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Book of Abstracts

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Comparison of Fabricated TiO2 Gas Sensor with MQ135 for Spoiled Fruit Detection

Yudesh Kumar[1], Ts.Dr.Siti Amaniah Bt Mohd Chauli [2]

1 Department of Electronic Industry, Faculty of Electronics & Computer & Engineering,Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia

2 Universiti Teknikal Malaysia Melaka (UTeM),Malaysia

Corresponding Author: *yudesh011021@gmail.com*

Abstract

This study presents a cost-effective and innovative ethylene gas detection system designed to monitor fruit ripening and minimize postharvest losses. The system integrates a commercial MQ135 gas sensor with a single fabricated TiO_2-based sensor to detect ethylene gas through voltage variations under controlled parameters. The TiO_2 sensor was fabricated and characterized to evaluate its electrical properties, exhibiting a resistance value of 557.90 MΩ, indicating high sensitivity and stability. Experiments were conducted inside a custom-designed 3D-printed gas chamber at room temperature. Five selected fruits such as banana, mango, papaya, pear, and apple with weight of 20 gram were tested and monitored continuously for 85 hours. Real-time voltage data were transmitted to the Blynk Internet of Things (IoT) platform and automatically recorded in Google Sheets for continuous analysis. A cobalt(II) chloride test paper was also used as a colorimetric indicator to provide a visual confirmation of ethylene gas presence. Based on sensing response analysis, the TiO_2 sensor exhibited superior performance compared to the MQ135 sensor across all fruit samples. The sensing responses for MQ135 and TiO_2 were 96.97% and 95.45% for banana, 97.50% and 98.79% for apple, 82.14% and 87.88% for papaya, 84.00% and 90.91% for pear, and 74.19% and 82.42% for mango, respectively. The sensing response for MQ135 was approximately 96.97%, 97.50%, 82.14%, 84.00%, and 74.19% for banana, apple, papaya, pear, and mango, respectively. Whereas TiO_2 sensor exhibited sensing response of 95.45%, 98.79%, 87.88%, 90.91%, and 82.42% for banana, apple, papaya, pear, and for mango, respectively. These findings revealed that the fabricated TiO_2 sensor demonstrates better responsiveness and selectivity toward ethylene gas, making it a more efficient and reliable choice for real-time fruit ripening and spoilage monitoring through IoT-based smart sensing technology.

Keywords:

Ethylene Gas Detection, TiO_2 Sensor, MQ135 Gas Sensor, Internet of Things (IoT), Fruit Ripening Monitoring

Poster Session / 71

QSPR Study on Photo Oxidation Reaction of Aromatic Micro Pollutants Using the Genetic Algorithm - Support Vector Machine

Eslam Pourbasheer[1], Maryam Nouri Majd[1]

[1] Department of Chemistry, Faculty of Science, University of Mohaghegh Ardabili, Ardabil, Iran

Corresponding Author: *e.pourbasheer@uma.ac.ir*

Abstract

Aromatic micropollutants (AMPs) are a group of organic chemical compounds that have an aromatic ring structure and may be substituted with various functional groups such as hydroxyl, amino, nitro or halogen. These pollutants are found in very low concentrations in surface water, ground water and waste water. Investigating the relationship between the chemical structure of Aromatic micropollutants and their reactivity in photocatalytic processes is crucial to improve the efficiency of removal methods and predict the environmental behavior of these pollutants. Developing models based on the structural features of AMPs can help predict the rate of degradation and understand their ultimate fate in nature. In this study, quantitative structure-activity relationship (QSAR) models were developed to predict the photooxidation reaction of aromatic micro-pollutants (AMPs) using the multiple linear regression (MLR) and support vector machine (SVM). The dataset consisted of 30 compounds, were divided into two training and test subsets by hierarchical clustering method. Genetic algorithm (GA) was used as a feature selection tool to identify the most relevant molecular descriptors. Model validation was performed using Y- randomization test, cross-validation, and external test set methods. The genetic algorithm- multiple linear regression (GA-MLR) model with three selected descriptors showed favorable statistical parameters (R2train=0.822, R2test=0.920). Comparison of the models' performance shows that, GA-SVM provided accurate results with strong statistical parameters for the training and test data sets (R2train=0.939, R2test=0.922). Analysis of the results showed that spheroid, atomic masses, and also difference between partial positively- and negatively-charged surface areas, of molecules play a decisive role in their activity. The developed models can be used as efficient tools in the targeted design of high-performance AMPs and understanding its photooxidation reaction behavior. The comparison between different models, allowed us to examine the advantages and limitations of linear and nonlinear models in analyzing the structure-reactivity relationship of Aromatic micropollutants.

Keywords:

QSAR, Support Vector Machine, Aromatic Micropollutants, Photooxidation

Poster Session / 72

Copper-Based Metal-Organic Framework Cu(BDC) as a Reusable Heterogeneous Catalyst for Efficient N-Arylation of NH-Heterocycles

Yagoub Mansoori[1], Abbas Jahanbani [2], Somayeh Fekri [3]

1 Department of Applied Chemistry, Faculty of Science, University of Mohaghegh Ardabili, Ardabil, 56199-11367, Iran
2 University of Mohaghegh Ardabili, Ardabil, Iran
3 University of Mohaghegh Ardabili, Ardabile province, Iran

Corresponding Author: *ya_mansoori@uma.ac.ir*

Abstract

Metal-organic frameworks (MOFs) are crystalline porous materials formed by coordinating metal ions or clusters with organic ligands, creating highly ordered 3D networks. We describe the synthesis and catalytic application of a copper-based metal-organic framework (MOF), Cu(BDC), for the N-arylation of NH-heterocycles with aryl halides. The metal-organic framework Cu(BDC) was prepared using a previously established method and extensively characterized through XRD, SEM, TGA, FT-IR, AAS, and nitrogen physisorption analyses. Atomic absorption spectroscopy revealed the final copper content to be 2.61 mmol g-1. The material has a specific surface area of 710 m2 g-1, Langmuir surface area of 753 m2 g-1, micropore volume of 0.78 cm3 g-1, and average pore size of 4.4 nm Multiple BJH peaks at 1.22, 10.65, 21.79, 33.24, and 59.76 nm reveal a multimodal pore size distribution. Cu(BDC) demonstrated efficient catalytic activity in facilitating C-N bond formation between NH-heterocycles and iodo-, bromo-, and chloroarenes. Optimal reaction conditions were established by systematically investigating key parameters, including solvent, temperature, base, and catalyst loading. The MOF was applied as the catalyst in the coupling reaction of NH-heterocycles with chloro-, bromo-, and iodoarenes. Iodo- and bromoarenes exhibited high reactivity, whereas chloroarenes were less reactive. Imidazole and benzimidazole demonstrated superior activity compared to 2-methylbenzimidazole. The efficiency and reusability of the catalyst were assessed over multiple catalytic cycles using the reaction between imidazole and bromobenzene as a model. It was observed that, the efficiency remained nearly constant during the first three cycles, followed by a gradual reduction in later cycles. The stability and heterogeneous characteristics of Cu(BDC) were investigated by quantifying copper leaching during the coupling reaction of bromobenzene (1.0 mmol) with imidazole (1.5 mmol) in the presence of the catalyst (30 mg, Cu 7.8 mol%). The analysis revealed copper leaching of 0.0016 mmol, corresponding to a negligible level of 2.0%.

Keywords:

N-Arylation, Metal Organic Framework (MOF), Cu(BDC), Heterogeneous Catalyst

Preparation of WO3-X Nanoparticles by UVA-Irradiation for Colorimetric Sensing of Cr(VI)

Ali Khodayari[1], Habibollah Eskandari[1], Haidar Abd Ali Abdulsada[1]

[1] Department of Chemistry, Faculty of Basic Sciences, University of Mohaghegh Ardabili, Ardabil 56199-11367, Iran

Corresponding Author: *h_eskandari2001@yahoo.com*

Abstract

Nanomaterials based on WO3-x have emerged as highly promising materials due to their unique chemical and physical structures. The intentional introduction of oxygen vacancies in these nanostructures significantly enhances their optical and electronic properties. For instance, they are used in the fabrication of optical and gas sensors, smart windows with photochromic capabilities, and photocatalytic systems for converting carbon dioxide into clean fuels [1-3]. Hexavalent chromium (Cr(VI)) is a highly toxic heavy metal ion widely used in industries such as stainless steel, automotive parts, and leather production. Its release into the environment poses severe risks, as it can contaminate groundwater and accumulate in aquatic organisms like fish, eventually entering the human body through consumption. Excessive intake of Cr(VI) is associated with serious health hazards, prompting strict regulatory limits in wastewater and food safety standards [4]. There is an urgent need for simple, rapid, and sensitive detection techniques. Based on the research presented, this study successfully developed a simple and effective colorimetric method for the precise determination of Cr(VI). The method is based on the direct reaction of Cr(VI) with WO3-x nanoparticles synthesized via a UVA irradiation method. Under UVA light irradiation in a hydrochloric acid solution containing choline chloride, WO3-x nanoparticles (blue color) were produced. The intensity of the color, which decreased proportionally with the concentration of Cr(VI), was monitored spectrophotometrically. The proposed method demonstrated a wide linear range for Cr(VI) quantification from 1 to 30 µM, making it suitable for detecting trace levels of Cr(VI) with limit of detection equal to 0.22 µM. The method exhibited excellent selectivity for Cr(VI) over other potential interfering ions. The practical applicability of this colorimetric sensor was validated by successfully determining Cr(VI) concentrations in various real water samples, including tap water, river water, and lake water.

Keywords:

UVA Irradiation, Preparation of WO3-X Nanoparticles, Cr(VI) Colorimetric Sensing

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Tetrachloroperylene Dianhydride as a Simple and Capable Sensor; Case Study: Cyanide Anion and Primary Aliphatic Amines

Mohammad Reza Zamanloo[1]

[1] Department of Applied Chemistry, Faculty of Science, University of Mohaghegh Ardabili, Ardabil, Iran

Corresponding Author: *mrzamanloo@uma.ac.ir*

Abstract

Persistent radical-anions generating electrochemically or photochemically offer an exciting platform for investigation due to easily generation, structure–stability correlation, colour modulation and etc. A wide range of applications including molecular magnets, sensors, polymerization initiators, CO2 reduction and etc., have been developed recently for these intermediates [1-3]. Carbonyl compounds such as diimides or dianhydrides possessing low-lying frontier orbitals and known as organic π-acids, participate generally in electron transfer (ET) processes which engender persistent radical-anions. Herein, tetrachloroperylene dianhydride (TCP) is presented as a simple and capable electron accepting material that generate its colourful radical anion. This capability was utilized as a powerful and selective colorimetric sensing method to identify and determine some analytes. Many different anions including CN-, Halide anions, SCN- and etc., as well as different types of amines were investigated as electron donor in solution ET to TCP. Upon exposer to CN- and primary aliphatic amines, TCP solution was changed to a colourful state enabled colorimetric identification and determination of these species. Only CN- could participate in ET to TCP in between twenty examined anions and only primary aliphatic amines in between different various amines perform such a redox reaction, made TCP as a selective sensing agent. The response time of emerging detectable coloration was immediate in the case of CN-, while the amines have a two-step interaction with the substrate comprising a fast complexation followed by ET process with a 3h period. The ET process was followed using absorption and emission along with H NMR spectroscopy techniques. In order to evaluate the effect of the chemical structure of TCP comprising chlorine atoms and anhydride functionality on the ET interaction, the pristine perylene dianhydride and two imide counterparts were also checked which did not showed any comparable results. The following figure illustrates a representative scheme for the thermal ET process.

Keywords:

Electron Transfer, Anion-Radical, Perylene Dianhydride, Amine, Cyanide.

Efficient CO-Free Carbonylation of Aryl Halides Catalyzed by SBA-15-Supported Pd-1,10-Phenanthroline

Yagoub Mansoori[1], Maryam Fathinejad [2], Somayeh Fekri [2]

[1] Department of Applied Chemistry, Faculty of Science, University of Mohaghegh Ardabili, Ardabil, 56199-11367, Iran
[2] University of Mohaghegh Ardabili, Ardabile province, Iran

Corresponding Author: *ya_mansoori@uma.ac.ir*

Abstract

Catalytic carbonylation reactions can be performed under ambient or low pressures (≤5 bar). However, the use of carbon monoxide in organic synthesis remains limited due to difficulties in storage, handling, and the need for high-pressure equipment. To overcome these issues, several CO surrogates have been investigated for the preparation of carbonyl-containing compounds. Formic acid has emerged as an efficient, benign, and inexpensive carbonyl donor in Pd-catalyzed reactions. Homogeneous palladium-catalyzed carbonylations generally provide high yields and selectivity under mild conditions; however, their practical application is restricted by issues inherent to homogeneous catalysis, including catalyst separation, recycling difficulties, and residual metal contamination. To address these limitations, heterogeneous catalysts have been developed to enhance catalyst recovery, reusability, and environmental compatibility. Herein, a heterogeneous palladium catalyst, SBA-15@PHEN-Pd(II), was prepared by immobilizing a 5-amino-1,10-phenanthroline–Pd(II) complex onto SBA-15 via CPTES silylation and ligand grafting. 5-Amino-1,10-phenanthroline was synthesized by nitration of 1,10-phenanthroline in concentrated H2SO4/HNO3, followed by reduction of the nitro group using hydrazine hydrate in the presence of Pd/C. The catalyst was characterized by TGA, SEM, EDX, and BET analyses, showing a ligand loading of ~174 mg g-1 and a Pd content of 0.16 mmol g-1. The catalytic performance of SBA-15@PHEN-Pd(II) was evaluated in the carbonylation of haloarenes using formic acid/DCC as a CO surrogate. Optimization identified DMF as the preferred solvent, NaOH (1.5 eq.) as the optimal base, and 120 °C as the ideal temperature, affording up to 66% yield at 0.63 mol% Pd. Substrate scope studies revealed the reactivity trend Ar–I > Ar–Br > Ar–Cl, with electron-withdrawing substituents enhancing conversion. The catalyst retained activity over six cycles with minimal deactivation. Leaching tests, hot filtration, and control experiments indicated that the reaction proceeds via surface-immobilized Pd species. These findings demonstrate that SBA-15@PHEN-Pd(II) constitutes a stable and recyclable heterogeneous system for CO-free carbonylation of aryl halides.

Keywords:

SBA-15; Supported Pd-1,10-Phenanthroline Complex; Heterogeneous Catalyst; CO-Free Carbonylation; Aryl Halide

Nitrogen-Doped Carbon Quantum Dots for Sensitive Colorimetric Assay of V(V)

Rabah Sabah Khamees[1], Habibollah Eskandari[2], Ali Khodayari[1]

1 Chemistry Department, University of Mohaghegh Ardabili
2 Department of Chemistry, Faculty of Basic Sciences, University of Mohaghegh Ardabili, Ardabil 56199-11367, Iran

Corresponding Author: *h_eskandari2001@yahoo.com*

Abstract

Carbon and graphene quantum dots (CQDs and GQDs) are highly attractive for a wide range of applications due to their excellent characteristics, including high photoluminescence, tunable bandgap, water solubility, and biocompatibility. These nanomaterials exhibit strong quantum confinement and edge effects, which can be further modulated through surface functionalization with groups such as -OH, -COOH, and $-NH_2$. Their capacity to participate in electron transfer and radical scavenging reactions makes them particularly useful for developing novel sensing platforms [1-3]. Furthermore, their synthesis from cost-effective precursors like citric acid facilitates scalable production. Vanadium is extensively used in steel production and other industrial processes, leading to its environmental release, primarily through the combustion of fossil fuels. Among its various oxidation states, V(V) is notably more toxic than its reduced forms, posing significant risks to ecosystems and human health [4]. Vanadium's dual role as both an essential trace element and a potential toxin underscores the need for accurate monitoring. This work introduces an innovative approach for the colorimetric detection of V(V) using nitrogen-doped CQDs (N-CQDs), synthesized via the thermal treatment of a mixture of citric acid and 3,4-diaminobenzoic acid. The synthesized N-CQDs were characterized using appropriate microscopic and spectroscopic techniques. In the detection mechanism, V(V) oxidizes 3-methyl-2-benzothiazolinone hydrazone in an aqueous solution containing sodium dodecyl sulfate and hydrochloric acid to generate a diazonium cation. This cation then couples with the N-CQDs to form a pink-colored azo dye. A linear calibration curve for V(V) was established in the range of 1.8–240 µM. The method achieved a low detection limit of 0.9 µM and a relative standard deviation of 1.7–5.3%. An interference study confirmed the method's high selectivity. To validate its practical utility, the method was successfully applied to the analysis of various environmental water samples.

