued square integrable functions defined on three-interval  $[a, \xi_1) \cup (\xi_1, \xi_2) \cup (\xi_2, b]$ . We say that they are orthogonal if

$$\int_a^{\xi_1-0} u(x, \lambda) v(x, \lambda) dx + \int_{\xi_1+0}^{\xi_2-0} u(x, \lambda) v(x, \lambda) dx + \int_{\xi_2+0}^b u(x, \lambda) v(x, \lambda) dx = 0$$

**Theorem 4.** Let  $u(x, \lambda)$  and  $v(x, \lambda)$  are two eigenfunctions, belonging to distinct eigenvalues  $\lambda$  and  $\mu$  respectively. If  $\begin{vmatrix} \alpha & \beta \\ \delta & \gamma \end{vmatrix} = 0$ , then  $u(x, \lambda)$  and  $v(x, \lambda)$  are orthogonal.

**Proof.** By integrating the Lagrange's identity

$$\frac{d}{dx} W(u, v; x) = uL(v) - vL(u)$$

Over the intervals  $[a, \xi_1)$ ,  $(\xi_1, \xi_2)$  and  $(\xi_2, b]$  we have

$$\begin{aligned} & (\lambda - \mu) \left( \int_a^{\xi_1-0} u(x, \lambda) v(x, \lambda) dx + \int_{\xi_1+0}^{\xi_2-0} u(x, \lambda) v(x, \lambda) dx + \int_{\xi_2+0}^b u(x, \lambda) v(x, \lambda) dx \right) \\ & = W(u, v; b) - W(u, v; \xi_2 + 0) + W(u, v; \xi_2 - 0) - W(u, v; \xi_1 + 0) \\ & \quad + W(u, v; \xi_1 - 0) - W(u, v; a) \end{aligned} \tag{10}$$

By applying the boundary conditions (2) we have

$$W(u, v; b) = W(u, v; a)$$

Now by using the impulsive conditions (3)-(6) we have

$$\begin{aligned} W(u, v; \xi_1 + 0) & = u(\xi_1 + 0) v'(\xi_1 + 0) - u'(\xi_1 + 0) v(\xi_1 + 0) \\ & = -\frac{\alpha}{\beta} u(\xi_1 - 0) \left( -\frac{\delta}{\gamma} v'(\xi_1 - 0) \right) - \left( -\frac{\alpha}{\beta} u'(\xi_1 - 0) \right) \left( -\frac{\delta}{\gamma} v(\xi_1 - 0) \right) \\ & = W(u, v; \xi_1 - 0) \end{aligned}$$

Similarly we have

$$W(u, v; \xi_2 + 0) = W(u, v; \xi_2 - 0)$$

Substituting these equalities in the equality (10) and taking into account that  $\lambda - \mu \neq 0$  we get the needed equality

$$\int_a^{\xi_1-0} u(x, \lambda) v(x, \lambda) dx + \int_{\xi_1+0}^{\xi_2-0} u(x, \lambda) v(x, \lambda) dx + \int_{\xi_2+0}^b u(x, \lambda) v(x, \lambda) dx = 0$$

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DIFFERENTIAL TRANSFORMATION TECHNIQUE TO SOLUTION OF TWO-  
INTERVAL BVP'S

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**ABSTRACT**

Boundary value problems for two-order linear differential equations (the so-called Sturm-Liouville equations) arise, as a rule, as a mathematical model of a wide class of phenomena in all areas of natural science. There are various analytical methods to find exact solutions of certain type of Sturm-Liouville boundary value problems. However, not all Sturm-Liouville equations can be solved analytically. Therefore, various semi-analytical, numerical or approximate methods, such as Taylor's series method, Euler method, Differential Transform Method, Runge-Kutta method, Finite Difference method, Variational Iterative method, Shooting Method, Adomian Decomposition method, Homotopy Perturbation method, etc. has been developed to investigate and understand the qualitative properties of the solutions of various type differential equations. Differential Transform method (DTM) is one of the efficient semi-analytical methods, which was developed in the famous works of Zhou in solving differential equations that arise when modeling electrical circuits. This method allows you to find an approximate series or analytical solution in closed form of various ordinary and partial differential equations. In this study the following boundary value transmission problem, consisting of a two-interval differential equation

$$(2x^2 + 11x + 15)y''(x) + (2x + 4)y'(x) - 2y(x) = 0, \quad x \in [-1,0) \cup (0,1]$$

under the boundary conditions

$$y(-1) = \frac{3}{2}, \quad y'(1) = 1$$

as well as additional transmission conditions

$$6y(-0) = 7y(+0), \quad 9y'(-0) = -y'(+0)$$

was solved using a new modification of the classical DTM. The resulting DTM-solution was compared graphically with the exact solution  $y(x) = x + 2 + \frac{1}{x+3}$ , for  $x \in [-1,0)$ ,  $y(x) = x + 2$ , for  $x \in (0,1]$ .

**Keywords:** Approximate solution, DTM, transmission conditions.

## 1. Introduction

Various types of important problems arising in engineering, physics, chemical physics and other fields of natural science can be modeled using so-called initial value and boundary value problems for high order ordinary and partial differential equations. In most cases, boundary value problems of this type may turn out to be impossible or too complex for analytical solution. Alternatively, many numerical methods have been developed that can provide approximate rather than analytical solutions to such problems. There are various methods for calculating approximate solutions of boundary value and/or initial value problems, such as the decomposition method, the shooting method, the Euler method, the rationalized Haar function method, the Galerkin method, the Runge Kutta method, the variational iteration method, the homotopy perturbation method, the differential transformation method, the finite difference method, etc.

In recent years, the differential transformation method and its various modifications have attracted great interest in solving boundary value and/or initial value problems. Note that the classical version of the DTM was first developed in 1986 by Zhou to solve BV problems, which is found as a mathematical model of electrical circuits [1]. Many authors have applied different numerical or semi-analytical methods for solving different types of boundary value problems for different types of equations (see, for example, [2],[3],[4],[5] and references cited therein) Ayaz [2] used a DTM to solve a system of differential equations. In [3], Yucel and Mukhtarov proposed a new differential transformation algorithm for solving non-classical boundary value problems for multi-interval differential equations, which differs from the classical DTM in that the differential equation contains some internal singular points at which additional transfer conditions are specified.