Keywords:

N-Doped Carbon Quantum Dots, Coupling Reaction, Colorimetric Vanadium Detection

Asymptotic Solution of Singular Perturbed Volterra-Type Integral Equations

Asan Omuraliev[1], Peyil Esengul Kyzy[2], Ella Abylaeva [3]

1 I. Razzakov Kyrgyz State Technical University
2 Department of Mathematics, Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic
3 Department of Applied Mathematics and Informatics, Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *peyil.esengul@manas.edu.kg*

Abstract

The structure of the boundary layer in the asymptotics of a singularly perturbed Volterra-type integral equation is determined by the kernel of the integral equation. Researchers studying singularly perturbed integral equations have transformed them into integro-differential equations by differentiation, and then they have constructed the asymptotics. We will directly regularize the integral equation. To regularize the integral operator, we use the Dirac delta function, while other researchers using Lomov's method use integration by parts.

Keywords:

Integral Equation, Asymptotic Solution, Volterra-Type Integral Equations, Singular Perturbed

Solution of Second Order Singular Perturbation Problem Using Cubic B-Spline Functions

Fevzi Erdoğan[1], Mehrdad Lakestani [2]

[1] Department of Mathematics, Van Yuzuncu Yil University, Van, Turkey
[2] Department of Applied Mathematics, University of Tabriz, Tabriz, Iran.

Corresponding Author: *mlakestani@gmail.com*

Abstract

This study addresses a second-order singularly perturbed problem using cubic B-spline functions. We first examine the properties of these functions and then introduce their dual basis for function expansion. Next, we construct an operational matrix of derivatives for the cubic B-splines. A hybrid scheme is developed to solve the problem efficiently. The numerical results demonstrate the effectiveness of the proposed method.

Keywords:
Cubic B-Spline Functions, Singular Perturbation Problem, Numerical Methods

DRAFT

Numerical Solution of Singularly Perturbed Differential Equations Using Interpolation and Collocation

Fevzi Erdoğan[1], Sedaghat Shahmorad [2]

[1] Department of Mathematics, Van Yuzuncu Yil University, Van, Turkey
[2] Department of Applied Mathematics, University of Tabriz, Tabriz, Iran.

Corresponding Author: *sshahmorad@gmail.com*

Abstract

Presented in this paper is a numerical method based on interpolation and collocation for solving singularly perturbed boundary value problems whose solutions exhibit boundary layers. First, the general properties of such singularly perturbed boundary value problems are discussed. Next, a Lagrange interpolation scheme using Chebyshev nodes, combined with collocation at same points, which yields a uniformly convergent approach for solving this class of equations were constructed. Numerical examples demonstrate the theoretical results in practice.

Keywords:

Numerical Solution, Interpolation, Collocation

Comparative Morphology of the Spleen in Mammals, Birds, and Amphibians (Frogs)

Bermet Kydyralieva[1], Nurbek Aldayarov[2]

1 Biology Department,Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan
2 Department of Biology, Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *bermet.kidiraliyeva@manas.edu.kg*

Abstract

This microscopic study aims to characterize the structural organization of secondary encapsulated immune organs, specifically the spleen and lymph nodes, in the gray marmot (*Marmota baibacina*). The gray marmot serves as a principal reservoir in Central Asian plague foci and plays a critical role in zoonotic pathogen dynamics; however, its lymphoid anatomy remains poorly characterized. Previous ecological studies underscore the epidemiological significance of this species. Using light microscopy on fixed tissue samples from wild *M. baibacina*, the splenic parenchyma was observed to be organized into distinct white and red pulp compartments, consistent with typical mammalian secondary lymphoid architecture. The white pulp contains periarteriolar lymphoid sheaths and scattered lymphoid follicles, indicating active sites of antigen-driven lymphocyte proliferation. In contrast, the red pulp comprises a dense network of reticular cells and sinusoidal capillaries, facilitating blood filtration and immune cell trafficking. This structural organization closely parallels that observed in other mammalian species. Lymph nodes exhibit classical histoarchitecture, being encapsulated by dense connective tissue and comprising cortical regions with B-cell follicles and germinal centers, as well as paracortical T-cell zones. The reticular stromal framework supports lymphocyte compartmentalization and likely facilitates antigen presentation. Considering the relatively large body size of *M. baibacina*, it is inferred that lymph nodes are relatively few in number but well-developed, reflecting scaling patterns of adaptive immune responses across mammals. These morphological insights provide a foundational understanding of the gray marmot’s immune system. Further immunohistochemical and functional investigations are warranted to delineate lymphocyte subpopulations, activation states, and immunological implications for plague ecology in this species.

Keywords:

Spleen, Comparative Morphology, Mammals, Birds, Amphibians

Enhanced Salinity Detection Using Zinc Oxide Nanorod Coated Tapered D-Shape Plastic Optical Fibers

Siti Halma Johari[1], Eliyana Ruslan [1], Siti Amaniah Mohd Chachuli [1], Siti Asma Che Aziz [1]

[1] Fakulti Teknologi dan Kejuruteraan Elektronik dan Komputer, Universiti Teknikal Malaysia Melaka

Corresponding Author: *siti.halma@utem.edu.my*

Abstract

Salinity detection plays a vital role in environmental monitoring, the food industry, and healthcare. Traditional methods such as conductivity meters or titration often involve bulky equipment, high costs, and limited sensitivity, making them less suitable for compact or cost-effective applications. This project focuses on the development of a zinc oxide (ZnO) coated tapered D-shape Plastic Optical Fiber (POF) sensor for saline concentration detection. The POF was fabricated with waist diameters of 500 µm, 550 µm, 600 µm, 650 µm, and 700 µm using a combination of chemical etching with acetone and deionized water, and mechanical polishing with sandpaper to enhance light interaction through the evanescent field. ZnO nanorods were grown on the tapered surface using the hydrothermal method, serving as a sensitive layer due to their high surface area and excellent optical properties. The sensors were tested with saline concentrations ranging from 0 g to 10 g, and a noticeable decrease in output voltage was observed as concentration increased. Among all samples, the ZnO-coated POF with a waist diameter of 600 µm showed the highest sensitivity at 0.1279 V/%, while the uncoated POF with a 700 µm diameter exhibited a sensitivity of 0.1127 V/%. The linearity of the ZnO-coated sensor was 95.46%, while the uncoated sensor reached 97.37%. These results demonstrate that ZnO coating significantly enhances sensor performance in terms of sensitivity, indicating the potential of ZnO-coated tapered POFs as a reliable, efficient, and cost-effective solution for accurate saline concentration monitoring in real-world applications.

Keywords:

Salinity, Plastic Optical Fiber, Zinc Oxide, Hydrothermal Method, Tapered D-Shape Fiber, Evanescent Wave

Development of a Sensor Array (MQ2, MQ4 and MICS5524) for Methane Gas Detection with IOT-based Monitoring

Afiq Irham[1], Siti Asma Che Aziz[1], Siti Amaniah Mohd Chachuli [1], Siti Halma Johari [2]

[1] Central for Telecommunication Research and Innovation (CeTRI), Faculty of Electronics & Computer Technology & Engineering, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia

[2] Department of Electrical Engineering, Faculty of Engineering, University of Malaya, Kuala Lumpur 50603, Malaysia

Corresponding Author: *afiqirhamrizal@gmail.com*

Abstract

The detection of methane gas is critically important for safety, environmental monitoring, and industrial process control, particularly in enclosed or high-risk areas such as laboratories, landfills, and gas pipelines. In confined spaces, excessive methane concentrations can result in explosions or suffocation, while its emission into the atmosphere significantly contributes to climate change due to its strong greenhouse effect. Conventional gas detection methods, such as gas chromatography and infrared sensing, tend to be expensive and require specialized handling. Therefore, this project focuses on the development of a sensor array integrating MQ2, MQ4, and MICS sensors, combined with an IoT-based monitoring platform, to enhance methane detection accuracy, real-time monitoring and provided sensing response performance comparison. The main objective of this project is to develop a methane gas detection system using a sensor array consisting of three commercial gas sensors which are MQ2, MQ4, and MICS5524. All the commercial was exposed to the methane gas for detection at the same time and environment simultaneously. The performance of each sensor will be analyzed by evaluating its sensing response and response time under six methane concentrations ranging from 5000 to 10,000 ppm. In parallel, the sensor array will be integrated with an IoT platform using Adafruit to enable real-time data monitoring and visualization. The results demonstrate that the combined sensor array successfully detected methane within the desired range, with the MQ2 sensor exhibiting highest sensing response at 7000 ppm concentrations, while MQ4 showed stable performance at higher ppm levels and the lowest sensing response of MICS 5524. The real-time monitoring system demonstrated reliable data monitoring to Adafruit with minimal latency and stable signal streaming. The successful integration of the sensor array with the IoT platform further proved the system’s practicality and readiness for field deployment.

Keywords:

Commercial Gas Sensors, Gas Methane, Adafruit, Iot, mq2, mq4, mics5524,

Methane Detection from Food Waste Digestion Using Titanium Dioxide-Graphene Gas Sensor with IOT Integration

Adam Zafry[1], Siti Asma Che Aziz[2], Siti Halma Johari [3], Siti Amaniah Mohd Chachuli [2]

1 Central for Telecommunication Research and Innovation (CeTRI), Faculty of Electronics & Computer Technology & Engineering, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysi

2 Central for Telecommunication Research and Innovation (CeTRI), Faculty of Electronics & Computer Technology & Engineering, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia

3 Department of Electrical Engineering, Faculty of Engineering, University of Malaya, Kuala Lumpur 50603, Malaysia

Corresponding Author: *mazafry@gmail.com*

Abstract

The study focuses on developing a low-cost and reliable methane gas sensor using a TiO_2–graphene composite material connected to an Adafruit platform for easy monitoring and data collection. Methane is a flammable gas commonly found in homes, industries, and the environment, so early detection is important to prevent accidents. TiO_2 is widely used in gas sensors because it is stable and inexpensive, but it has low electrical conductivity when used alone. To improve its sensing ability, graphene is added because it provides high conductivity, a large surface area, and strong chemical stability. When TiO_2 and graphene are combined, the composite creates more active sites for methane molecules and allows faster electron movement, which increases the sensor's sensitivity. The sensor works by measuring changes in electrical resistance when methane is present. These changes are sent to the IOT, such as an Adafruit IO, which processes the signal and displays the gas levels in real time. The Adafruit IO system is chosen because it is easy to use, supports many sensors, and can connect to displays or wireless modules for data logging and alerts. During testing, the TiO_2–graphene sensor showed sensing response, response time, and stable performance at room temperature or slightly elevated temperatures, making it more energy-efficient than many traditional sensors. The real-time readings provided by the Adafruit IO interface help users understand gas concentration levels quickly and clearly. Overall, the combination of the TiO_2–graphene sensing material with the Adafruit platform offers a simple, affordable, and effective solution for methane detection, demonstrating how nanomaterials and accessible electronics can work together to improve safety in practical applications.

Keywords:

Fabrication Gas Sensor, TiO2 Graphene, Adafruit IOT, Methane Gas, Response Time, Sensing Response

Gross and Micromorphological Evaluation of Yak (Bos Grunnies) Hindlimb Muscle Under Refrigeration and Freezing Conditions

Nazgul Imanberdieva[1], Nurbek Aldayarov[2]

1 Faculty of Sciences Department of Biology, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan
2 Department of Biology, Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *nazaman@inbox.ru*

Abstract

This study provides a comprehensive assessment of the macro- and micromorphological changes in yak (Bos grunnies) hindlimb muscle during storage under refrigeration (+4 °C) and freezing (-22 °C) conditions. Meat is a complex, nutritionally valuable food source, composed of muscle fibers, fat, connective tissue, blood, nerves, and vascular structures, with its quality dependent on the structural interplay among these components. Muscle and fat tissues are particularly critical in determining nutritional and functional properties. For experimental analysis, approximately 500 g of hindlimb muscle were collected from three yaks. An initial 50 g sample was fixed in 10% neutral buffered formalin as a control. The remaining tissue was subdivided into 12 samples of 50 g each, allocated to refrigeration (six samples) and freezing (six samples), and stored in dedicated plastic containers. Histological sections were prepared and stained using hematoxylin-eosin. The results revealed distinct macro- and micromorphological features, providing a detailed reference for veterinary-sanitary evaluation and for differentiating pathological changes in muscle tissues of varying origins. Refrigerated yak muscle should be stored for no longer than 7–10 days, as prolonged refrigeration leads to significant structural deterioration and promotes microbial growth, including pathogenic species. In frozen storage exceeding two months, muscle fiber deformation intensifies, accompanied by autolytic processes, inevitably resulting in qualitative deterioration. These findings provide standardized morphological data that can serve as a reference in future studies on meat quality, storage practices, and muscle tissue integrity in wild ungulates. The study emphasizes the critical influence of storage conditions on preserving the structural, nutritional, and hygienic properties of game meat.

Keywords:

Yak Meat, Histology, Muscle Tissue, Refrigeration, Freezing

Experimental and Numerical Investigation of the Rermo-Hydraulic Performance of Mini-Channel Graphite Foam and Aluminum Heat Sinks

Zekeriya Kutlu[1], Beytullah İsmet Toprak[2], Ercan Doğan[1], İsmail Solmaz[1]

1 Department of Mechanical Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye
2 Department of Mechanical Engineering, Faculty of Engineering, Ataturk University, Erzurum, Türkiye

Corresponding Author: *zekeriya.cukutlu@gmail.com*

Abstract

Effective thermal management remains essential for enhancing the performance and operational stability of modern electronic systems. In this study, a numerical investigation was conducted to examine the influence of mini-channel quantity on the thermo-hydraulic behavior of a modified heat sink configuration. Cylindrical mini-channels were integrated along the flow direction to enhance heat dissipation, and comparative simulations were performed using graphite foam and aluminum heat sink structures. The analysis, carried out over a Reynolds number range of 163–1862 using COMSOL Multiphysics, focused exclusively on evaluating how varying the number of mini-channels affects the Nusselt number (Nu), pressure drop (ΔP), and thermal performance factor (η). The results indicate that increasing the mini-channel count improves convective heat transfer while maintaining a moderate pressure drop, thereby yielding an overall enhancement in η. Furthermore, while graphite foam consistently provides lower ΔP due to its porous morphology, both materials exhibit comparable Nu values, demonstrating that each offers distinct yet competitive thermo-hydraulic advantages. These findings highlight the significance of mini-channel quantity as a key structural parameter in optimizing heat sink performance.

Keywords:

Mini Channel Heatsink, Heat Transfer Enhancement, Numerical Study, Graphite Foam, Thermal Effectiveness Factor

Energy Efficiency-Focused Entropy Analysis: Investigation of Nanofluid Heat Transfer Processes

Mansur Mustafaoglu[1], Muhammed Taha Topcu[2], Muhammet Kaan Yeşilyurt[2], Kadir Bilen[2], İlhan Volkan Öner [4], Ali Sharifi [4]

[1] Department of Nanoscience and Nanoengineering, Institute of Science, Atatürk University, Erzurum, Türkiye
[2] Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye
[3] Department of Mechanical Engineering, Faculty of Engineering, Ataturk University, Erzurum, Türkiye
[4] Faculty of Mechanical Engineering, University of Tabriz, Tabriz, Iran

Corresponding Author: *ali.sharifi@tabrizu.ac.ir*

Abstract

With the increasing importance of heat transfer applications, the development of new methods to increase energy efficiency and reduce energy consumption has become inevitable. In this context, the use of nanofluids as an alternative heat transfer medium offers higher heat transfer performance compared to conventional fluids, thereby reducing energy losses. Entropy analysis, a measure of energy quality, plays a critical role in evaluating the effectiveness of energy conversions in thermodynamic systems. Because entropy production represents the level of irreversibility and energy losses of a system, it stands out as an important parameter in the performance analysis of energy systems. In this study, the behavior of water–Al_2O_3 (aluminum oxide) nanofluid with variable thermophysical properties, within a square chamber with a moving and cold top wall, a fixed and hot bottom wall, and insulated side walls, was numerically investigated under natural convection conditions in terms of entropy production. Simulations were performed for a fixed Grashof number ($Gr = 10^4$), three different Reynolds numbers ($Re = 100$, 300, and 600), and two different nanoparticle volume fractions ($\phi = 0.01$, 0.02, 0.03, and 0.04). The results revealed that total entropy production increased with increasing nanoparticle volume fraction at all Reynolds numbers examined. Furthermore, when the entropy production components were evaluated, it was determined that entropy production due to friction was negligible, and the largest contribution to total entropy production came from entropy production due to heat transfer.

Keywords:

Heat Transfer, Entropy Generation, Energy Conservation, Nanofluids

Numerical Analysis of Heat Transfer in Laminar Flow with Star-Cross Section Channel and Central and Circular Pipes

Mansur Mustafaoglu[1]

[1] Department of Nanoscience and Nanoengineering, Institute of Science, Atatürk University, Erzurum, Türkiye

Corresponding Author: *mansour@atauni.edu.tr*

Abstract

The forced convection heat transfer behavior of water-titanium oxide (TiO_2) nanofluid was investigated numerically in a system consisting of a hollow tube in the middle of which water flows within a star-section channel. In this study, the motion and heat transfer of the nanofluid were modeled under the assumption of single-phase flow and the channel walls were evaluated under the condition of constant heat flux. Continuity, momentum and energy equations were solved numerically to describe the behavior of the fluid. Calculations were made using the finite volume method and the SIMPLE algorithm was preferred for pressure-velocity coupling. In the investigation, parameters such as Reynolds number, nanoparticle concentration in the nanofluid and particle diameter (in the range of 20-100 nm) were varied and the effects of these variables on the Nusselt number and overall heat transfer performance were analyzed. The accuracy of the obtained results was tested by comparing them with the simulation results of the same system using only pure water. The study findings show that the Nusselt number; The results show that the heat transfer coefficient increases significantly with increasing titanium oxide concentration in the nanofluid, decreasing the nanoparticle diameter, and increasing the Reynolds number. This demonstrates that nanofluids are an effective solution for enhancing heat transfer performance, especially in channels with complex geometries.

Keywords:

Heat Transfer, CFD, Water/(TiO_2) Nanofluids

A Shift Toward Simplicity: Current Progress, Technical Challenges, and Future Prospects of ETL-Free Perovskite Solar Cells

Faiz Arith[1], Fauziyah Salehuddin [2], Nabilah Ahmad Jaluluddin [2]

[1] Faculty of Electronics and Computer Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, 76100, Melaka, Malaysia

[2] Universiti Teknikal Malaysia, Melaka

Corresponding Author: *faiz.arith@utem.edu.my*

Abstract

This work presents a comprehensive overview of the development of ETL-free perovskite solar cells, highlighting their progress, current challenges, and prospects. By eliminating the electron transport layer (ETL), these devices simplify the solar cell architecture, reducing fabrication complexity and cost while maintaining competitive performance. The discussion begins with the fundamental principles and material innovations that have enabled ETL-free designs, including advances in perovskite composition, interface engineering, and device stability. Key obstacles such as charge extraction efficiency, interfacial recombination, and long-term operational stability are examined in detail. Various fabrication strategies, including surface passivation and multifunctional buffer layers, are compared for their effectiveness in addressing these issues. Looking ahead, the focus turns to scalable manufacturing approaches, improved reliability under real-world conditions, and exploration of novel perovskite compositions to enhance performance and commercial viability. Overall, the work aims to guide researchers toward simpler, more efficient, and cost-effective perovskite solar cells based on ETL-free architectures.

Keywords:

Charge Extraction, Device Stability, ETL-Free Perovskite Solar Cell, Fabrication Simplicity, Interface Engineering

Fluorescence Spectroscopy in the Study of Animal Meats

Zhyldyzai Ozbekova[1], Asylbek Kulmyrzaev [1]

[1] Department of Food Engineering, Faculty of Engineering, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *zhyldyzai.ozbekova@manas.edu.kg*

Abstract

The potential of fluorescence spectroscopy was assessed to study cow, goat, sheep and yak meat. Meat samples were taken from muscles, viz. Gluteus medius (GM), Longissimus dorsi (LD) and Semitendinosus (ST). The moisture, fat and protein content of meat samples were measured. The emission fluorescence spectra of tryptophan (305–500 nm), riboflavin (410–700 nm) and vitamin A (340–540) were recorded directly on meat samples at 290, 382 and 322 nm, respectively. Principal component analysis (PCA), partial least squares regression (PLSR) and partial least squares discriminant analysis (PLSDA) were applied to process the spectra obtained. Moisture content with R2=0.94, protein content with R2=0.86, and fat content with R2=0.91 were predicted from the fluorescence emission spectra. The PLSDA applied at 410–700 nm fluorescence spectra showed 100, 100, 94.4 and 92.6% of discrimination for cow, goat, sheep and yak meat, respectively. This study demonstrates that fluorescence spectroscopy has a potential for the accurate, non-destructive and rapid prediction of meat composition and it could replace existing traditional analytical methods.

Keywords:

Chemical Parameters, Fluorescence Spectroscopy, Meat, Animal Species, Statistics

Electrospun Carbon-Based Nanofibers for Advanced Material Applications

Mohd Ali Mat Nong[1], Juraina Md Yusof [2], Suzila Sabil [3]

1 Functional Nanotechnology Devices Laboratory (FNDL), Institute of Nanoscience and Nanotechnology Universiti Putra Malaysia, Serdang, Selangor, Malaysia.

2 Functional Nanotechnology Devices Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, Malaysia

3 Kolej Komuniti Jelebu, Jalan Seperi, Kampung Chempedak, 71600 Kuala Klawang, Negeri Sembilan, Malaysia

Corresponding Author: *mohd_alee@upm.edu.my*

Abstract

The development of conductive and mechanically robust nanofibers remains a significant challenge for advanced applications in sensors, energy devices, and flexible electronics. This study addresses the need for enhanced nanofiber performance by fabricating carbon-based nanofibers reinforced with carbon fillers through an optimized electrospinning process. Polyacrylonitrile (PAN) (0.2–1.0 g) was dissolved in 10 mL of dimethylformamide (DMF) and subsequently blended with 0.2–1.0 g of carbon-based fillers. The mixture was sonicated for 30 minutes and stirred for 4 hours to achieve a uniform electrospinning solution. The solution was electrospun at a flow rate of 0.8 mL/hour, with a needle-to-collector distance of 20 cm and an applied voltage of 18 kV, using aluminum foil as the collection substrate. Characterization of the fabricated nanofibers was conducted using field emission scanning electron microscopy (FESEM) to examine fiber morphology, a four-point probe to evaluate electrical conductivity, and a universal testing machine to assess mechanical strength. The results show that the incorporation of carbon fillers significantly improved fiber uniformity, reduced bead formation, and enhanced both electrical conductivity and tensile performance. These improvements demonstrate that controlled carbon filler loading can effectively tailor the functional properties of PAN-based nanofibers. Overall, this work contributes to the development of high-performance electrospun nanofibers and highlights their potential for use in next-generation electronic and structural applications.

Keywords:

Electrospinning, Carbon-Based Nanofibers, Polyacrylonitrile (PAN), Conductivity, Mechanical Properties

Investigation of Erzurum Ilıca District Liquefaction Potential With Different Methods

Hamit Çakıcı[1], Koray Babadan [2]

[1] Department of Architecture and Urban Planning, Pasinler Vocational School, Atatürk University, Erzurum, Türkiye
[2] Graduate Student

Corresponding Author: *hcakici@atauni.edu.tr*

Abstract

Soil liquefaction is the sudden loss of strength and stiffness in water-saturated, loose, and cohesionless (non-clayey) granular soils (especially sandy and silty soils) due to cyclic dynamic loading (vibrations) during an earthquake. As a result, the soil, instead of behaving like a solid, temporarily becomes fluid, like a viscous liquid. When liquefaction occurs, the soil loses its bearing capacity, causing foundations to sink, tilt, or topple. Permanent deformations such as sand volcanoes, horizontal spreading (lateral spreading), and excessive settlement occur on the ground surface. Within the scope of the thesis study, it was aimed to determine the liquefaction potential to be obtained as a result of examining the liquefaction potential of Erzurum Ilıca District with the methods given by Iwasaki et al. (1982) and Sönmez and Gökçeoğlu (2005). In the study, Standard Penetration Test (SPT) was performed in the boreholes drilled in the field. Consistency limits, natural and saturated unit volume weight, sieve analysis and hydrometer tests were carried out in the laboratory on the samples taken from the research pits. Using data obtained from field and laboratory experiments, Iwasaki et al. (1982) and Sönmez and Gökçeoğlu (2005) the liquefaction potential was examined.As a result of field and laboratory tests, the average values were SPT-N 12.3, Natural unit volume weight 11.53 (kN/m^3), Saturated unit volume weight 12.70 (kN/m^3), Plasticity Index 23.63, Clay Content % 20.13, fine grain content was determined to be 75.9%. Depending on these values, liquefaction potential analyzes were made according to Iwasaki et al. (1982) and Sönmez-Gökçeoğlu (2005). As a result of the field and laboratory studies, it was determined that liquefaction was expected in SK-1 and SK-5, while the liquefaction potential was very low in SK-2, SK-3, SK-4 and SK-6.

Keywords:

SPT, Consistency Limits, Liquefaction, Erzurum Liquefaction Potential

Quantitative Characterization of Essential Micro- and Macronutrients in Rymus ıNcertus Klok from the Alai Range, Kyrgyzstan

Nurbek Aldayarov[1], Bakyt Borkoev [2]

1 Department of Biology, Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic
2 Department of Chemical Engineering, Faculty of Engineering, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *bakyt.borkoev@manas.edu.kg*

Abstract

Thymus incertus Klok, a member of the Lamiaceae family, is widely recognized in pharmacopoeias and ethnomedicine for its therapeutic properties. Its extracts are used to manage gastrointestinal disorders, cough, bronchitis, and pertussis, and as antiseptics for oral hygiene, wound care, and throat rinses in laryngitis. Bioactive constituents, including essential oils and thymol, are incorporated into medicinal formulations such as syrups, ointments, and inhalants. A quantitative evaluation of macro- and micronutrient composition was performed using ICP-MS to assess elemental content and safety. Macroelement concentrations were determined as follows: calcium 12,243 ppm, potassium 38,614 ppm, magnesium 2,524 ppm, phosphorus 3,519 ppm, and sulfur 1,299 ppm, indicating the plant is a rich source of nutrients essential for metabolic and physiological functions. Trace elements analysis showed iron at 393 ppm, slightly above reference ranges, whereas copper (4.69 ppm), zinc (17.1 ppm), and boron (19.1 ppm) were slightly below normative values. Chromium approached the upper limit of its range, and arsenic was minimally elevated (<3.2 ppm). Other micronutrients, including cobalt, manganese, molybdenum, lithium, and selenium, were within normal limits. Toxic metals – cadmium (0.036 ppm), mercury (0.064 ppm), and lead (0.94 ppm) – were within safety thresholds. The elemental profile confirms that T. incertus provides essential nutrients at levels supportive of human health, with no hazardous excesses. Minor deviations in trace elements are not considered detrimental. These data serve as a reference for future studies and quality control in herbal preparations, emphasizing the importance of periodic monitoring to ensure safety and efficacy in medicinal and nutritional applications.

Keywords:

Ethnomedicine, Macro- and Micronutrients, ICP-MS Analysis, Thymus Incertus, Kyrgyzstan

Comparative Assessment of Micro- and Macronutrient Profiles in COusınıa Carduncelloıdea Regel & Schmalh from the Alai Range, Kyrgyzstan

Kalipa Salieva[1], Nurbek Aldayarov[2]

1 Department of Chemical Engineering, Faculty of Engineering, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic
2 Department of Biology, Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *kalipa.salieva@manas.edu.kg*

Abstract

Plants of the Cousinia genus, belonging to the Asteraceae family, are traditionally used for external applications, including compresses, baths, washes, and poultices, primarily to treat eye disorders. They also serve as a source of glucofructans (inulin). Among them, Cousinia carduncelloidea Regel & Schmalh is widely recognized in Central Asian folk medicine. Despite its ethnobotanical significance, detailed studies on its chemical composition and pharmacological potential remain limited. This study presents a comprehensive evaluation of the micro- and macronutrient composition of C. carduncelloidea. A total of 50 elements were analyzed, including essential macroelements, trace metals, and potentially toxic elements, and compared with established reference ranges. Overall, the plant exhibited a balanced elemental profile, with the majority of nutrients within safe limits, supporting its traditional use. Calcium and potassium were particularly abundant, reflecting the plant's potential nutritional value, while magnesium and sodium were slightly lower but not limiting. Trace elements were largely within normal ranges, although minor elevations in iron, arsenic, and chromium were observed. Mercury concentrations exceeded typical reference values, suggesting potential low-level anthropogenic influence, yet absolute levels remained minimal. These findings provide a baseline characterization of C. carduncelloidea, highlighting its predominantly safe elemental composition alongside minor deviations that warrant monitoring in areas subject to environmental contamination. The data contribute to understanding the plant's nutritional and toxicological profile, supporting its continued use in traditional medicine and potential applications as a dietary supplement. This work lays the foundation for further phytochemical and pharmacological studies to explore its bioactive properties.

Keywords:
Folk Medicine, Macro- and Microelements, Nutritional Profile, Cousinia Carduncelloidea, Kyrgyzstan

Graphene/Cellulose Nanocomposite Accelerate Oral Wound Healing in Diabetic Rats by Mitigating Oxidative Stress and Apoptosis in Gingival Fibroblasts.

Sana Ghaffarzadeh[1], Jalal Pourahmad[2], Parvaneh Naserzadeh[3], Fatemeh Ghanbary[4], Mir-Jalal Hosseini[5]

1 Department of Pharmacy, School of Pharmacy, Shahid Beheshti University of Medical Sciences, Tehran, Tehran, Iran.
2 Department of Toxicology and Pharmacology, School of Pharmacy, Shahids Beheshti University of Medical Sciences, Tehran, Iran.
3 Endocrine Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran
4 Department of Chemistry, MAH.C., Islamic Azad University, Mahabad, Iran.
5 Zanjan Applied Pharmacology Research Center, Health and Metabolic Diseases Research Institute, Zanjan University of Medical sciences, Zanjan, Iran.

Corresponding Author: *sanna_gh@yahoo.com*

Abstract

Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, impairs oral wound healing through fibroblast dysfunction, persistent inflammation, and excessive apoptosis, leading to delayed closure and higher infection risk. While graphene-based nanomaterials show promise for tissue regeneration, their effects on fibroblast survival in diabetic oral wounds remain poorly understood. Here, we report the structural characterization and therapeutic evaluation of graphene/cellulose nanocomposites in a streptozotocin-induced diabetic rat oral wound model. Nanoparticles, synthesized with uniform graphene dispersion (38.9–77.6 nm) and strong interfacial bonding within a cellulose matrix, were confirmed by FTIR, XRD, XPS, and SEM. Untreated diabetic wounds displayed profound fibroblast injury, including reduced viability, elevated lipid peroxidation, reactive oxygen species, oxidized glutathione, cytochrome c release, and high apoptosis/necrosis rates versus healthy controls ($p < 0.001$). Nanoparticle treatment significantly restored viability ($p < 0.01$), suppressed oxidative stress ($p < 0.01$), normalized glutathione redox balance ($p < 0.001$), and reduced mitochondrial-mediated apoptosis, with most parameters approaching healthy levels within five days. These findings demonstrate that graphene/cellulose nanocomposites possess favorable nanoscale architecture and also confer potent cytoprotective effects in the diabetic wound microenvironment. This nanoplatform offers a promising strategy to counteract oxidative stress and enhance healing in diabetes-impaired oral tissues.