## 2. On the DTM

Let  $m = m(t)$  be any analytic function in some around of the point  $t = t_0$ . Then this function can be expanded in Taylor's series as

$$m(t) = \sum_{l=0}^{\infty} M_{t_0}(l) (t - t_0)^l \quad (1)$$

where  $M(l)$  is Taylor's coefficient defined by

$$M_{t_0}(l) = \frac{1}{l!} \left[ \frac{d^l}{dt^l} m(t) \right]_{t=t_0}, \quad l = 0, 1, 2, \dots \quad (2)$$

**Definition 1.** The sequence  $M_{t_0}(0), M_{t_0}(1), M_{t_0}(2), \dots$  is said to be the differential transform of the analytic function  $m(t)$ , where  $M_{t_0}(l), l = 0, 1, 2, \dots$  is defined by (2). The inverse differential transformation (IDT) of the sequence  $(M_{t_0}(l))$  is defined by (1). Here  $m(t)$  is said to be the original function and the sequence  $(M_{t_0}(l))$  is said to be the Z-transform of  $m(t)$ .

Let us denote the Z-transform of the original function  $m(t)$  by  $Z_{t_0}(b)$ , and the differential inverse transform of  $(M_{t_0}(l))$  by  $T_{t_0}^{-1}(M_{t_0}(l))$ . From the definition of the Z-transform it follows easily the following properties:

- $Z_{t_0}(a_1 + a_2) = Z_{t_0}(a_1) + Z_{t_0}(a_2)$
- $Z_{t_0}(\gamma b) = \gamma Z_{t_0}(b)$  for any  $\gamma \in \mathbb{R}$
- If  $Z_{t_0}(m) = (M_{t_0}(l))$ , then  $Z_{t_0}\left(\frac{dm}{dt}\right) = ((l+1)M_{t_0}(l+1))$  and

$$Z_{t_0} \left( \frac{d^2 m}{dt^2} \right) = ((1+1)(1+2)M_{t_0}(1+2))$$

▪ If  $Z_{t_0}(n) = (N_{t_0}(l))$ ,  $Z_{t_0}(m) = (M_{t_0}(l))$  and  $Z_{t_0}(nm) = (C_{t_0}(l))$ , then  $C_{t_0}(l) = (N_{t_0}(l) * M_{t_0}(l))$ , where  $N_{t_0}(l) * M_{t_0}(l)$  is denoted the convolution of the sequences  $N_{t_0}(l)$  and  $M_{t_0}(l)$ .

▪ If  $f(t) = t^m$  ( $m \in N$ ),  $Z_{t_0}(\rho) = \begin{cases} \frac{m!}{\rho!(m-\rho)!} t_0^{m-\rho}, & \rho < m \\ 1, & \rho = m \\ 0, & \rho > m \end{cases}$

In a real application, the differential inverse transform  $Z_{t_0}^{-1}(M_{t_0}(l))$  is defined by a finite sum

$$Z_{t_0}^{-1}(M_{t_0}(l)) = \sum_{l=0}^s M_{t_0}(l)(t-t_0)^l$$

for sufficiently large  $s$ .

### 3. by Using Modified DTM

### Solution of Transmission Problems

Consider the two-interval differential equation,

$$(2t^2 + 11t + 15)y''(t) + (2t + 4)y'(t) - 2y(t) = 0, \quad t \in [-1,0) \cup (0,1]$$

together with the BCs,

$$y(-1) = 1,5$$

$$y'(1) = 1$$

subject to the transmission conditions(TCc)

$$6y(-0) = 7y(+0), \quad 9y'(-0) = -y'(+0).$$

Devote by  $Y_{-1}^-(k)$  and  $Y_1^+(k)$  the Z-transforms of the function  $y(t)$  at the end-points  $t = -1$  and  $t = 1$ , respectively. If DTM is applied to the differential equation in the left interval, at the point  $t = -1$ , we have

$$6(\rho + 2)(\rho + 1)Y_{-1}^-(y^-, \rho + 2) + (\rho + 1)(-3\rho + 2)Y_{-1}^-(y^-, \rho + 1) + 2(\rho^2 - 1)Y_{-1}^-(y^-, \rho) = 0 \quad (3)$$

where  $Z^-(\rho) = \frac{1}{k!} \left[ \frac{d^\rho}{dt^\rho} z(t) \right]_{t=t_0}$ . The IDT in the left interval has the following form:

$$y^-(t) = \sum_{\rho=0}^n (t+1)^\rho Y_{-1}^-(\rho) = Y_{-1}^-(0) + (t+1)Y_{-1}^-(1) + (t+1)^2 Y_{-1}^-(2) + \dots \quad (4)$$

The first boundary condition  $y(-1) = \frac{3}{2}$ , becomes  $Y_{-1}^-(0) = \frac{3}{2}$ . Let  $Y_{-1}^-(1) = f$ .

Now proceed with the iteration using (3); we can calculate the other terms of the Z- transform as

$$Y_{-1}^{-1}(2) = \frac{1}{6} \left( \frac{3}{2} - f \right), \quad Y_{-1}^{-1}(3) = \frac{1}{108} \left( \frac{3}{2} - f \right), \quad Y_{-1}^{-1}(4) = \frac{-1}{81} \left( \frac{3}{2} - f \right), \dots$$

If we carry out the iteration up to  $n = 4$ , then we have the following approximation of the left solution:

$$y^{-}(t) = \frac{3}{2} + f(t + 1) + \frac{1}{6} \left( \frac{3}{2} - f \right) (t + 1)^2 + \frac{1}{108} \left( \frac{3}{2} - f \right) (t + 1)^3 + \frac{-1}{81} \left( \frac{3}{2} - f \right) (t + 1)^4. \quad (5)$$

Secondly, let us get the solution for the problem in the right interval  $(0, 1]$ . If the DTM is applied to the differential equation, in the around of the point  $t_0 = 1$ , we have

$$28(\rho + 1)(\rho + 2)Y_1^+(y^+, \rho + 2) + (15\rho + 6)(\rho + 1)Y_1^+(y^+, \rho + 1) + 2(\rho - 1)(\rho + 1)Y_1^+(y^+, \rho) = 0. \quad (6)$$

The differential inverse transform in the right interval  $(0, 1]$  has the following form:

$$y^+(t) = Y_1^+(0) + (t - 1)Y_1^+(1) + (t - 1)^2Y_1^+(2) + \dots$$

The second boundary condition  $y'(1) = 1$ , becomes  $Y_1^+(1) = 1$ . Let us  $Y_1^+(0) = g$ . By using relation (6), we find

$$Y_1^+(2) = \frac{1}{28}(g - 3), \quad Y_1^+(3) = \frac{-1}{112}(g - 3), \quad Y_1^+(4) = \frac{7}{3136}(g - 3), \dots$$

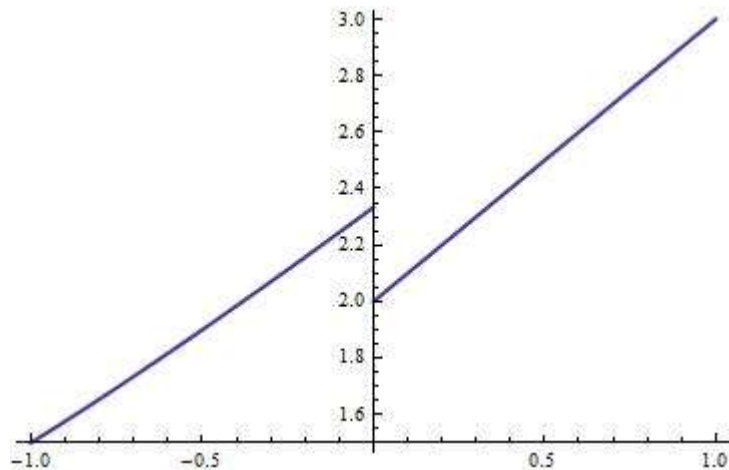
Now, applying differential inverse transform for  $n = 4$ , we have

$$y^+(t) = g + (t - 1) + (t - 1)^2 \frac{1}{28}(g - 3) + (t - 1)^3 \frac{-1}{112}(g - 3) + (t - 1)^4 \frac{7}{3136}(g - 3) \quad (7)$$

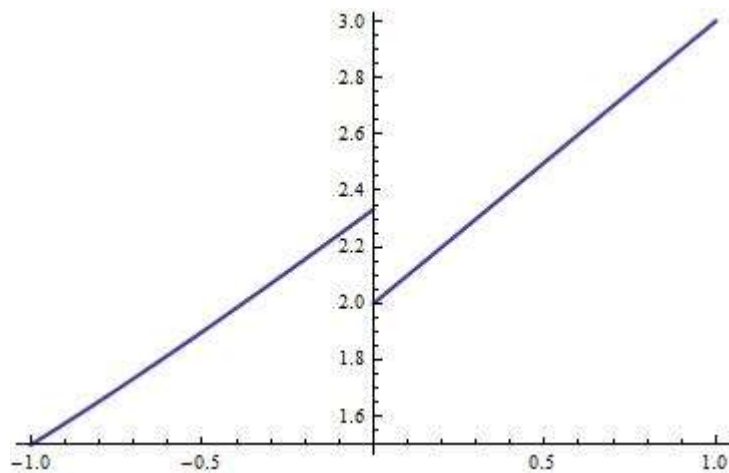
Substituting (5)-(6) in the TCs

$$6y(-0) = 7y(+0), \quad 9y'(-0) = -y'(+0),$$

we can find,  $f = -0.858008$ ,  $g = 1.92905$ .



**Fig. 1** Approximate solution of DTM



**Fig. 2** Exact solution for the problem

### Referances

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**THE EFFECT OF GLOBAL WARMING AND CLIMATE CHANGE ON  
SUSTAINABLE AGRICULTURAL PRODUCTION**

**KÜRESEL ISINMA VE İKLİM DEĞİŞİKLİĞİNİN SÜRDÜRÜLEBİLİR TARIMSAL  
ÜRETİME ETKİSİ**

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**ABSTRACT**

Climate change is expected to affect all sectors, including agriculture. For the sustainability of agricultural activities, it is necessary to take measures now. The study reveals the effects of climate change and global warming in many areas of activity on the sustainability of agricultural operations and the necessary measures to be taken. In particular, the scenario activities on this subject were examined in line with the literature. According to researchers, the world population will exceed 9 billion in 2050, and the needs of people will increase in this context. As the demand for food increases with the increasing world population, global warming and climate change issues are more critical in sustainable agriculture. In terms of cultivation in the agricultural sector, the use and supply of water resources within sustainable agricultural activities are essential. In this context, demand, transportation, supply and use of water resources are increasing daily. Changes occurring on the Earth due to global warming and climate change may adversely affect these resources. In this study, the necessary measures to reduce the effects of climate change and global warming on the sustainability of agricultural activities have been put forward. Reducing the increase in temperature was predicted as the most important factor in preventing global warming. The measures to be taken in this direction are summarized as follows: reducing the emissions of gases characterized as greenhouse gases into the atmosphere as a result of various activities, reducing the use of fossil fuels, increasing the use of renewable energy resources, protecting water resources, managing water resources correctly, increasing especially pressurized irrigation systems, preventing the destruction of forests, planning improved roof systems related to rain harvesting of greenhouses in greenhouse areas that are expected to increase with climate change. Moreover, people's awareness of global warming and the amount of training and publications on the subject should be increased.