Keywords:

Graphene/Cellulose Nanocomposite; Diabetic Oral Wound Healing; Gingival Fibroblasts; Oxidative Stress; Apoptosis; Nanomedicine

Comparison of Metal-Oxide Semiconductor Sensors for Ethanol Detection at Room Temperature

Raja Ahmad Arifikri Raja Ismail[1], Nazreen Waeleh [2], Siti Amaniah Mohd Chachuli [1], Ömer Çoban [3]

[1] Central for Telecommunication Research and Innovation (CeTRI), Faculty of Electronics & Computer Technology & Engineering, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia
[2] Universiti Teknikal Malaysia Melaka
[3] Department of Electrical and Electronics Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *arif020208@gmail.com*

Abstract

Ethanol is a colourless, volatile, and flammable liquid that is widely used in industrial, medical, and consumer applications. However, prolonged ethanol exposure to humans at 1000 ppm and above can pose a serious health risk with symptoms such as throat irritation, dizziness, intoxication, and unconsciousness if the concentration continues to increase. This makes the detection of ethanol essential in applications such as industrial safety, breath analysis, and environmental monitoring. Thus, this study proposes a gas sensor to detect ethanol using three different metal-oxide semiconductors, which are Titanium Dioxide (TiO2), Nickel Oxide (NiO), and Zinc Oxide (ZnO) at room temperature. The sensors were fabricated using a screen-printing method by implementing an interdigitated electrode as the first layer and metal-oxide semiconductor paste as the second layer on a Kapton film. Silver paste was used as an interdigitated electrode and fired at 150ºC for 15 minutes in an oven. The metal-oxide semiconductor paste was prepared by mixing the sensing powder (TiO2, NiO, and ZnO) with a binder. All sensing layers were annealed at 200ºC for one hour in an oven. The results indicated that all sensors responded to 35,000 ppm of ethanol at room temperature. The sensing response was approximately 85.61%, 19.12%, and 11.64% for ZnO, NiO, and TiO2, respectively. The result revealed that ZnO is the best sensor for ethanol with the highest sensing response as compared to NiO and TiO2. This research can be applied in developing low-powered gas sensors that are effective in detecting ethanol presence to ensure workplace safety and monitoring procedures.

Keywords:

Gas Sensor, Zinc Oxide, Titanium Dioxide, Nickel Oxide, Ethanol, Room Temperature

Study of Elemental (Micro- and Macro-) Nutrient Content in Dracocephalum ıMberbe Bunge from the Alai Range, Kyrgyzstan

Nurbek Aldayarov[1], Nurgul Ermekova[2]

1 Department of Biology, Faculty of Sciences, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

2 Department of Biotechnology, Institute Of Graduate Studies, Kyrgyz Turkish Manas University

Corresponding Author: *1912.02025@manas.edu.kg*

Abstract

Dracocephalum imberbe Bunge (Lamiaceae) is a perennial species endemic to the Alai Range, Kyrgyzstan, traditionally used in ethnomedicine. Its aerial parts are employed in decoctions and infusions for respiratory and gastrointestinal ailments and exhibit mild anti-inflammatory effects. Quantitative assessment of macro- and micronutrient composition in both aerial and root tissues is critical for evaluating its biochemical profile, pharmacological potential, and safety. Analytical results indicate that all investigated elements in leaves and roots fall within acceptable ranges for medicinal plants, confirming the ecological purity of the samples. The aerial parts exhibit high concentrations of essential macronutrients, including potassium (K), calcium (Ca), magnesium (Mg), and phosphorus (P), while toxic elements such as cadmium (Cd), lead (Pb), mercury (Hg), and arsenic (As) remain at minimal levels. Slight deviations include marginally reduced copper (Cu) and values of chromium (Cr) and selenium (Se) approaching the upper limits of normative ranges, without exceeding permissible thresholds. Roots demonstrate elevated accumulation of barium (Ba), strontium (Sr), sodium (Na), and calcium (Ca), reflecting typical patterns of ion storage in subterranean tissues. Although lead (Pb) and molybdenum (Mo) concentrations are higher in roots than in aerial parts, they remain within acceptable limits. Comparative analysis underscores distinct element distribution between plant organs, with leaves preferentially accumulating essential macronutrients and roots concentrating certain non-essential or trace elements. Overall,

D. imberbe exhibits a stable elemental profile, highlighting its suitability for medicinal applications and supporting its use in ethnopharmacology. These findings provide a foundation for quality assessment, standardization, and optimization as a botanical resource.

Keywords:

Ethnomedicine, Macronutrients and Micronutrient, Elemental Profile, Dracocephalum Imberbe, Kyrgyzstan

Comparative Effects of Cold Plasma and Microwave Pretreatments on Bioactive Compounds in Hydroalcoholic Quince Leaf Extracts

Bahram Fathi-Achachlouei[1], Rezvan Shaddel[2], Simin Tolouei[2]

1 Department of Food Science and Technology, University of Mohaghegh Ardabili, Ardabil, Iran
2 Department of Food Science and Technology, University of Mohaghegh Ardabili, Ardabil, Iran.

Corresponding Author: *b_fathi@uma.ac.ir*

Abstract

In recent years, there has been growing interest in plants rich in natural antioxidants and bioactive compounds, with quince leaves emerging as a notable example. Due to their high phenolic and antioxidant content, quince leaf extracts serve as effective natural antioxidants, offering a sustainable alternative to synthetic antioxidants. Over the past decade, emerging extraction technologies such as microwave, cold plasma, and ultrasound have gained significant attention in food science for their efficiency and environmental benefits. This study investigated the impact of cold plasma and microwave pretreatments on the chemical composition and antioxidant properties of hydroalcoholic extracts from quince leaves. The results demonstrated that a cold plasma and microwave pretreatments significantly increased ($P<0.05$) total chlorophyll content, whereas extending microwave pretreatment to 6 minutes led to a notable reduction compared to the control. Additionally, cold plasma and microwave pretreatments, significantly decreased moisture content. Ash content also declined significantly after 6 minutes of microwave and 15 minutes of cold plasma pretreatments, compared to the control. Both of cold plasma and microwave pretreatments, significantly enhanced ($P<0.05$) total phenolic content and antioxidant activity (especially pretreatment of cold plasma at 10 minutes was effective than microwave). However, color indices (L, *a*, b*) decreased significantly compared to the control due to cold plasma, but due to microwave pretreatment, there was no significant difference compared to the control. Based on the results of this research, cold plasma can be a better and more efficient method to extract and replace conventional thermal methods than the microwave pretreatment.

Keywords:

Cold Plasma, Microwave, Quince Leaves, Bioactive Compounds

Poster Session / 99

Production of Low-Fat Mayonnaise Using Pomegranate Peel Powder and Evaluation of Its Physicochemical and Sensory Properties

Bahram Fathi-Achachlouei[1], Shayesteh Hassanloo[2], Fatemeh Ghannadiasl[2]

1 Department of Food Science and Technology, University of Mohaghegh Ardabili, Ardabil, Iran
2 Department of Food Science and Technology, University of Mohaghegh Ardabili, Ardabil, Iran.

Corresponding Author: *b_fathi@uma.ac.ir*

Abstract

In this study, Production and investigation of the physicochemical and sensory properties of low-fat mayonnaise using pomegranate peel powder was carried out. The objective of this research was to produce low-fat mayonnaise enriched with fiber and nutrients by replacing part of its fat content with pomegranate peel powder to develop a functional low-fat mayonnaise. The studied treatments included 4 formulations (Treatment1: Control, Treatment2-4: Mayonnaise containing 2%, 4% and 6% w/w pomegranate peel powders,respectively). Measurements of certain physicochemical properties such as pH, fat content, peroxide value, crude fiber content and total phenolic content (TPC), color and sensory properties were conducted over a 30-day storage period of the produced mayonnaise samples. The results of the statistical analysis showed that the addition of pomegranate peel powders in the production of low-fat mayonnaise had a significant effect on the physicochemical properties, sensory properties of the samples ($P< 0.05$). In terms of pH, the control treatment exhibited the lowest values compared to the enriched mayonnaise with pomegranate peel powders. The fat content of all produced low-fat sauces was lower than that of the control, with treatment 4 (containing 6% pomegranate peel powder) having the lowest fat content. Furthermore, treatment 4 exhibited the highest total phenolic content (TPC). Colorimetric results revealed that pomegranate peel powder directly influenced the redness and lightness intensity of the samples, increasing redness and reducing lightness. Moreover, pomegranate peel powder resulted in the greatest reduction in peroxide value and significantly delayed the formation of hydroperoxides ($P < 0.05$). The overall acceptability results from the sensory evaluation indicated that control sample received the highest scores in terms of sensory properties. In conclusion, the use of valuable agricultural by-products, including pomegranate peel powders, proved to be an innovative and effective strategy for producing low-fat mayonnaise enriched with fiber and nutrients.

Keywords:

Low-Fat Mayonnaise, Fiber, Pomegranate Peel Powder, Physicochemical and Sensory Properties

Investigation of the Cellular Effects of Infrared Electromagnetic Waves and Carbon Nanotubes on HT29 Cell Line

Farshad Lotfollahzadeh[1]

[1] Department of Physics, MAH., Islamic Azad University, Mahabad Iran

Corresponding Author: *naserzadeh_2011@yahoo.com*

Abstract

Colon cancer can occur as small, non-cancerous cell masses called polyps that form in the lining of the colon. Targeted cancer therapy is a method in which substances or drugs are used to target cancer cells without affecting normal cells. This method often uses nanoparticles. Among the nanoparticles that are of great importance are carbon nanotubes, which have many applications in medicine due to their unique properties such as high tensile strength and carbon structure. They are synthesized in the form of nanotubes. They are generally activated by an external agent and increase their effectiveness in dealing with cancer tissue. Infrared radiation is electromagnetic energy that is associated with atomic energy levels. If absorbed by a substance, it stimulates it. It can be used to shrink or eliminate tumors and reduce some of the side effects of cancer, such as bleeding or obstruction and to remove colon polyps or tumors that have caused obstruction of the colon or stomach. The aim of this study is to investigate the synergistic effects of infrared electromagnetic waves, carbon nanotubes, and HT29 cell line. carbon nanotubes were obtained from Merck and the dimensions of the nanoparticles were examined using a SEM microscope to ensure their size. The cytotoxicity effect and damage to the integrity of the lysosomal membrane were evaluated at time. The average diameter of the nanoparticles was in the range of less than 100 nm, and the cytotoxic effect of infrared waves and nanoparticles alone and simultaneously with infrared and nanoparticles on cancer cells showed that the simultaneous effects of nanoparticles with infrared waves were greater than the single case. This study shows that the use of nanoparticles and excitation by an infrared energy source has a great effect on dealing with cancer cells.

Keywords:

Cell Death Signaling, Apoptosis, Nanosructure, Photothermal Therapy

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Cellular Toxicity of Laser, Iron Oxide and Manganese Oxide Nanoparticles on the Viability of Breast Cancer Cells Line

Aysan Mansournia[1]

[1] Department of Physics, MAH. Islamic Azad University, Mahabad, Iran

Corresponding Author: *parvaneh.naserzadeh1988@gmail.com*

Abstract

Breast cancer is one of the most common cancers among Iranian women, and 7,000 women are diagnosed with this cancer annually. Currently, this technology is used in various medical fields, but one of the most important areas of nanomedicine is related to cancer treatment, because it has had very positive effects on it so far. Iron and manganese oxide nanoparticles are particles in the size range of 100 nanometers. Iron oxide nanoparticles have attracted considerable attention due to their superparamagnetic properties and potential biomedical applications due to their biocompatibility and non-toxicity. Manganese oxide nanoparticles are widely used in the decomposition of hazardous chemicals due to their catalytic properties. Laser therapy uses high-energy light to treat cancer and other diseases. Lasers can also be used to shrink or destroy tumors. Lasers are most commonly used to treat superficial cancers such as basal cell skin cancer, and early stages of some cancers such as cervical, vaginal, and non-small cell lung cancer. The aim of this study was to investigate the synergistic cytotoxic effects of laser, iron oxide, and manganese oxide on a breast cancer cell line. Materials and Methods: Nanoparticles were purchased from Merck, and their dimensions were examined using a scanning electron microscope to ensure their size. The cytotoxicity effect was evaluated by MTT assay and damage to the lysosomal membrane at time. The average diameter of nanoparticles was in the range of less than 100 nm, and the cytotoxicity effect of laser and nanoparticles individually and simultaneously with laser and nanoparticles on cancer cells showed that the simultaneous effects of nanoparticles with laser gave the best response more than the single mode in less time. This study shows that the use of nanoparticles simultaneously with laser has a more effective effect than exposure to a single intervention.

Keywords:

Cell Death Signaling, Apoptosis, Nanostructure, Laser Therapy

Solar Technology / 102

Structural Analysis of La-Doped MoO_3 Hole Transport Layers and Reir Correlation with Perovskite Solar Cell Performance

Zulfanizam Abdul Wahab[1], Faiz Arith [2], Fauziyah Salehuddin [3]

1 Universiti Teknikal Malaysia Melaka
2 Faculty of Electronics and Computer Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, 76100, Melaka, Malaysia
3 Faculty of Technology & Engineering Electronic and Computer (FTKEK), Universiti Teknikal Malaysia Melaka, Melaka, Malaysia

Corresponding Author: *p022210003@student.utem.edu.my*

Abstract

The hole transport layer (HTL) is a critical component in perovskite solar cells (PSCs), governing charge extraction efficiency and interfacial stability. Molybdenum trioxide (MoO_3), a wide-bandgap transition metal oxide, offers favorable energy alignment and high work function, yet its performance can be further optimized through controlled doping. In this work, lanthanum (La)-doped MoO_3 thin films were synthesized via spin-coating and systematically characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), ultraviolet-visible spectroscopy (UV-Vis), and electrical measurements. XRD analysis confirmed the orthorhombic α-MoO_3 phase with high crystallinity and phase purity, while peak broadening revealed microstrain and reduced crystallite size, enhancing surface reactivity and charge transfer dynamics. At 3 mol% La doping, the films exhibited the widest optical bandgap (3.58 eV), minimized defect scattering, and peak electrical conductivity, attributed to improved crystallinity and reduced dislocation density. These structural and electronic improvements translated into enhanced carrier mobility and selective hole transport, reducing recombination losses at the perovskite/HTL interface. The findings establish La-doped MoO_3, particularly at 3 mol% concentration, as a promising HTL candidate for stable, high-performance PSC architectures.