**Keywords:** Agricultural production; Climate change; Global warming; Sustainable agriculture



## ÖZET

İklim değişikliğinin tarım dahil tüm sektörleri etkilemesi bekleniyor. Tarımsal faaliyetlerin sürdürülebilirliği için artık önlem alınması gerekiyor. Bu çalışma, tarımsal faaliyetlerin sürdürülebilirliği için iklim değişikliğinin ve küresel ısınmanın birçok faaliyet alanında etkilerini ve alınması gereken önlemleri ortaya koymaktadır. Özellikle bu konuyla ilgili senaryo çalışmaları literatür doğrultusunda incelenmiştir. Araştırmacılara göre 2050 yılında dünya nüfusu 9 milyarı aşacak ve insanların bu bağlamda ihtiyaçları artacaktır. Artan dünya nüfusuyla birlikte gıdaya olan talep de arttığından, sürdürülebilir tarımda küresel ısınma ve iklim değişikliği ile ilgili konular çok daha fazla önem kazanacaktır. Tarım sektöründe yetiştiricilik açısından sürdürülebilir tarımsal faaliyetler içerisinde su kaynaklarının kullanımı ve temini önemlidir. Bu bağlamda su kaynaklarına olan talep, ulaşım, arz ve kullanımı her geçen gün artmaktadır. Küresel ısınma ve iklim değişikliği nedeniyle yeryüzünde meydana gelen değişiklikler bu kaynakları olumsuz yönde etkileyebilmektedir. Bu çalışmada iklim değişikliği ve küresel ısınmanın tarımsal faaliyetlerin sürdürülebilirliği üzerindeki etkilerinin azaltılması için gerekli önlemler ortaya konmuştur. Atmosferdeki sıcaklık artışının azaltılması, küresel ısınmanın önlenmesinde en önemli faktör olarak öngörülmektedir. Bu doğrultuda alınacak tedbirler özet halinde verilebilir: Sera gazı olarak nitelendirilen gazların çeşitli faaliyetler sonucu atmosfere salınımının azaltılması, fosil yakıt kullanımının azaltılması, yenilenebilir enerji kaynaklarının kullanımının artırılması, su kaynaklarının korunması, su kaynaklarının doğru yönetilmesi, özellikle basınçlı sulama sistemlerinin artırılması, orman tahribatının önlenmesi, iklim değişikliğiyle birlikte artması beklenen sera alanlarında seraların yağmur hasadına ilişkin iyileştirilmiş çatı sistemlerinin planlanması olarak düşünülebilir. Ayrıca insanların küresel ısınma ve iklim değişikliği konusundaki farkındalığının artırılması için, bu konuda eğitim ve yayın faaliyetlerinin yaygınlaştırılması gerektiğini düşünüyoruz.

**Anahtar kelimeler:** tarımsal üretim; iklim değişikliği; küresel ısınma; sürdürülebilir tarım

## 1. Introduction

The world's geography has continuously changed since the day humans came into existence, and with these changes, disruptions in the natural balance have followed one another. When we look at the past periods of climate change, it is obvious that meteorological conditions constantly change and bring many problems (socio-economic, environmental, social) [1]. From the 1850s, when the Industrial Revolution was felt, until 2000, an average temperature increase of 1°C was recorded worldwide, and it is known that the accelerated use of fossil fuels, industrialization, rapid population growth and deforestation caused this change. In the 21st century, it is accepted by all climate scientists that the world's climate system is deteriorating. Suppose people who impact the deterioration of the natural balance do not take the necessary precautions and continue their activities that cause the deterioration of this balance in the same way and intensity. In that case, it is thought that climate deterioration and its vital effects will increase due to global warming [1,2].

The rapidly increasing world population and uncontrolled industrialization process, unhealthy urbanization, regional wars, chemicals such as pesticides used to increase productivity, unconscious fertilization and detergents have started to pollute the environment. As a result, the air, water and soil, which have been significantly polluted, have reached dimensions that may harm living things. With the industrial revolution, the increasing use of fossil fuels and the rapid destruction of forests have brought these negative impacts to almost unpreventable serious dimensions. Considering that fossil fuels (oil, coal, natural gas) account for about 85% of the world's current energy resources [3], it can be argued that the only cause of global warming is

the increase in greenhouse gases in the atmosphere, primarily carbon dioxide from fossil fuels, largely due to industrial (including energy and transportation) and to some extent agricultural, human activities [4].

Recently, excessive and unconscious use of resources has led to global warming and climate change. Due to global warming, temperature increases and changes in precipitation regimes have come to the agenda. Climate change impacts river flows, groundwater and lake water volumes due to temperature changes and precipitation. The fact that this effect does not have a regular process causes a decrease in precipitation in winter, sudden precipitation in summer and above or below the seasonal temperature averages [5,6].

It has been revealed by measurements that greenhouse gases in the atmosphere have increased temperature. Moreover, temperature is one of the most important factors affecting evaporation from the lake's surface. There is a direct proportion between surface temperature and evaporation. Therefore, surface temperatures increase as a result of global warming and evaporation increases due to the direct proportion between them [5,6].

Water, an indispensable element of life, is one of the basic inputs of agriculture. While irrigation increases agricultural production on the one hand, on the other hand, if necessary precautions are not taken, it damages the environment. Furthermore, it leads to the deterioration of the natural balance. The agriculture sector, the largest water user in many countries, faces two major challenges: the increasing need for food due to the growing population and the expected decrease in water potential due to climate change. As the demand for increasingly scarce water resources grows rapidly, the water used in agriculture is restricted, and world food security is jeopardized [7].

With the increase in the world population, the importance of food, one of the basic needs, is increasing daily. However, agricultural production is limited by the lack of increase in available land, incorrect agricultural practices, misuse of agricultural lands, establishment of industrial facilities on fertile lands and damage to soils due to the use of intensive chemicals in production. Furthermore, agricultural production is expected to increase in response to the increasing population [8].

Population growth also leads to the depletion of natural resources, air, soil and water pollution and disruption of the ecological balance. Increasing carbon dioxide emissions and global warming, drought with the disappearance of water resources, and high economic growth targets lead to a global food crisis affecting countries [9].

The decrease in water resources due to global warming is expected to lead to decreased agricultural and forestry products and energy shortages. In order to maintain the ecological balance and ensure the sustainable development of human communities, water resources must be used in the most rational way to meet present and future needs. As a result of the decrease in annual flows in river basins, water shortages will start in cities, and water demand will increase. The decrease in water resources due to climate change will harm agricultural production. In addition to the expansion of arid and semi-arid areas, the increase in average annual temperature will increase desertification, salinization and erosion [10].

This study, in which the effects of global warming on sustainable agriculture and water resources are examined, aims to summarize the relevant studies by reviewing the relevant literature on the subject and providing theoretical information about the measures and actions to be taken.

## **2. Global Warming and Climate Change**

As the gases released into the atmosphere by humans increase the effect of natural greenhouse gases, the average temperature on the Earth's surface and the resulting climate changes are called global warming [11]. Climate change is caused by temperature increases and related effects as a result of increasing changes in the composition of gases in the atmosphere. The temperature of the Earth has been increasing steadily. It is estimated that the temperature of the Earth has increased by 0.7-0.8°C in the last 100 years [12], and will increase by 0.9-3.5°C by 2100 [13] and will continue to increase if necessary measures are not taken [12].

In recent years, global warming has been occurring due to the increase in greenhouse gas emission values in the atmosphere, as well as the thinning of the ozone layer with industrial development and the increase in the average temperature of the world. Climate change caused by global warming constitutes the most important ecological problem of the world (14-16]. Global warming is caused by gases released into the atmosphere due to human activities, leading to an increase in the average temperature on the Earth's surface and, as a result, climate change [11].

Global warming affects the world, and all sectors are affected by global warming. However, it is seen that global warming has a greater impact on the agricultural sector than on other sectors. Considering that agricultural production is largely dependent on natural conditions, it is thought that changing climate and soil characteristics will cause changes in the yield and quality of agricultural products. Agriculture is a sector of great economic importance with its contribution to population and employment, national income, public nutrition and foreign trade. Therefore, it is clear that this sector will suffer great economic and social losses due to global warming [17].

The warming caused by the increasing temperature effect at the global level causes changes in other interrelated climate elements. Global warming caused by temperature increase is the source of problems such as drought, change in the hydrological cycle, decrease in the volume and quality of water resources, mixing of clean water resources into the sea and water problems, sea level rise, melting of snow and glaciers, excessive evaporation, increase in meteorological disasters, changes in precipitation amount and regime, and fires. Global warming has economic, sociological, psychological, and physical effects. The decrease in agricultural and forestry products, energy bottlenecks due to the decrease in water resources, negative impacts on many sectors due to the limitation of tourism and recreation opportunities, settlements in the coastal areas being at risk, migration increasing and causing social and economic difficulties, increasing health costs due to the negative effects on human health, crises because underdeveloped countries do not have the resources to cope with the problems reveal the socio-economic and political importance of climate change [18,19-22].

## **3. Impact of Global Warming and Climate Change on Sustainable Agriculture**

Agriculture is carried out largely depending on climate and weather events [23]. When we look at the impact of climate change on agriculture, it is seen that it is greater than other sectors. Since agriculture is an activity that uses natural resources, it affects soil and water resources, and changes in natural resources affect agricultural production. Due to all these features and its different structure from other sectors, agriculture is more affected by climate change.

### **3.1. Impact of Global Warming and Climate Change on Fruit Growing**

Since fruit growing is a perennial agricultural activity, it is highly affected by global warming. In addition, the chilling requirement for fruit set and balanced flowering in fruit cultivation and for obtaining quality products varies depending on the species. Studies using dynamic models

that calculate the amount required for winter chilling have determined that sudden decreases in winter cold may threaten production in warm and temperate regions and sudden increases in cold regions [25; 26]. However, when global warming is examined in general, it has the potential to increase the air temperature in the winter period, and these predicted temperature changes will have negative effects in regions where most fruit species, grapevine, and hard-shelled fruit cultivation is common [26-29]. Extreme changes in air temperatures also harm the flowering periods of fruit species [30,31].

While the temperature increase that will occur in winter creates some problems during the winter cooling requirement and bud awakening period in fruit species, the temperature increases during the flower bud differentiation period in the summer cause twin fruit formation [25,32,33].

### **3.2. Impact of Global Warming and Climate Change on Vegetable Cultivation**

In a study conducted in the Seyhan region, it was predicted that there would be approximately a 16% increase in maximum temperatures and a 20% decrease in precipitation in the coming years and that there would be an 18% decrease in yield and a 10% increase in biomass in tomato plants produced in the region, and that there would be shifts in the first flower, first fruit and harvest periods of the plant [34]. Climate change will be the leading cause of biodiversity loss over the next 100 years, resulting in changes in species distributions, phenology and ecological interactions. For example, many vegetable crops, such as onions and root crops, are pollinated by insects, and the distribution of insect species will affect pollination. Infestation of agricultural systems with weeds can be another problem [35]. Pepper is sensitive to prolonged flooding. Continuous flooding of pepper plants for four weeks has been reported to cause poor growth, yellowing of the leaves, blackening of the root tips and marked swelling at the junction of the shoot and roots [36]. For succulent leafy vegetables such as spinach, drought has been reported to reduce the water content in the plant, resulting in poor quality and yield [37].

### **3.3. Impact of Global Warming and Climate Change on Field Crops Cultivation**

The first effect of the increased temperature on the grains will appear as a decrease in yield and quality due to the shortened ripening time. Increasing temperature accelerates the grain filling period in grains, therefore yield and quality characteristics change. Along with the decrease in arable land, there will be a decrease in the yield of grain and other products. Although there will be some production increases due to the increasing temperature and carbon dioxide level, the main loss will occur due to excessive temperature and carbon accumulation and reduction in production areas in the following period. In a model made specifically for India on this subject, it is assumed that if the temperature increases by 4 °C due to a possible global warming effect, grain production will decrease by 25-40%, rice production by 15-25%, and wheat production by 30-35% [38].

Chmielewski et al. [39] stated that an increase in the length of the growing season may have positive effects on field crops, such as species selection and rotation, but the shortened development period may have negative effects on grain density and fullness, grain weight per ear and number of grains. Afzal et al. [40] conducted a study examining the impact of global warming on three major agricultural products (wheat, rice and cotton) between 1981 and 2012 in Punjab, Pakistan. They reported that the temperature positively affected wheat production in the sowing and harvesting stages and negatively affected the flowering period. They determined that the minimum temperature, precipitation and humidity rate had a positive effect on rice production during planting and a negative effect during harvest, precipitation had a positive effect in three stages of cotton production, and temperature increase harmed the first and second phases of cotton production and had a positive effect on the third phase.

### **3.4. Impact of Global Warming and Climate Change on Viticulture**

It has been estimated that global warming has the potential to increase air temperatures in winter periods, and it has been reported in some scientific studies that these temperature changes will have negative effects in places where vine cultivation is common [28,29]. In addition, it was stated in a study on this subject that the temperature increases in the summer months delayed the grape harvest and negatively affected the grape quality [27]. Jackson and Lambord [41], in their study of the Merlot grape variety, reported that the temperature increase brought by global warming affected the bud burst, flowering and fruit ripening times and shifted this period earlier. In another study carried out in Baden, Germany, conducted with the Pinot Noir grape variety, it was stated that the annual average temperature increased by 1.2 °C from 1976 to 2005, and it was determined that this situation brought the ripeness to start time and harvest forward by two weeks [42]. In wine growing, the increase in harvest period and temperature leads to increased sugar concentration and alcohol level, lower acidity and modification of aroma compounds depending on the variety. These negative changes in wine phenology and grape composition also affect wine microbiology, chemistry and sensory characteristics [43].