Keywords:

MoO3, Perovskite Solar Cells (PSC), X-Ray Diffraction (XRD), Ultraviolet-Visible Spectroscopy (UV-Vis), Scanning Electron Microscopy (SEM)

Integrated Geophysical, Geochemical and Hydrogeological Methods to Investigation of Groundwater Contamination: A Case Study of Osubi, and its Environ Southern Nigeria

Wasiu Osisanya[1], Onifade Sikiru Yemi [1], Maruf A Bello [2], Saleh Alhaji Saleh [3], Iduseri O. Murphy [4]

1 Department of Physics, College of Science, Federal University of Petroleum Resources, Effurun, Delta State, Nigeria
2 Department of Petroleum Engineering and Geosciences, Petroleum Training Institute, Effurun, Nigeria
3 Department of Petroleum Engineering and Geosciences, Petroleum Training Institute, Effurun, Delta State, Nigeria
4 Department of Physics, Faulty of Physical Science, University of Benin, Benin City, Edo State, Nigeria

Corresponding Author: *wasiu.osisanya@uniben.edu*

Abstract

This study evaluates groundwater vulnerability and contamination in Osubi and surrounding communities, Delta State, Nigeria, using an integrated geophysical, hydrogeological, and geochemical approach. The investigation combined 1D, 2D, and 3D electrical resistivity surveys (21 Wenner–Schlumberger profiles and 38 VES), ten MASW seismic traverses, hydrogeological data from fifty hand-dug wells, and laboratory analysis of eleven water and fifteen soil samples. Geoelectrical parameters—including longitudinal conductance, transverse resistance (TR), longitudinal (PL) and transverse resistivity (PT), coefficient of anisotropy (COA), hydraulic conductivity, and transmissivity—were analyzed to assess aquifer integrity and protective capacity. Longitudinal conductance (9.6×10^{-5}–0.159mhos) indicates predominantly poor to moderate overburden protection, suggesting vulnerability to downward contaminant migration. TR, PL, and PT values reveal largely coarse-grained, resistive lithologies consistent with permeable, hydraulically active aquifer systems. COA (0.12–2.00) reflects a mix of homogeneous sands and heterogeneous sand–clay sequences driven by natural depositional variability. Hydraulic conductivity (0.122–3.481m/day) and transmissivity (0.43–67.18m²/day) further confirm moderate to high groundwater potential, particularly around VES 17–20. Localized low-resistivity zones (<50Ωm) at VES 19, 20, 22, 24, and 35 suggest possible shallow contamination. Inverted 2-D and 3-D resistivity models (RMS error 7.29%) show subsurface resistivities generally above the contamination threshold (<40–50Ωm), indicating an overall uncontaminated groundwater system. MASW results delineate a three-layered sequence comprising a loose topsoil, a semi-compacted transition zone, and a deeper saturated aquifer, with limited confining layers that enhance vertical infiltration and aquifer vulnerability. Geochemical indices indicate low to moderate pollution, with notable hotspots near PTI Skills, WOJ-30, and Government Land. PCA and correlation analyses attribute metal enrichment primarily to anthropogenic activities including vehicle emissions, industrial effluents, waste disposal, and agriculture. While groundwater metal concentrations mostly remain within acceptable limits, health-risk assessments highlight greater susceptibility in children, particularly from Pb-, Cd-, and Cr-exposure. Overall, integrated results underscore vulnerable but largely uncontaminated groundwater system requiring continuous monitoring and targeted mitigation.

Keywords:

Groundwater vulnerability, Electrical Resistivity, MASW, Geochemical assessment, Aquifer integrity

Integrated Electrical Resistivity Investigation of Subsurface Peat and Clay Deposits in Orile Whitesand, Orile–Iganmu, Lagos, Southwestern Nigeria

Wasiu Osisanya[1], Maruf A Bello [2], Saleh Alhaji Saleh [3], Iduseri O. Murphy [4], Ohwoharhohwo Etaoghene [5]

1 Department of Physics, College of Science, Federal University of Petroleum Resources, Effurun, Delta State, Nigeria
2 Department of Petroleum Engineering and Geosciences, Petroleum Training Institute, Effurun, Nigeria
3 Department of Petroleum Engineering and Geosciences, Petroleum Training Institute, Effurun, Delta State, Nigeria
4 Department of Physics, Faulty of Physical Science, University of Benin, Benin City, Edo State, Nigeria
5 Department of Geosciences, Faculty of Science University of Lagos, Akoka, Lagos State, Nigeria

Corresponding Author: *wasiu.osisanya@uniben.edu*

Abstract

This study employs electrical resistivity methods—Vertical Electrical Sounding (VES) and 2D Electrical Resistivity Imaging (ERT)—to delineate subsurface peat and clay deposits in Orile Whitesand, Orile–Iganmu, Lagos State, Southwestern Nigeria. A total of twenty-four (24) VES and eight (8) 2D resistivity profiles were acquired using a PASI Terrameter (Model 16GL). The Schlumberger array was utilized for VES and the Wenner array for 2D imaging. Data were processed using WinResist 1.0 and DIPROFWIN software to generate geoelectric sections and resistivity models. Results revealed four to six distinct subsurface layers, notably topsoil, clay, peat, sandy clay, clayey sand, and sand. Peat was identified by its extremely low resistivity values (0.3–9.6 Ωm) and variable thickness (1.7–27.2 m), while clay exhibited resistivity values ranging from 11.1 to 31.9 Ωm with thicknesses of 1.3–27.3 m. In several VES stations (e.g., 10, 12, and 14), current penetration was insufficient to resolve complete peat layers, indicating highly resistive overburden or localized saturation anomalies. The 2D resistivity profiles provided enhanced lateral continuity and confirmed the spatial distribution of low-resistivity peat and clay zones. The presence and distribution of these materials are critical for environmental and hydrogeological planning due to their influence on groundwater flow, contaminant retention, and foundation stability. The study recommends complementary hydrochemical analyses to evaluate groundwater quality in relation to the identified peat and clay zones.

Keywords:
Electrical resistivity survey, vertical electrical sounding, Peat and clay delineation, Overburden, Orile Iganmu Lagos

Opening Session / 105

AI and Bioinformatics Synergy: Transforming Data Into Precision Healthcare

Md. Habibur Rahman[1]

1 Department of Health Sciences, Novel Global Educational Foundation, NSW, Australia

Corresponding Author: *globaldreamer111990@gmail.com*

Abstract

By transforming complicated, high-dimensional biomedical data into clinically actionable insights across the care continuum, the convergence of bioinformatics and artificial intelligence is transforming healthcare. In fields including oncology, neurology, and autoimmune illnesses, AI-driven algorithms now incorporate multi-omics profiles, medical imaging, and electronic health records to enable earlier diagnosis, molecular disease stratification, and customized treatment selection. Simultaneously, deep learning and machine learning-enhanced bioinformatics pipelines speed up in silico drug screening, biomarker validation, and target discovery, reducing development times and increasing the success rate of translational research. These developments enable intelligent clinical decision support systems that enhance rather than replace doctors by offering risk prediction, therapeutic optimization, and workflow automation. This improves patient outcomes and system efficiency. However, in order to minimize algorithmic bias and guarantee that AI-enabled bioinformatics serves a variety of patient populations, realizing this transformational potential necessitates systematic attention to data quality, model interpretability, regulatory and ethical frameworks, and equitable deployment.

Keywords:

Bioinformatics, Biomarker Discovery, Multi-Omics Integration, Machine Learning

Pharmacological Properties of Curcumin-Encapsulated Nanoclays

Shahriyar Karimdoust[1]

[1] Department of Geology, Payame Noor University, Ardebil, Iran

Corresponding Author: *karimdoust_sh@yahoo.com*

Abstract

In recent years, the use of naturally derived bioactive compounds as adjunct therapeutic agents for the treatment of various diseases has received increasing attention in the medical and pharmaceutical sciences. Curcumin, as demonstrated in numerous studies, exhibits potent anti-inflammatory, antimicrobial, antiviral, and antiphrastic activities, and has proven beneficial in the management of several chronic disorders. Moreover, curcumin possesses notable anticancer properties. Curcumin (Diferuloyl Methane) is the principal active constituent of turmeric and a powerful antioxidant with significant therapeutic potential, particularly in enhancing the immune system and counteracting inflammatory and infectious pathogenic factors. Despite its broad pharmacological benefits, curcumin suffers from extremely low aqueous solubility and poor bioavailability, which substantially restrict its clinical applicability. Nanoclays hydrated silicate minerals with a layered architecture and at least one dimension in the nanoscale range have emerged as promising materials in modern industrial applications, especially in the fields of healthcare and therapeutics, due to their unique structural and physicochemical characteristics. The utilization of advanced nanotechnology and clay-based nanoparticles to improve drug delivery performance and overcome clinical limitations has become a major contemporary research focus. Reducing curcumin to the nanoscale significantly increases its solubility and enhances its therapeutic efficacy. The incorporation of plant-derived compounds into nanoclay matrices has enabled the development of a new generation of eco-friendly, biocompatible, non-chemical therapeutic agents. Modern biomedical formulations produced through micro and nanostructural engineering, combined with enhanced cell mediated therapeutic performance, represent a remarkable advancement an impressive convergence of traditional medicine with state of the art therapeutic technologies.

Keywords:

Curcumin, Nanoclay, Pathogens, Bioavailability

Improving the Pharmacological Properties of Curcumin by Nanoclay

Shahriyar Karimdoust[1]

[1] Department of Geology, Payame Noor University, Ardebil, Iran

Corresponding Author: *karimdoust_sh@yahoo.com*

Abstract

The synthesis of nanoparticles using plant extracts is a simple, cost-effective, and environmentally friendly method. Medicinal plants have long been valued for their therapeutic properties, and their use continues to increase today. Accordingly, extensive research is being conducted to revisit and revitalize the applications of these natural, non-chemical remedies, with modern technologies playing a major role in enhancing and optimizing their therapeutic potential. Nanoclays are among the valuable mineral materials that, due to their microstructural characteristics, high surface area, and compatibility with the body's metabolism, have become essential tools in recent studies. Curcumin, the main active component of turmeric, possesses effective therapeutic properties, particularly in boosting the immune system and combating inflammatory and infectious agents. However, its extremely low water solubility, poor bioavailability, limited gastrointestinal absorption, rapid metabolism, and fast elimination from the bloodstream pose significant challenges to its clinical use. Modifying mineral nanoclays with curcumin is one of the most effective strategies for increasing the stability, efficiency, and bioavailability of this compound, thereby enabling the development of mineral–herbal drugs with enhanced therapeutic performance. Plant-based medicines formulated with clay minerals through advanced technological methods not only offer combined therapeutic benefits but also lack harmful chemical additives and exhibit minimal side effects. Furthermore, they demonstrate high compatibility with both the environment and human metabolism. These structural features represent key standards in the pharmaceutical and medical industries.

Keywords:

Curcumin, Nanoclay, Pathogens, Bioavailability.

Design and Manufacture of PLC Controlled Laboratory Wear Device for in Vitro Biomedical Applications

Efe Çetin Yılmaz[1], Ibrahim Elebeyd[2]

1 Department of Control Systems Electrical and Electronic Engineering, Engineering and Architecture Faculty, Kilis 7 Aralık University, Kilis, Türkiye

2 Department of Electrical and Electronics Engineering, Graduate School of Natural and Applied Sciences, Kilis 7 Aralık University, Kilis, Turkey. // Department of Electrical and Electronics Engineering, Faculty of Engineering, Firat University, Elazig, Turkey

Corresponding Author: *popp75966@gmail.com*

Abstract

This study aims to design and manufacture a Programmable Logic Controller (PLC) controlled wear device with high accuracy and precision that can simultaneously move in two axes through the wear process. Within the scope of the study, synchronous step motors that can provide lateral and vertical axis motion drive and a PLC controller that can provide real-time control were used through the wear test process. The designed and manufactured laboratory device will enable various wear testing methods in the biomedical field. The device will model the wear mechanisms occurring on living tissue over time and can be performed in vitro in a laboratory environment. In addition, the wear and fatigue mechanisms caused by the mechanical movements of the designed and produced wear device were modelled using the finite element method, and the mathematical modelling of the test method was carried out through the wear test process. In this way, test methods that are performed on living tissue for long periods of time will be modelled in a laboratory environment, and results will be obtained in a short time. These data will guide the developments in material engineering and will make a great contribution to the selection of materials for a satisfactory treatment process. In addition, the flexible design structure of the device for modelling different parts of the human body with different modules will contribute to the impact area in research. Finally, by incorporating different modules into the designed and manufactured wear device, fatigue and corrosion mechanisms can be simultaneously analysed through the wear process. This will enable the continuous and complex damage mechanisms occurring in the human body to be simulated in a laboratory environment.

Keywords:

Wear Device, in Vitro Simulation, Biomaterials, PLC

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Investigation Contact- and Contact-Free Wear Resistance of Titanium for Biomedical Applications: Correlation with Wear Depth and Volume Loss

Efe Çetin Yılmaz[1]

1 Department of Control Systems Electrical and Electronic Engineering, Engineering and Architecture Faculty, Kilis 7 Aralık University, Kilis, Türkiye

Corresponding Author: *efecetinyilmaz@msn.com*

Abstract

Commercially pure titanium is often preferred in biomedical applications due to their high biocompatibility behaviour. However, the inadequate wear, fatigue and corrosion resistance of titanium limit their use as a biomaterial in the human body. The purpose of the present study was to investigate contact- and contact-free wear resistance and hardness of titanium for biomedical applications. In this study, five specimens of each test material were exposed to contact- and contact-free wear tests using a computer-controlled chewing simulator with a steatite ball as antagonist (100 N bite force loads, 1.0 Hz chewing frequency, 100.000 chewing cycles, 30° contact angle immersed in distil water. Initially surface hardness values of test materials in Vicker's hardness (HV) were determined. The maximum wear depth and the volume loss of the worn surfaces were measured with a 3D profilometer. Additionally, SEM analysis was performed to examine surface wear tracks. The interactions between titanium test specimen and maximum depth of wear and volume loss were found to be significant through wear test process. According to in this study obtain data as the zirconium ratio in the titanium alloy content increased, the alloy showed higher wear resistance under wear test procedures. However, it has been observed that micro cracks occur on the wear surfaces direction of lateral movement mechanism. These micro cracks can be the continuation of cracks that occur subsurface of titanium test material. This can be suggested as an indication of fatigue wear.

Keywords:

Biomaterials, Wear, Titanium, Volume Loss, in Vitro Study

An Evaluation of Optimum Inclination Angle for Fixed-angle Solar Panel Installations in Erzurum Province

Emre Koşar[1], Muhammet Kaan Yeşilyurt [1]

[1] Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding Author: *kaan.yesilyurt@atauni.edu.tr*

Abstract

Whether due to the scarcity of fossil fuels or environmental concerns, humanity is rapidly realizing the importance of renewable energy sources and turning to them. Solar energy, among renewable energy sources, is a type of energy whose importance is rapidly increasing globally due to its environmental sustainability and economic viability. Especially in the fight against climate change, its low carbon emissions place solar energy in a privileged position among other energy sources. Photovoltaic (PV) systems are systems that convert direct solar radiation into electrical energy. However, the efficiency of PV systems depends not only on the panel technology but also directly on environmental factors such as the panel's installation angle (tilt), orientation, climatic conditions, atmospheric density, air temperature, and altitude. Within the scope of our country's energy needs, the main problem for Erzurum province, which has a high altitude and cold climate, is the lack of sufficient academic research in the implementation of solar power plants. In practice, it is observed that solar power plants in Erzurum are installed at a fixed angle. Erzurum province, being one of the highest altitude provinces in Turkey with the most pronounced continental climate characteristics, serves as an ideal example for this type of study. Erzurum has an average annual solar energy potential of 1,650 kWh/m²; however, the long winter season, high snow cover, and low temperatures significantly affect PV efficiency. Therefore, determining the optimum tilt angle for fixed-slope PV panel installations in high-altitude regions like Erzurum is both a scientific and economic necessity to increase energy efficiency. This study aims to determine the optimum installation angles of PV panels in Erzurum province during summer and winter periods, and to examine the effects of seasonal differences on efficiency in the context of physical, atmospheric, and geometric parameters.