### **3.5. Impact of Global Warming and Climate Change on Insects and Bees**

Changes in the global climate will probably affect the behavior and lifestyles of many living organisms, including insects. The increase in temperature and humidity for many insects means an increase in growth rate, displacement rate and reproductive capacity [44]. Some researchers believe that the effects of temperature on insects are more effective than other environmental factors [15]. According to estimates, it has been revealed that insects can give 1-5 additional offspring per season at a temperature increase of 2°C [45]. Other researchers consider the effects of moisture and CO<sub>2</sub> on insects to be of potential importance in global climate change [46-48].

Bekret et al. [49] stated in their research that the nectar and pollen resources that bees can use to raise young are scarce, especially in the early spring months in the Kayseri region. Not having enough nectar in the nectar source that honeybees visit is an important stress factor. In this case, it is seen that cooperation aimed at reducing competition among field bees is aimed [50]. In fact, in case of insufficient nectar and pollen sources, honeybees destroy themselves by sticking their heads into the cells of the comb in order to keep the limited food available to the next generation [51].

### **3.6. Impact of Global Warming and Climate Change on Livestock**

While extreme events and seasonal fluctuations affect the welfare of animals, they cause a decline in yield and reproductive performance [52]. Climate change is a major threat to the sustainability of livestock systems globally. Adaptation and mitigation approaches play an important role in addressing the negative impacts of climate change on animals [53]. Animals can adapt to warmer climates, but the response mechanisms that help them survive can negatively impact their productive performance. Farm animals perform at their best between 10-30 °C. It is stated that there is an average of 3-5% decrease in feed consumption of cattle, sheep, goats and chickens with every 1°C increase above 30°C [54].

In addition to the direct effects of global warming in countries where animal production is intensive, indirect effects such as water scarcity, reduced roughage production and pathogens will affect animal production much more negatively [55]. Pasture-based livestock systems are expected to be more affected by global warming than industrial ones. Pasture farming is the preferred system, mainly in developing countries, and a 25% loss in animal production due to global warming is predicted in these countries. In the coming years, the increase in per capita



consumption in parallel with the population growth will cause an increase in the demand for animal products [56,57].

#### **4. The Effect of Global Warming and Climate Change on Water Resources**

Records from 1860 to the present show that the average global temperature has increased by 0.5 to 0.8 degrees Celsius. If no measures are taken, it is estimated that the global temperature will increase by 2 degrees on average by the end of this century [58]. Land and aquatic ecosystems and socio-economic systems (agriculture, forestry, fisheries and water resources) are vital to human development and well-being and are highly sensitive to climate change. Due to climate change today and in the future, there will be an increase in the severity and frequency of natural disasters such as hurricanes, heavy rains and floods in some parts of the world. Some regions may experience prolonged and severe droughts and associated desertification phenomena, which will hamper crop production [59]. Moreover, these events will adversely affect all ecosystems. As a result of global warming, there will be a decrease in water resources, forest fires, drought and ecological deterioration due to them. Furthermore, climate change also affects rivers and lakes, increasing water temperatures and decreasing their ice cover [60,61]. Also, they directly influence the hydro-meteorological parameters of rivers [62]. As a result of the decrease in the annual flows in the river basins, water shortages will begin in the cities, and the need for agricultural and urban water will increase [10,63].

##### **4.1. Global Warming and Drought**

The increase in global temperature and the decreasing trend of precipitation, which will be experienced with global warming, will reveal the water problem and drought. Drought is one of the most important negative consequences of global warming and climate change on precipitation regimes. In this context, it is predicted that there will be more precipitation in regions that have received precipitation before, and that drought will increase in regions with drought. Global warming will cause floods, floods and hurricanes and severe droughts in some areas. This will put many people at risk of hunger and thirst [18]. The warming trend in the atmosphere reveals more evaporation, drought and irregular precipitation. Therefore, humanity has faced the risk of experiencing periodic droughts as a result of the decrease in beneficial precipitation and irregular precipitations worldwide [22]. With global warming, many water-rich countries will become water-poor countries. The gradual drying up of water resources will increase the danger of thirst [18].

##### **4.2. Precipitation**

Climate change changes the distribution of precipitation. Precipitation is distributed differently in various parts of the world and seasons. Precipitation increases in the fall and winter in the middle and high latitudes of the northern hemisphere and decreases in both hemispheres' tropics and sub-tropical regions. The largest changes in precipitation over land with climate change are projected to occur in some equatorial regions near the pole and in Southeast Asia [63]. With warming, more water will evaporate from the oceans and seas, and the Earth will become more humid. This will lead to increased precipitation. Precipitation falling on the continents has increased by 1% in the last century [64]. In the 20th century, a 5-10% increase was determined in the precipitation falling on the continents in the middle and higher latitudes. A 2-4% increase was observed in the frequency of heavy precipitation. On the other hand, precipitation falling on land in subtropical areas decreased by 3% [65]. Especially some northern and western African and Mediterranean countries experienced decreased precipitation. In the last 10 years, there has been an increase in drought and temperature intensities in some continents such as Asia and Africa [66].



### **4.3. Underground Water Resources**

Groundwater is rural areas' main drinking and utility water source, especially in arid and semi-arid regions. Precipitation, rivers and lakes recharge the aquifer. It has been understood that the flow changes occurring from year to year are due to changes in precipitation rather than temperature. Sea level rise will cause saltwater intrusion in coastal zone aquifers. The amount of this interference depends on the hydraulic gradient of the groundwater. Shallow coastal aquifers are at greatest risk. The decrease in precipitation caused by rising seas is the reason for the decline in the collectable water volume and will also reduce the scarce freshwater resources [67].

### **4.4. Soil**

Moisture stored in the soil is vital for agriculture, and the actual evaporation rate has an impact on groundwater recharge and runoff water production. The observed localized effects of global warming on soil moisture vary not only with the rate of climate change but also with soil properties. The soil's water-holding capacity will affect possible changes in soil moisture clearance. The lower the capacity, the higher the sensitivity to climate change. Climate change can also affect soil characteristics through its water absorption or cracking properties. These facts reveal the moisture storage properties of the soil. The frequency and intensity of frost affect many soil types' infiltration and water-holding capacity. [68].

### **4.5. Changes in Snow Cover and Glaciers**

The effects of global warming are most clearly seen at the poles. The Arctic Research Commission reported that the volume of glacial areas will decrease by approximately 40% by 2050. While this decrease will cause problems for the living creatures depending on the ice cover, rising sea water levels due to melting will cause floods, erosion and more sediment transport [12]. The world is losing its glaciers rapidly, from continental ice fields to high mountain peaks. Glaciers, which significantly impact the balance of the climate system, are very sensitive to changes in the climate system. With temperature increases due to global warming, glaciers are melting, ice sheets are disintegrating, and permafrost is melting. In the Arctic, sea ice has thinned significantly in the last 50 years, and its area has decreased by 10% in the last 30 years [18,24].

### **4.6. Sea Level**

Sea level rise causes significant changes in coastlines, leading to the loss of land and the merging of freshwater resources near the coast with the sea. It varies depending on many factors, such as the amount and pattern of precipitation, especially temperature increase, and the melting of sea glaciers. The variation of these factors is the atmospheric concentrations of these gases due to greenhouse gas emissions. It is predicted that a significant part of the rise in sea level is related to the increase in global temperature observed in the same period. In the 20th century, the sea level rose by 0.1-0.2 m and was higher than in the 19th century [10, 66]. The rising sea level will cause soil loss in coastal countries and the merger of clean water resources near the coast with the sea [66].

### **4.7. Water Quality**

Global warming and climate change will affect not only the quantity but also the quality of water resources. With the increase in temperature, pollution concentrations will increase due to the decrease in precipitation and currents, causing an increase in water quality problems [22,69]. Drought and excessive rainfall put pressure on water quality. Reduced water levels in rivers and lakes during dry months will lead to higher concentrations of pollutants, especially from point sources (e.g. a factory). This will lead to a decrease in water quality. Warmer waters mean

less oxygenated water. The decrease in dissolved oxygen levels, one of the most important determinants of water quality, brings serious pollution problems. In warmer water, dissolved oxygen concentrations are lower, and the increased temperature also encourages the growth of algal blooms, which deplete oxygen as they decay. The river water temperature increases slightly less than the air temperature. The least increases occur in basins with a large contribution of groundwater. Biological and chemical processes are highly dependent on water temperature. Only higher temperatures will increase the concentration of some chemical species and a decrease in others. On the other hand, the chemical load of water depends on reaching the riverbed. For example, torrential rains often take nitrates into rivers after long drought periods [68].

## **5. Expected Future Global and Regional Effects of Climate Change**

The scenarios used constitute the most important part of the climate model studies. Scenarios are stories used to portray future situations [70]. Based on different greenhouse gas emission scenarios, assumptions have been made for North Africa and most of the Mediterranean basin, Turkey and the Middle East, according to the projections of various climate models. It is stated here that there will be significant decreases in precipitation, water resources and flows for the next century, significant increases in surface air temperatures and evapotranspiration, and extreme weather and climate events [71].

As a result of the studies conducted worldwide, precipitation is predicted to increase in the middle latitudes, tropical Africa and Antarctica in winter and South and East Asia in summer. In this context, winter precipitation continuously decreases in Australia, Central America and South Africa. In other words, drought is expected. In addition, it is predicted that stream flows will increase at high latitudes and in Southeast Asia and decrease in Central Asia, around the Mediterranean basin, South Africa and Australia [72].

Scientists have been working on the effects of climate change in the future for a long time, and projection studies are carried out with various models according to various greenhouse gas emission scenarios. Studies have shown that the trend of the expected effects of climate change is generally in the same direction; it is predicted that only the limit ranges will change. In other words, while all models agree on the global average temperature increase, the amount of increase varies [73].

### **5.1. Atmosphere**

Global surface temperature change will likely exceed 1.5°C over the 1850-1900 period, and two new scenarios (RCP6.0 and RCP6.0) based on all new IPCC scenarios (RCPs) except one (RCP2.6) by the end of the 21st century RCP8.5), it will likely exceed 2°C; According to the RCP4.5 scenario, it will more likely not exceed 2°C [74].

Global warming will continue beyond 2100 based on all new IPCC RCP scenarios except for one scenario (RCP2.6). Warming will continue to show variability from inter-annual to ten-year variability and will not be regionally homogeneous. The global average surface temperature change in the 2016-2035 period compared to the 1986-2005 period will likely be in the range of 0.3-0.7°C. According to natural internal variability, short-term increases in seasonal average and annual average temperatures are expected to be higher in tropical and subtropical zones than in mid-latitudes [71].

### **5.2. Sea level**

It is stated that the sea ice in the Arctic will decrease by 22-33% until 2100 [23,25,30]. The sea level is predicted to rise 50 cm by 2100 [10,19,66]. Although all studies focus on the period until 2100, warming and sea level rises will be estimated to continue in a new millennium if

greenhouse gas levels reach a stable level [75]. If this process continues, it is thought that Alaska, where glacier tourism is made, will lose its tourism revenues. In addition to the decrease in the number of tourists, the population living in Alaska will inevitably be adversely affected. According to the Arctic Research Commission, by 2050, glacial areas will decrease by approximately 30% and by 40% in volume. Depending on the ice cover, this decrease will cause problems for underwater diatoms, seals, polar bears and walruses [76,77]. Moreover, the rise in seawater level that will occur with the melting of glaciers will cause floods, erosion and increased sediment transport. In addition, as the glaciers melt, houses, roads, airports, and pipelines will be damaged, and landslides will occur in these regions [78].

### **5.3. Scenarios for Agricultural Products**

It is possible to predict the effects of climate change on agriculture and food security with the help of data and assumptions produced from climate change scenarios [79]. Climate change is influencing the forms of agricultural production. This reduces the efficiency of agricultural products and creates stress on the world food supply [80].