Keywords:

Solar Energy, Fixed-angle solar panels, Optimum inclination angle, Erzurum province

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Re Effect of Fractal Phenomena on the Rermal Conductivity of Nanofluids

Bahman Rahmatinejad[1], Hadi Ghasemi Zavaragh[2]

1 Department of Mechanical Engineering, Technical and Vocational University (TVU) Tehran, Iran
2 Department of Mechanical Engineering, Technical and Vocational University (TVU), Tehran, Iran

Corresponding Author: *brahmati@tvu.ac.ir*

Abstract

The thermal conductivity of nanofluids, suspensions of nanoparticles in base fluids, can be significantly influenced by the fractal nature of nanoparticle aggregates. Fractal structures, characterized by self-similarity across multiple scales, determine how nanoparticles cluster and form conductive pathways within the fluid. This study investigates the effect of fractal phenomena on the thermal conductivity of nanofluids by integrating theoretical models, computational simulations, and experimental observations. The fractal dimension of aggregates, a measure of their structural complexity, is found to play a critical role: low-fractal-dimension aggregates, which are open and chain-like, promote continuous heat transfer pathways and enhance effective thermal conductivity, while high-fractal-dimension aggregates, which are more compact, disrupt connectivity and reduce thermal transport efficiency. Factors such as nanoparticle concentration, temperature, and interparticle forces significantly influence aggregation behavior and fractal dimension, thereby modulating thermal performance. Experimental studies on copper oxide and silicon dioxide nanofluids confirm that fractal clustering creates low-resistance conductive networks, validating the predictive capabilities of fractal-informed models. Understanding the fractal characteristics of nanoparticles enables the optimization of nanofluid formulations for enhanced heat transfer, improved cooling efficiency, and greater operational stability. Overall, the integration of fractal theory with nanofluid research offers a robust framework for predicting and tailoring thermal properties, opening pathways for the design of high-performance thermal fluids and advanced energy management systems. This approach provides fundamental insights into the interplay between microstructure and heat transport in nanofluids, highlighting the critical role of fractal aggregation in thermal enhancement.

Keywords:

Nanofluid, Thermal Conductivity, Nanoparticles, Fractal Dimension, Heat Transfer Enhancement, Nanoparticle Aggregation

DRAFT

Modelling Economic Variables in Offshore Oilwell Drilling

Dalmo S. Amorim Jr.[1], Edmilson Moutinho Dos Santos [1], Hirdan Katarina De Medeiros Costa [1]

[1] Department of Energy, IEE-USP, Institute of Energy and Environment, University of São Paulo, Brazil

Corresponding Author: *dalmo.amorim@gmail.com*

Abstract

Drilling costs and CO_2 emissions in oilwell drilling are direct functions of the time spent on drilling operations. This is because all the energy used during the drilling operations is generated on site by diesel-electric systems. The longer the operations take, the greater the diesel consumption, and the higher are costs and emissions. However, drilling time varies significantly from one well to another. These variations stem from differences in rock properties, drilling equipment, operational conditions and drilling efficiency. Due to this complexity, traditional statistical methods are not sufficient to adequately analyze the operational results. In this study, we present regression models capable of capturing these complex relationships to provide a more accurate representation of the results in a field or sedimentary basin. The results offer new and useful insights for technical, operational, economic and contractual decision-making. An immediate application is supporting the assessment of testing new technologies and remunerating Turn-Key contracts. The conclusions of this work provide relevant and original contributions to the enterprise at the intersection of drilling engineering and environmental sustainability.

Keywords:

Petroleum Engineering. Drilling Cost Modeling. Environmental Preservation.

Removal of Heavy Metals in Ice Tea Beverages Using Electrochemically Synthesized Glutathione Modified Electrodes

Ayşenur Şuvak[1], Fatma Bayrakçeken Nişancı [2]

[1] Department of Chemistry, Faculty of Science, Ataturk University, Erzurum, Türkiye
[2] Department of Chemistry, Faculty of Science, Atatürk University, Erzurum, Türkiye

Corresponding Author: *aysesuvak2427@gmail.com*

Abstract

Electrodes with enhanced active surface area were successfully synthesized by electrochemical methods using excellent L-glutathione nanostructured materials, prepared with the aim of eliminating heavy metals that may endanger human health, particularly in beverages. Most importantly, through these electrochemical methods, high-performance L-glutathione nanostructured electrodes can be directly fabricated at room temperature and atmospheric pressure, in a cost-effective manner, without the need for additional steps or extensive processing. Furthermore, with this method, L-glutathione nanostructures of desired composition, structure, and size could be easily synthesized by controlling electrochemical parameters such as potential and time. The nanostructured layers of the electrodes not only provide higher and more stable structural properties but also demonstrate significant morphological effects on electrode performance. Since this thin film formation is carried out electrochemically directly on ITO, interfacial defects and other contact-related problems are minimized. The surface morphology of the prepared three-dimensional (3D) electrodes was characterized using scanning electron microscopy (SEM). The functional groups and optical properties of L-glutathione thin nanostructured films were analyzed by Fourier transform infrared spectroscopy (FTIR) and UV-VIS spectroscopy. In addition, in the application stage, inductively coupled plasma mass spectrometry (ICP-MS) was employed to determine the heavy metal removal capacities of these electrodes.

Keywords:

L-Glutathione, Electrodeposition, Nanofabrication, Heavy Metals

Unraveling the Mechanism of TiCN Film-Coated NiTi Substrate Toxicity: Evidence of Mitochondrial Electron Transport Dysfunction in Gingival Cells from Diabetic Rats

Parvaneh Naserzadeh[1]

1 Colorectal Research Center, Iran University of Medical Sciences, Tehran, Iran

Corresponding Author: *pnnew2011@yahoo.com*

Abstract

In recent years, considerable attention has been directed toward exploring alternative materials for screws used in jawbone tissue replacement. Nevertheless, issues related to the cytotoxicity and biocompatibility of these materials remain subjects of ongoing debate. In this study, we developed a novel implant for jawbone tissue regeneration by depositing a titanium carbonitride (TiCN) film onto a NiTi shape memory alloy substrate using the Cathodic Arc Physical Vapor Deposition (CAPVD) technique. The investigation focused on evaluating the cellular responses of TiCN-coated NiTi substrates in gingival cells derived from diabetic rats over periods of 1, 15, and 30 days.Initially, the research involved characterizing the NiTi alloy and assessing its distribution within the tissue. Subsequently, several biological parameters—including white blood cell (WBC) components, adenosine triphosphate (ATP) levels, oxidative stress markers, cytochrome c release, and lysosomal membrane integrity—were analyzed across all experimental groups.The findings revealed that diabetic rats implanted with the TiCN-coated NiTi substrate exhibited notably reduced oxidative stress markers, alongside enhanced cell viability, increased intracellular glutathione (GSH) and ATP concentrations, and diminished cytochrome c release and lysosomal membrane damage.Overall, the results suggest that the TiCN-coated NiTi screw demonstrates excellent biocompatibility and minimal cytotoxicity, making it a promising candidate for jawbone tissue replacement in diabetic patients.

Keywords:

Cell Death Signaling, Apoptosis, Nanosructure,

Functional Nanoparticle Incorporated Bioprinted Scaffolds

Behnaz Ashtari[1], Fatemeh Barati[2], Maryam Khosravi[3], Mohamad Javad Hadi[4]

1 Department of Medical Nanotechnology, Faculty of Advanced Technologies in Medicine, Iran University od Medical Sciences. Tehran, Iran
2 Department of Medical Nanotechnology, Faculty of Advanced Technologies in Medicine, Iran University of Medical Sciences, Tehran, Iran
3 Department of Medical Nanotechnology, Faculty of Advanced Technologies in Medicine, Iran University of Medical Sciences, Tehran, Tehran, Iran.
4 Graduate Student, Iran University of Medical Science, Tehran, Iran

Corresponding Author: *fatemehbarati.h@gmail.com*

Abstract

By incorporating functional and stimuli-responsive nanoparticles, passive bioprinted scaffolds can be transformed into controllable and adaptive material systems. Such particles impart chemical, electrical, magnetic, and light-responsive behavior while reinforcing polymer networks and improving rheology. These nanoparticles create nanoscale domains that convert external stimuli into localized thermal, mechanical, or chemical outputs, enabling conductivity tuning, photothermal heating, magnetic actuation, and sustained ion exchange. Together, these effects shift scaffolds from static structures to dynamic, stimulus-regulated platforms designed for next-generation responsive biomaterials.

Keywords:

3D Bioprinting, Bioinks, Smart Biomaterials, Nanoparticles, Responsive Scaffolds

Mechanistic Insights Into Tissue Regeneration Using Carbon-Based Nanoparticles in 3d Bioprnting

Behnaz Ashtari[1], Fatemeh Barati[2], Maryam Khosravi[3], Mohamad Javad Hadi[4]

1 Department of Medical Nanotechnology, Faculty of Advanced Technologies in Medicine, Iran University od Medical Sciences. Tehran, Iran
2 Department of Medical Nanotechnology, Faculty of Advanced Technologies in Medicine, Iran University of Medical Sciences, Tehran, Iran
3 Department of Medical Nanotechnology, Faculty of Advanced Technologies in Medicine, Iran University of Medical Sciences, Tehran, Tehran, Iran.
4 Graduate Student, Iran University of Medical Science, Tehran, Iran

Corresponding Author: *fatemehbarati.h@gmail.com*

Abstract

Carbon-based nanomaterials are emerging as key modifiers in 3D bioprinting due to their electrical, surface, and biochemical properties. They enhance shear-thinning, print fidelity, and mechanical strength by forming conductive polymer–nanomaterial networks. They also influence ionic flux, Ca^{2+} dynamics, and redox conditions through controlled ROS generation, supporting signaling pathways relevant to bone and cartilage regeneration. Through these combined effects, carbon-nanomaterial-enhanced bioinks create microenvironments that promote structural maturation and tissue development, positioning them as next-generation functional enhancers for regenerative scaffolds.

Keywords:

Tissue Engineering, 3D Bioprinting, Bioinks, Scaffold, Carbon Nanoparticle

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Graphenated Carbon Nanotubes: Bridging 1D–2D–3D Carbon for Advanced Functional Systems

Ismayadi Ismail[1]

1 Nanomaterials Synthesis And Characterization Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan, Malaysia

Corresponding Author: *ismayadi@upm.edu.my*

Abstract

This keynote presents a 10 year journey into graphenated carbon nanotubes (g-CNT), an advanced hybrid carbon architecture where graphene foliates emerge directly from the walls of carbon nanotubes to form an ultra-light and highly conductive three-dimensional aerogel. The talk invites the audience to explore how this unique structure evolved from fundamental discovery into a platform material for next generation energy and electronic systems. The keynote begins with the scientific motivation behind hybrid carbon design. It highlights the performance limits of graphene and carbon nanotubes when they are used on their own, including restacking, low interfacial activity, restricted charge transport pathways, and limited mechanical anchoring. These gaps form the basis for the development of a new architecture that integrates one dimensional conduction, two-dimensional surface interaction, and three-dimensional porosity. The talk then traces the experimental milestones from the first cotton like g-CNT aerogel produced using FCCVD to the introduction of sustainable precursors, morphology tuning, and refinement of the unzipping and regrowth mechanism. This foundation enables a deeper understanding of conductivity, surface polarization, ion transport, and mechanical behaviour. The application segment showcases how g-CNT transitions from a laboratory curiosity to a functional material. Case studies include platinum free counter electrodes for dye sensitized solar cells, conductivity enhanced TiO_2 photoanodes, flexible supercapacitors built on MoS_2 and WS_2 nanowalls, and emerging opportunities in electromagnetic interference shielding for the 5G ecosystem. Each example highlights how the hierarchical carbon network improves device performance, stability, and scalability. The keynote concludes with a forward-looking perspective on hybrid carbon systems. It outlines a vision where architectured carbon materials can be tailored for specific functions, integrated into industrial composites, and paired with future two dimensional materials. The journey of g-CNT represents an early and significant step toward this future.

Keywords:

Carbon Materials, Hybrid Nanostructures, Graphenated Carbon Nanotubes, Energy and Electronic Devices, Hierarchical Conductive Networks

Effect of Sliding Wear Mechanism of Titanium Biomaterials: 3D Finite Element Analysis

Efe Çetin Yılmaz[1]

1 Department of Control Systems Electrical and Electronic Engineering, Engineering and Architecture Faculty, Kilis 7 Aralık University, Kilis, Türkiye

Corresponding Author: *efecetinyilmaz@msn.com*

Abstract

This study aims to analyze the effect of the lateral movement mechanism occurring during the chewing movement on the pure titanium material-based implant body using the Finite Element Analysis (FEA) method. In this study, a pure titanium-based dental implant material designed to international standards was subjected to 0.5 mm lateral movement mechanisms under a 70 N bite force. The force distribution generated within the implant body was analyzed using the FEA method. The obtained data showed that the load distribution generated by the lateral movement mechanism of the implant body and the bite force was distributed in the direction of movement. Additionally, it was observed that some residual loads occurred in the implant body upon completion of the chewing period. This suggests that residual stresses may be generated in the implant structure and may lead to various damage mechanisms depending on the parameters of the chewing movement. The ability of researchers to observe these data, which can be obtained over long periods of time in living tissue studies, through in vitro and FEA-method analysis, will make a great contribution to material development. In future studies, modeling the lateral wear movement mechanism in vitro with the FEA method and analyzing it on different materials will greatly contribute to the understanding of this mechanism.

Keywords:

Finite Element Analysis, Sliding Wear Mechanism, Biomaterials

Fe-Pt Nanoparticles: Synthesis and Characterization

Zhazgul Kelgenbaeva[1]

[1] Institute of Chemistry and Phytotechnology, National Academy of Sciences of the Kyrgyz Republic, 720071, Bishkek, Kyrgyzstan

Corresponding Author: *zhazgul.k@gmail.com*

Abstract

Fe-Pt nanoparticles were synthesised from Fe-Pt alloy electrodes using pulsed plasma in ethanol. As synthesized A1 and annealed L10 type FePt nanoparticles were studied by XRD, HR-TEM analysis and VS-Magnetometer. VSM indicated strong ferromagnetic behaviour at room temperature.

Keywords:

Nanoparticles, FePt, Pulsed Plasma in Liquid, Ferromagnetism

Product Innovation and Processing Technologies for Agroforestry Food Products

Jamila Smanalieva[1]

[1] Food Chemistry, Faculty of Chemistry and Food Chemistry, Technische Universität Dresden, Germany

Corresponding Author: *jamila.smanalieva@tu-dresden.de*

Abstract

Ensuring food and nutrition security remains a major challenge in Kyrgyzstan, where 40% of the population cannot afford adequate nutrition, 70% of children under five lack minimally diverse diets, and 47% suffer from micronutrient deficiencies, especially iron. Meanwhile, non-communicable diseases account for up to 80% of deaths (WHO, 2019), highlighting the urgent need for healthier dietary options. Sustainable agri-food supply chains, focused on value-added processing rather than export of raw materials, represent a key pathway to improving national nutrition and economic resilience. This research presents advances in product innovation and processing technologies for agroforestry food products with the goal of expanding the range of functional, nutrient-dense foods. Comprehensive analyses were conducted on nutrient composition and bioactive components of dried apricots and kernels, as well as freeze-dried strawberries, blackberries, and apricots. The influence of blanching on macronutrients, total polyphenol content, antioxidant capacity, and microbiological stability of dried plums was also evaluated. New functional foods derived from local forest fruits were developed, including nine types of fruit balls, two formulations of fruit marshmallows, four “Baltalkan” cereal–honey bars, and three “Balmaizhemish” fruit spreads. Technological instructions were prepared for production, two patent applications submitted, and one patent already granted. In addition, improved drying technologies were introduced by substituting sulfur dioxide with organic acids during apricot pre-treatment to enhance product safety, preserve color and texture, and reduce microbiological risks. Overall, the outcomes demonstrate significant potential to strengthen sustainable value chains, enhance the quality and safety of dried fruit products, and contribute to improved nutritional health through increased availability of functional foods in Kyrgyzstan.

Keywords:
Functional Foods, Total Polyphenol Content, Antioxidant Capacity, Microbiological Stability, Dried Fruts

Design and Rermodynamic Analysis of a Geothermal-Based Tri-Generation System for Simultaneous Production of Power, Fresh Water, and Domestic Hot Water

Yaser Shokri[1], Hadi Ghasemi Zavaragh [2], Bahman Rahmatinejad [3], Omid Khanmohammadi [4], Abolfazl Taghavi [5]

1 Department of Mechanical Engineering,Faculty of Engineering, University of Tabriz, Tabriz, Iran
2 Department of Mechanical Engineering, Technical and Vocational University (TVU), Tehran, Iran
3 Department of Mechanical Engineering, Technical and Vocational University (TVU) Tehran, Iran
4 B.s student, Department of Mechanical Engineering, Technical and Vocational University (TVU), Tehran, Iran.
5 B.s student,Department of Mechanical Engineering, Technical and Vocational University (TVU), Tehran, Iran.

Corresponding Author: *yaser_shokri@tabrizu.ac.ir*

Abstract

In recent years, there has been a growing emphasis on the use of sustainable energy resources to reduce carbon emissions and improve energy efficiency. In this study, an energy and exergy analysis of a trigeneration system consisting of a double-flash geothermal cycle, a domestic water heater (DWH) system, and a humidification- dehumidification (HDH) desalination unit has been investigated. This system, powered by a renewable geothermal energy source, produces three distinct outputs: electrical power, domestic hot water, and potable water. The results of the analysis indicate that under baseline conditions, the net power output, freshwater production rate, energy efficiency, and exergy efficiency of the proposed system are 49.06 kW, 0.2392 kg/s, 47.6%, and 58.06%, respectively. In addition, the thermal power of the domestic hot water was found to be

329.6 kW. The exergy analysis also reveals that the highest share of exergy destruction occurs in components subjected to high temperature differences and irreversible conversion processes. These findings suggest that optimizing thermal design and reducing exergy losses can enhance the overall performance and promote more sustainable utilization of geothermal energy resources.

Keywords:

Geothermal Energy, Thermodynamic Analysis, Humidification-Dehumidification Process, Energy Efficiency, Domestic Hot Water

Cauliflower Disease Classification Using Vision Transformer Architecture

Rabiye Kılıç[1], Ahmed N. Nusari[2], Emin Argun Oral [2], İbrahim Yücel Özbek [2]

[1] Department of Computer Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye
[2] Department of Electrical and Electronics Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *rabiyekilic@atauni.edu.tr*

Abstract

In this study, a deep learning model based on the Vision Transformer (ViT-B/16) architecture was employed to automatically classify cauliflower leaf diseases using image data. The VegNet dataset, which consists of four classes—Black Rot, Downy Mildew, Bacterial Spot Rot, and Healthy—was utilized to evaluate the effectiveness of the proposed method. All images were manually divided into training, validation, and test subsets to ensure a balanced and controlled experimental setup. Data augmentation techniques, including random rotation and horizontal flipping, were applied only to the training and validation sets to enhance model generalization, while the test images were kept in their original form to provide an unbiased performance assessment.

The pretrained ViT-B/16 model, originally trained on the ImageNet dataset, was fine-tuned by replacing its classification head with a task-specific output layer suitable for four-class prediction. This approach enabled the model to adapt its learned global representations to the more domain-specific task of plant disease identification. Experimental results demonstrate that the proposed model achieved a test accuracy of 99.05%, indicating its strong capability to distinguish visually similar disease patterns. Confusion matrix analysis and class-wise ROC curves further confirmed the model's robustness and reliability across all disease categories.

Overall, the findings highlight that Vision Transformer-based architectures offer a highly effective and competitive alternative to traditional CNN-based approaches for plant disease classification. The global self-attention mechanism of ViT allows it to capture complex spatial relationships within leaf images, making it a promising solution for agricultural decision-support systems and automated disease monitoring applications.

Keywords:
Classification, Cauliflower Disease, Vision Transformer, VegNet

Effect of Concrete Strength Class, Maximum Aggregate Particle Size, and Curing Type on Ultrasonic Pulse Velocity

Ibrahim Ishaq M Alkhattab[1], Remzi Şahin [1]

[1] Department of Civil Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *ibm.19th@gmail.com*

Abstract

The Ultrasonic Pulse Velocity (UPV) method, although being a non-destructive testing technique, has certain limitations and may yield different results due to factors related to the internal structure of concrete. In this study, strength measurements were carried out using the UPV method on concrete mixtures produced by considering several parameters that are frequently varied in practice. For this purpose, concretes of different strength classes were produced by varying the water/cement ratio (W/C) and cement content (C), and these concretes were cured under different curing conditions (water, air, and moisture). The maximum aggregate particle size (8 mm, 16 mm, and 22.4 mm) was also defined as a parameter in the study. Fresh concrete tests included air content, unit weight, and slump tests. Hardened concrete tests were conducted on a total of 54 cube specimens with dimensions of 15×15×15 cm^3 at the age of 28 days. The results obtained from the experiments indicated that the behavior of fresh concrete varied depending on the concrete strength class achieved by changing the water/cement ratio and cement dosage, as well as on the maximum aggregate particle size. As the concrete strength class increased, UPV values also increased. Likewise, as the maximum aggregate particle size in the mixtures increased, UPV values were observed to increase depending on the concrete strength class. For all three concrete strength classes, the highest UPV values were obtained from specimens cured in water.

Keywords:

Compressive Strength, Ultrasonic Pulse Velocity, Schmidt Hammer, Concrete Curing, Maximum Aggregate Particle Diameter

Non-Invasive Marine Monitoring with Baited Remote Underwater Video (BRUV) Systems: Capabilities, Limitations, and Regional Opportunities

Rafet Çağrı Öztürk[1], Ayşe Cebeci[2], Melike Alemdağ[2], Şirin Firidin[2], Yahya Terzi[1]

1 Department of Fisheries Technology Engineering, Faculty of Marine Sciences, Karadeniz Technical University, Trabzon, Turkey
2 Central Fisheries Research Institute, Trabzon, Türkiye

Corresponding Author: *rafetcagriozturk@gmail.com*

Abstract

Baited Remote Underwater Video (BRUV) systems have emerged as one of the most effective non-invasive tools for assessing marine biodiversity, detecting species presence, and monitoring fish assemblages across a wide range of habitats. By using bait as a controlled attractant and deploying underwater cameras on fixed frames, BRUVs provide standardized, replicable observations of demersal and pelagic species without disturbing the environment or altering natural community structure. BRUV systems overcome many limitations associated with traditional methods such as trawl sampling, gillnets, and diver-based visual censuses, which are depth-restricted, habitat-destructive, or biased by diver presence. Their ability to operate across depth gradients, including remote, hazardous, or low-visibility areas, has made BRUVs central to contemporary marine monitoring and conservation planning worldwide. The method generates quantitative metrics such as MaxN, species richness, biomass proxies, behavioral interactions, and trophic composition, enabling long-term ecological assessments and impact studies related to marine protected areas, invasive species, fisheries pressure, artificial reefs, and aquaculture operations. Technological improvements, such as high-resolution cameras, and emerging AI-based species recognition have expanded the analytical capabilities of BRUV systems. Despite these advances, certain limitations persist, including variability in bait plume dispersion, current-dependent attraction ranges, reduced detectability of highly mobile or non-scavenging species, and the need for substantial video processing. When paired with complementary tools such as environmental DNA, or diver surveys, BRUVs provide a more accurate and comprehensive picture of marine biodiversity.In Türkiye, BRUVs show potential across diverse marine environments, from the low-visibility Black Sea to the species-rich Mediterranean. They enable effective monitoring of rocky reefs, seagrass beds, artificial habitats, and aquaculture zones, and are particularly valuable for tracking invasive species and evaluating marine protected areas.

Keywords:

Non-Invasive, Marine Protected Areas, BRUV

Preserving Genetic Diversity: Why Türkiye Needs a National GenBank

Yahya Terzi[1], Rafet Çağrı Öztürk[1]

[1] Department of Fisheries Technology Engineering, Faculty of Marine Sciences, Karadeniz Technical University, Trabzon, Türkiye

Corresponding Author: *rafetcagriozturk@gmail.com*

Abstract

The preservation of genetic diversity is fundamental to effective biodiversity research, conservation planning, and long-term ecosystem management. Türkiye, situated at the junction of major biogeographic regions and home to rich terrestrial, freshwater, and marine biota, remains underrepresented in global biodiversity and genomic datasets. Recent international analyses highlight large “biodiversity blindspots”, areas where species are present but missing from digitized records due to inadequate specimen archiving or the absence of coordinated genetic repositories. These gaps hinder accurate species assessments, limit the resolution of ecological monitoring tools, and reduce the reliability of conservation decision-making. Establishing a National GenBank for Türkiye would address these limitations by providing a centralized, long-term repository for DNA, tissues, seeds, gametes, and high-quality genomic reference material across taxonomic groups.

A national genbank would function as a scientific and conservation infrastructure that (i) preserves genetic diversity threatened by climate change, habitat degradation, overexploitation, invasive species, and emerging diseases; (ii) supports taxonomic and genomic research by enabling reliable species identification and the development of high-resolution reference libraries for tools such as eDNA metabarcoding; (iii) enhances the quality and reproducibility of biodiversity monitoring programs, including BRUV, UVC, fisheries assessments, and long-term ecological surveys, by linking observational data with verified genetic material; and (iv) strengthens restoration, aquaculture improvement, and species recovery efforts through access to well-curated, traceable biological samples.

Keywords:

Genetic Diversity, National GenBank, Ecosystem Monitoring, Biodiversity Conservation

DRAFT

Chemical Composition, Physico-Chemical Properties and Amino Acid Profile of Muffins Enriched with Cricket Powder (Acheta Domesticus)

Akylai Chynalieva[1], Bermet Sultanova[1], Aichurok Mazhitova[2]

[1] Department of Food Engineering, Engineering Faculty, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan
[2] Department of Food Engineering, Engineering Faculty, Kyrgyz-Turkish Manas University, Bishkek 720038, Kyrgyzstan

Corresponding Author: *aichurok.mazhitova@manas.edu.kg*

Abstract

The incorporation of insect-based protein into muffins is a growing trend in the food industry due to the demand for sustainable and nutritious options. Insect proteins provide a robust nutritional profile, encompassing high-quality protein, and essential amino acids, making them an appealing substitute for conventional protein sources. This research aimed to analyze the chemical composition, color characteristics, physico-chemical properties, and amino acid profile of muffin recipes developed by substituting wheat flour with cricket powder (Acheta domesticus) at levels of 10%, 20%, and 30%. The addition of cricket powder (CP) significantly increased protein content from 9.26% in the control muffins to 14.08% at 30% CP. The initial high fat content (13.00%) in control muffins rose to 20.40% with 30% CP. The ash content, indicating mineral presence, also increased with CP concentration, enhancing the muffins' mineral profile. Muffins with 30% CP had a significantly lower pH than the control and lower-enriched samples. Total titratable acidity increased with CP levels, confirming the pH reduction. CP changed the muffins' color significantly, with greater color differences observed as CP concentration rose. The crust showed a noticeable color change even at 10% CP, and the crumb had the most significant color shift at this level before stabilizing at higher concentrations. Water activity (aw) decreased to 0.65 with 30% CP, indicating improved microbial stability. CP inclusion led to an overall increase in essential and non-essential amino acids, with essential amino acids like histidine, threonine, and leucine rising with CP addition. Glutamic acid remained the most abundant amino acid in all samples. Adding cricket powder to muffins effectively enhances protein content and improves amino acid profiles, making them a better nutritional choice than traditional muffins.

Keywords:

Food with Added Value, Protein Content, Enriched Muffin, Insect Powder, Amino Acid Composition

Innovative Pathways for Circular Economy: Repurposing Coal Mine Waste in Construction Materials

Bishnu Pada Bose[1]

[1] Department of Civil Engineering, Haldia Institute of Technology, Haldia, India

Corresponding Author: *bosebishnu@gmail.com*

Abstract

Rapid population growth and urbanization have accelerated waste accumulation, pushing the biosphere beyond its natural regenerative capacity under the prevailing linear “take–make–use–dispose” model. Transitioning to a circular economy is essential for mitigating environmental degradation. This study aims to identify environmentally harmful yet abundantly available waste materials that could be repurposed in civil engineering applications. Based on a systematic evaluation of multiple waste streams, coalmine overburden was selected for comprehensive experimental investigation. The results demonstrate that all components of coal mine waste can be successfully transformed into valuable construction resources. After pulverizing large stones and separating silt and coal particles, the processed stones can be used as coarse and fine aggregates for concrete, bricks, and mortar. Silt, when blended with ordinary clay, is suitable for producing fired bricks, while residual coal particles offer additional energy recovery potential. The mechanical performance of concrete, bricks, and mortar manufactured from mine-derived aggregates is comparable to standard materials. These findings highlight the significant potential of recycling waste to extend material life cycles, prevent uncontrolled dumping, and partially replenish rapidly depleting natural resources. The approach aligns with the traditional 3R framework (Reduce, Reuse, Recycle) while extending it to include Replenish (restoring scarce resources) and Release land (freeing land previously occupied by waste). This expanded framework advances the circular economy from a linear “make–use–dispose” trajectory toward a regenerative “make–use–recycle–replenish” cycle. By reducing environmental harm, relieving pressure on ecosystems, and enabling land reclamation, the process contributes to long-term sustainability. Moreover, entrepreneurial adoption of the technologies developed in this study offers substantial social and environmental benefits. Transforming polluting waste into usable resources can mitigate soil, water, and air contamination, enhance agricultural productivity by reducing heavy metal accumulation, and strengthen local economies, further reinforcing a regenerative, resource-efficient circular economy.

Keywords:

Circular Economy, Waste, Mine Waste, Waste Recycling, Construction Materials

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An Integrated Web-Based System for Managing MEDEK, MÜDEK, and YÖKAK Accreditation Processes

Mahmut Yeşilyurt[1]

1 Department of Computer Technologies, İzmir Kavram Vocational School, İzmir, Türkiye

Corresponding Author: *mahmut.yesilyurt@kavram.edu.tr*

Abstract

Accreditation processes in Turkish higher education have become increasingly detailed and demanding under efforts to meet the standards and requirements of MEDEK, MÜDEK, and YÖKAK. Institutions must collect and manage large amounts of data, demonstrate consistent alignment between program outcomes and national frameworks, document assessment and improvement cycles, and prepare periodic reports for internal and external evaluations. These tasks are often carried out manually or through uncoordinated systems, which leads to high workload, loss of time, data inconsistencies, and difficulty in maintaining continuous accreditation readiness. To address these challenges, a web-based software system was developed using C-Sharp to support accreditation process management in a structured and efficient way. The system organizes key components of accreditation—such as outcome mapping, evidence collection, assessment tracking, and report generation—into a single platform. It provides predefined templates that match MEDEK, MÜDEK, and YÖKAK criteria, ensures version control, and allows multiple users to work in parallel. Automated workflows reduce repetitive work, support accurate documentation, and make it easier to monitor progress throughout the accreditation cycle. The software is currently in its beta-testing phase and is being used at İzmir Kavram Vocational School. Early use shows improvements in the clarity, consistency, and accessibility of accreditation data. The platform helps institutions maintain up-to-date documentation, prepare required reports with less effort, and manage the process in a more predictable and organized manner. This study presents a practical digital tool that responds to common problems faced by higher education institutions during accreditation. The system shows that software-supported process management can reduce administrative load, improve data quality, and contribute to a more stable and sustainable approach to meeting MEDEK, MÜDEK, and YÖKAK requirements.