The global projections on agricultural production estimate that while developing countries will be adversely affected by temperature increases, European Union countries and the USA will be positively influenced by a temperature increase up to 2°C. However, it is estimated that the average temperature increase exceeding 2°C will also have negative consequences for the European Union countries. In addition, a temperature rise of 2.5°C by 2080 is expected to cause starvation risk for close to 50 million people [81].

With the increase in temperatures, the areas where some agricultural products are grown are expected to expand towards the north and higher regions. Countries located in northern latitudes, such as Canada and Russia, may have the opportunity to engage in agricultural activities in larger areas due to global warming. However, even if climatic conditions improve with the effect of warming weather in these countries, some doubts are expressed about whether soil conditions will be suitable for intensive agriculture [82]. Global warming may reduce the quality of soil and seeds, allowing agricultural pests to multiply leading to decreased agricultural production [83].

On the other hand, favourable climatic conditions and increased agricultural production in northern countries with warming weather will adversely affect developing countries' economies in the tropics. Global warming will adversely affect African and Central American countries located in the tropics and earn most of their income from exporting agricultural products. However, it should not be overlooked that increasing temperatures can disrupt local agricultural production. It is predicted that rice production in the Philippines will be adversely affected by the increase in temperature. When the temperature increase is 1°C, rice production in the Philippines is expected to decrease by 10% [84]. Moreover, as a result of the warming of 2.4°C to 6.4°C, which will occur on watermelon pollination until 2099, it has been stated that there will be a 14.5% decrease in pollination managed by honeybees and an increase in pollination provided by native wild species [85].

Another study on the effects of global climate change on apple growing in the Hesse region reported that between 2031 and 2060, trees will begin to bloom 6-8 days earlier, and there will be a significant increase in the risk of late spring frost during the flowering period [86]. For Turkey, studies were conducted on four products for 2050, and it was estimated that the production amount would decrease by 2.24% in barley, 8.18% in wheat, 4.53% in cotton, 9.11% in corn and 12.89% in sunflower [11]. With the effect of global climate change, it has been predicted that between 2031 and 2060, flowering will start 6-8 days earlier in trees, and this will cause a significant increase in the risk of late spring frosts during flowering [87–89].

Furthermore, Luck et al. [90] reported expecting a 16% decrease in potato yield by 2050 for West Bengal if no specific strategy is implemented. Possible effects of climate change on anthocyanin and titratable acidity levels of grapevine cultivars grown in West Australian wine regions are estimated for the years 2030-2050 and 2070, and it is stated that it will be negatively affected by global warming under current management practices [91].

## **6. Conclusions and recommendations**

The problems experienced due to global warming and climate change will be effective globally. Therefore, the measures to be taken need to be considered on a large scale. Considering that water is used mostly in agricultural activities, it can be said that the agricultural sector will be the most affected in case of drought. Fertilizing programs prepared according to soil and leaf analyses and fertilizer applications are some of the measures that can be taken to prevent the level of gases causing global warming from increasing further. In addition, since unscheduled fertilizer applications will pollute water resources by washing the soil, due care should be taken. However, it can be said that fertilizers applied in an unplanned manner will create pollutant elements, and negative situations may arise in terms of the sustainability of agriculture. The use of fertilizers in sustainable agriculture is inevitable. However, choosing organic fertilizers will prevent increased carbon levels in the atmosphere. For this reason, recycling organic wastes as fertilizers will prevent soil, water and atmosphere damage and reduce the effect of global warming.

Livestock activities also play an important role in sustainable agriculture. Considering that livestock activities also contribute to the methane gas in the atmosphere, it can be mentioned that there is a need for measures to prevent global warming for livestock activities. When animals graze unplanned in open areas, fertilizers are directly mixed into the soil and water resources. If the animals are in the shelters, it will be possible to prevent the fertilizers collected in the manure depots from polluting the water and soil resources. However, if animals are required to be present in the pastures, providing scheduled grazing may reduce the carbon level in the atmosphere. However, it can be mentioned that due care should be taken in this regard since poor adjustment of the concentrate and roughage balance will affect the methane increase.

Due to global warming and climate change, irregular temperatures and precipitation regimes will adversely affect the sustainability of agricultural activities. For this reason, it is thought that global warming and climate change may increase greenhouse areas where controlled environments can be provided for agricultural production. However, greenhouse heating should not be heated with fossil fuels that cause an increase in greenhouse gas emission values in the atmosphere and should use renewable energy sources for greenhouse areas as much as possible. In addition, the design of the covered roof surfaces in a way that allows rainwater harvesting will allow more effective and efficient water use and the continuity of sustainable agriculture. The effective and efficient use of water resources is of great importance in the sustainability of agriculture and food security. Therefore, it can be said that the efforts to prevent global warming and climate change are steps to protect water resources and ensure food safety.

Some products grown in agricultural production activities may be specific to the region and transported to another region to meet the demand. In this case, considering that vehicles such as airplanes, ships and trucks used for transportation use fossil fuels, it can be thought that agricultural production causes an increase in greenhouse gas emissions. In order to reduce the effect of this negative situation, it should be ensured that the vehicles used in transportation are not used in transportation before their full capacity is reached.

The use of tools and machinery in agricultural production is quite high. Using tractors is important in terms of efficiency in large and challenging worklands. However, greenhouse gas emissions that affect global warming and climate change are increasing due to the fossil fuel used by tractors. As a result, the sustainability of agriculture is adversely affected. Therefore, the widespread use of electric tractors will be a step to prevent the increase in greenhouse gas emissions.

In order to increase agricultural production, studies should be carried out to obtain more efficiency from the unit area rather than opening new agricultural areas. In addition, afforestation of non-agricultural areas will be important for reducing the CO<sub>2</sub> level in the atmosphere. Against global warming and climate change, water resources should be used in a planned and efficient manner. It can be said that the dissemination of pressurized irrigation systems for more efficient use of water resources and the prevention of water loss in irrigation systems are the primary measures that can be taken to reduce the effect of drought. However, the unconscious use of groundwater should be prevented. Moreover, necessary studies should be carried out to use rain harvest in all possible structures to ensure a more effective use of water in agricultural production. Since raising awareness of people on global warming and climate change will form the basis of the measures to be taken, education and extension studies are of great importance.

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