Keywords:

Higher Education Accreditation, YOKAK, MEDEK, MUDEK, Web-Based Software

Network Pharmacology and Machine Learning-Driven Virtual Screening with Dynamics Simulations of Natural Compounds for Glioblastoma

Damilola Omoboyowa[1], Abayomi O. Adelaja [2], Babasola Aiyeku [3], Magdi E. A. Zaki [4], Mohit Agrawal [5], Temitope C. Aribigbola [6]

[1] Adekunle Ajasin University, Akungba-Akoko Ondo State, Nigeria
[2] Pharmacology Department, Faculty of Basic Medical Sciences, Olabisi Onabanjo University, Ago-Iwoye, Ogun State, Nigeria
[3] Northern Lincolnshire and Goole NHS Foundation Trust through Medocho Ltd, Scunthorpe, UK
[4] Chemistry Department, College of Science, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh Saudi Arabia
[5] School of Medical & Allied Sciences, K.R. Mangalam University, Gurugram, 122103, India
[6] Faculty of Medicine and Dentistry, Department of Medical Microbiology and Immunology, University of Alberta Edmonton, AB T6G 2E1, Canada

Corresponding Author: *damilola.omoboyowa@aaua.edu.ng*

Abstract

Glioma progression is driven by dysregulated signaling networks, including CDK4-Cyclin D3, PI3K-Akt, and EGFR pathways. Targeting CDK4-Cyclin D3 offers a promising therapeutic strategy. A systems-level computational approach was employed to identify potential CDK4-Cyclin D3 inhibitors from the OTAVA library. Network pharmacology, molecular docking, MMGBSA, AutoQSAR modeling, Density function theory (DFT) calculations, drug-likeness and ADMET profiling, and 200 ns molecular dynamics simulations were performed alongside temozolomide as a reference. Network analysis identified 16 shared glioma targets for vorasidenib and temozolomide, highlighting central pathways regulating metabolism, cell survival, and DNA repair. Docking and MMGBSA analyses revealed Compounds 781, 792, and 2299 as potent CDK4-Cyclin D3 inhibitors, outperforming temozolomide. AutoQSAR predicted higher pIC_{50} values for the hits, with Compound 781 ranked highest. DFT calculations indicated favorable electronic properties for protein-ligand interactions. Drug-likeness and pharmacokinetic profiling demonstrated good oral absorption, moderate blood brain barrier (BBB) permeability, and acceptable cardiotoxicity. Molecular dynamics simulations at 200 ns demonstrated stable binding, minimal structural fluctuations, and strong hydrogen bond, particularly for Compound 781. Compounds 781, 792, and 2299 have higher predicted potency, binding stability, and favorable pharmacokinetic properties than temozolomide, indicating their potential as CDK4-Cyclin D3 inhibitors for glioma treatment. These computational insights provide a strong rationale for experimental validation in vitro and in vivo.

Keywords:

Glioma, CDK4-Cyclin D3, Network Pharmacology; Virtual Screening, MD Simulation

Electrochemical Synthesis of $CoBi_2O_4$ Nanostructures

Arzu Kavaz Yüksel[1], Hulya Ozturk Doğan[2], Neslihan Çelebi[2], Pınar Anlar Daldal[3]

1 Department of Food Processing, Vocational School of Technical Sciences, Atatürk University, Erzurum, Türkiye
2 Department of Chemical Technology, Vocational School of Technical Sciences, Atatürk University, Erzurum, Türkiye
3 Department of Food Technology, Vocational School of Technical Sciences, Atatürk University, Erzurum, Türkiye

Corresponding Author: *hdogan@atauni.edu.tr*

Abstract

Spinel metal oxides have the general formula AB_2O_4 (A, B = Co, Cu, Mn, Ni, etc.) and exhibit high thermal and chemical stability compared to single metal oxides. Therefore, spinel metal oxide structures have attracted greater attention than single-metal oxides in recent years. Traditional noble metal materials have strong catalytic properties and are used in a wide range of applications. In this study, the one-pot electrochemical synthesis of cobalt bismuthate ($CoBi_2O_4$) nanostructures, $Co(NO_3)_2.6H_2O$ and $Bi(NO_3)_3$ solutions were mixed at a 1:2 ratio. O_2 gas was passed through the solution at a constant flow rate. A cyclic voltammogram (CV) was recorded with the cleaned pencil graphite electrode (PGE). This determined the deposition potential at which $CoBi_2O_4$ nanostructures could be deposited. The produced $CoBi_2O_4$ nanostructures were characterized using various techniques, including XRD, XPS, Raman, and SEM.

Keywords:
Electrochemical Synthesis, $CoBi_2O_4$, Nanomaterial

Application of Dynamic Light Scattering Method in Nanofluids

Bahman Rahmatinejad[1], Farzin Azimpour Shishevan [2], Hadi Ghasemi Zavaragh [3]

1 Department of Mechanical Engineering, Technical and Vocational University (TVU) Tehran, Iran
2 Department of Mechanical Engineering, Technical and Vocational University (TVU), Tehran, Iran.
3 Department of Mechanical Engineering, Technical and Vocational University (TVU), Tehran, Iran

Corresponding Author: *brahmati@tvu.ac.ir*

Abstract

Dynamic Light Scattering (DLS), also known as photon correlation spectroscopy or quasi-elastic light scattering, is a widely used technique for characterizing nanoparticle size, size distribution, and aggregation behavior in dispersions, making it essential for nanofluid research engineered colloidal suspensions of nanoparticles in base fluids such as water, ethylene glycol, or oils. The thermophysical properties of nanofluids, including thermal conductivity, viscosity, optical characteristics, and stability, are strongly influenced by particle size and dispersion quality, with minor variations potentially causing aggregation or sedimentation. DLS measures fluctuations in scattered light intensity due to Brownian motion, from which the diffusion coefficient is obtained and converted to a hydrodynamic diameter via the Stokes–Einstein equation. This hydrodynamic size accounts for primary particles, aggregates, solvation layers, and surfactant coatings, providing insight into real dispersion conditions. DLS is widely applied to assess colloidal stability, detect aggregation, monitor zeta potential, and perform time-dependent studies under storage or operational stresses, guiding the optimization of surfactants, pH, ionic strength, and preparation methods. It also evaluates the effectiveness of nanofluid synthesis techniques such as ultrasonication, high-shear mixing, and one-step versus two-step approaches. Correlating DLS-derived particle size distributions with thermophysical properties enables the design of nanofluids with predictable performance. Modern instruments allow in-situ monitoring under controlled temperature, flow, or shear conditions, simulating practical operating environments. Despite its advantages, DLS has limitations for highly polydisperse, concentrated, or non-spherical particle systems, necessitating complementary techniques like TEM, SEM, AFM, or nanoparticle tracking analysis for validation. Overall, DLS serves as a critical diagnostic tool, linking nanoscale particle behavior to the macroscale performance of nanofluids.

Keywords:
Nanofluids; DLS; Particle Size Distribution; Colloidal Stability; Thermophysical Properties

Evaluation of Entrepreneurial Projects Using Multi-Criteria Decision-Making Methods: the Case of the KOSGEB Entrepreneurial Support Program

Halil Barış Gezmiş[1], Elif Kiliç Delice[2]

1 Department of Industrial Engineering, Atatürk University, Erzurum, Türkiye
2 Faculty of Engineering, Department of Industrial Engineering, Ataturk University, Erzurum, Türkiye

Corresponding Author: *halilbarisgezmis@hotmail.com*

Abstract

Allocating public funds to the most suitable entrepreneurial projects is critical for ensuring resource efficiency. Since this allocation also influences economic growth, the project evaluation process requires a precise approach. This study presents a model for the KOSGEB Entrepreneur Support Program designed to remove subjectivity and establish a balanced evaluation framework. To achieve this, the Level Based Weight Assessment (LBWA) method was employed. The analysis incorporates perspectives from experts, academics, and jury members. Notably, the study integrates these opinions into the weighting calculations using a specific coefficient system based on each evaluator's professional experience and past performance

The proposed model assigns a weight of 60% to KOSGEB experts and 40% to independent evaluators. Results indicate a distinct divergence in the priorities of these groups: experts prioritize technical infrastructure and experience, while academics emphasize economic and strategic contributions. Under the two-stage evaluation system, 'Economic and Strategic Contribution' emerged as the highest-weighted criterion for board assessments. Conversely, in jury evaluations, 'Entrepreneurial Competence'—specifically the level of project mastery—held the most weight. Ultimately, the study highlights the necessity of striking a balance between technical feasibility and strategic vision. As one of the pioneer applications of the LBWA method to public support mechanisms in Türkiye, this research addresses a significant gap in the literature.

Keywords:

Multi-Criteria Decision-Making (MCDM), Entrepreneurship, KOSGEB, LBWA, Project Evaluation.

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Colostrum-Derived Exosomes as a Next-Generation Drug Delivery Platform: Mechanisms, Rerapeutic Applications, and Future Perspectives

Selçuk Özdemir[1], Şeyma Aydın[1]

[1] Department of Genetics, Veterinary Faculty, Atatürk University, Erzurum, Türkiye

Corresponding Author: *seyma.aydin@atauni.edu.tr*

Abstract

Background: Colostrum, an immunologically active biofluid rich in proteins, lipids, and vesicular structures, contains extracellular vesicles that exhibit remarkable stability and biocompatibility. Colostrum-derived extracellular vesicles (CDEVs) have recently attracted attention as natural nanocarriers due to their ability to withstand digestive conditions, cross biological barriers, and deliver therapeutic molecules efficiently.

Objective: This review aims to summarize the structural characteristics, isolation methods, and drug-loading approaches of CDEVs, and to evaluate their potential as emerging drug delivery platforms.

Methods: Recent literature on colostrum extracellular vesicle composition, physicochemical properties, and applications in drug and compound delivery was examined. Studies focusing on oral bioavailability, transport mechanisms, and pharmacokinetic advantages were included.

Results: CDEVs demonstrate high resistance to enzymatic degradation and acidic pH, enabling efficient gastrointestinal absorption. Their membrane composition facilitates cellular uptake and supports the encapsulation of various therapeutic cargos, including small molecules, peptides, and proteins. Drug-loading strategies such as passive incubation, sonication, and electroporation have been successfully applied to enhance delivery efficiency. Preclinical models reveal improved stability, reduced systemic toxicity, and enhanced tissue targeting when therapeutic compounds are delivered via CDEVs.

Conclusion: Colostrum-derived exosomes represent a promising and safe natural nanocarrier system with substantial advantages over synthetic platforms. Their unique physicochemical stability and scalable production potential position them as strong candidates for future pharmaceutical and nutraceutical applications.

Keywords:

Colostrum, Extracellular Vesicles, Drug Delivery, Nanocarriers, Bioavailability, Oral Delivery

Use of Nanoparticles for Drilling Fluid in Petroleum Industry

Abdollah Esmaeili[1], Afonso Cesar Rodrigues Nogueira [1]

[1] Geosciences Institute (IG/UFPA), Faculty of Geology, Universidade Federal do Pará (UFPA), Belém, PA, Brazil

Corresponding Author: *esmailyabdollah@gmail.com*

Abstract

In drilling operations, drilling fluids are used to improve drilling operations and bring drilling cuttings to the surface. The formulation of these fluids, commonly known as drilling mud, is one of the most important factors of a successful drilling operation. Considering that the major part of the costs of drilling a well is related to the supply and pumping of drilling mud, the use of more efficient and better fluids plays an important role in reducing costs and increasing drilling efficiency. A suitable drilling fluid should have a high ability to cool the drill bit, bring the drilling cuttings to the surface, smooth the movement of the rotating drill pipes, control the wall pressure, transfer the hydraulic power of the pump to the drill bit and many other things. Preparation of drilling mud with the best formulation and effective materials is an important factor in increasing the speed of drilling, increasing the productivity of drilling operations, preventing the reduction of flow rate, reducing the cost of drilling a well, and finally increasing the success rate in post-drilling operations. In general, the purpose of using nano additives in drilling mud is to reduce the cost and prepare an optimal fluid by reducing the consumption of materials and improving its properties. Adding nanomaterials to the base fluid creates favorable rheological properties, very good stability of suspension and proper lubrication. The use of nanoparticles in drilling fluid enables petroleum industry engineers to quickly correct the properties of drilling fluid by changing the composition, size and distribution of nanoparticles. Also, in well cementing operations, by using advanced compounds, efficiency and productivity as well as operation costs can be greatly improved by using nanotechnology.

Keywords:

Nanoparticles , Drilling ,Fluid, Petroleum, Industry

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Towards High-Efficiency $CsPbI_3$ Perovskite Solar Cells: A Computational Pathway to Material and Device Optimization,

Nurul Farina Mohd Nazli[1]

[1] Faculty of Electronic and Computer Technology and Engineering (FTKEK), Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100, Durian Tunggal, Malaysia

Corresponding Author: *m122410008@student.utem.edu.my*

Abstract

The rapid evolution of perovskite photovoltaic technology has positioned cesium lead iodide ($CsPbI_3$) as a promising candidate for next-generation solar cells due to its exceptional thermal stability, suitable bandgap, and long carrier diffusion length. However, achieving practical device efficiencies remains constrained by suboptimal layer configurations, defect-induced recombination, and non-optimized charge transport properties. This study presents a comprehensive computational framework to enhance the performance of $CsPbI_3$-based perovskite solar cells through systematic material and device optimization using SCAPS-1D. Key structural and electrical parameters including layer thicknesses, doping concentrations, and defect densities across the absorber, TiO_2 electron transport layer (ETL), and Spiro-OMeTAD hole transport layer (HTL) were systematically varied and analyzed to determine their influence on open-circuit voltage (Voc), short-circuit current density (Jsc), fill factor (FF), and overall power conversion efficiency (PCE). To effectively address multi-parameter interactions, a hybrid Taguchi–Grey Relational Analysis (GRA) approach employing an L27 orthogonal array was implemented. This statistical configuration enabled simultaneous optimization of multiple device parameters while minimizing the computational burden associated with conventional parametric sweeps. The optimization revealed that precise control of thickness profiles, carrier concentrations, and defect densities within each functional layer significantly reduces recombination losses and enhances charge extraction pathways. Under optimized SCAPS-1D conditions, the device achieved a PCE of 23.83%, accompanied by marked improvements in Voc, Jsc, and FF. Subsequent refinement using the Taguchi–GRA L27 framework further enhanced performance, yielding a PCE of 25.01%, corresponding to a 4.95% improvement over the conventionally optimized structure. This study demonstrates that hybrid statistical optimization offers a robust and data-driven pathway for designing efficient and stable inorganic perovskite solar cells. The proposed computational methodology provides actionable design guidelines that can accelerate the fabrication and commercialization of high-performance $CsPbI_3$ photovoltaic devices within the global renewable energy landscape.

Keywords:

Perovskite Solar Cells, $CsPbI_3$, SCAPS-1D, Taguchi-GRA, Optimization

Evaluation of the Sensitivity and Specificity of the Diagnostic Electrochemical Biosensor Using MicroRNAs Biomarkers Involved in Multiple Sclerosis

Azizeh Shadidizaji[1], Farideh Ghalamfarsa[2], Yousef Fazli[3], Ramin Jannesar[3], Kagan Tolga Cinisli[1], Mahmut Sinan Taşpınar[1], Ahmet Hacımüftüoğlu[4]

1 Department of Agriculture Biotechnology, Faculty of Agriculture, Ataturk University, Erzurum, Türkiye
2 Department of Cellular and Molecular, Yasuj University of Medical Sciences, Yasuj, Iran
3 Department of Pathology, Yasuj University of Medical Sciences, Yasuj, Iran
4 Department of Pharmacology, Faculty of Medicine, Atatürk University, Erzurum, Türkiye

Corresponding Author: *ls_shadi@yahoo.com*

Abstract

Multiple sclerosis (MS) is a chronic neurodegenerative disease requiring early diagnosis for effective intervention. Current diagnostic methods, such as MRI and cerebrospinal fluid analysis, are costly, time-consuming, and lack sufficient sensitivity for early detection. MicroRNAs (miRNAs), particularly miR-145 and miR-326, have emerged as promising biomarkers due to their differential expression in MS patients and stability in circulating biofluids. This study aims to develop a novel electrochemical biosensor for the rapid, sensitive, and specific detection of these miRNAs in serum samples. The biosensor is constructed using a glassy carbon electrode modified with multi-walled carbon nanotubes and gold nanoparticles, functionalized with thiolated probes for miR-145 and miR-326. Detection is achieved via hybridization-induced changes in methylene blue redox current. The biosensor demonstrates high sensitivity, detecting target miRNAs at femtomolar concentrations, and excellent specificity in distinguishing miR-145 and miR-326 from homologous miRNAs. Validation in spiked human serum confirms its potential for clinical application. This non-invasive, cost-effective platform offers a significant advancement towards point-of-care MS diagnostics, enabling earlier and more accurate disease monitoring.

Keywords:

Electrochemical Biosensor, Multiple Sclerosis, MicroRNA Biomarkers, Mir-145 and Mir-326, Gold Nanoparticles.

Evaluation of Liquefaction Potential in Erzurum Aziziye District

Onur Temiz[1], Hamit Çakıcı [2]

1 Department of Geological Engineering, Institute of Science, Atatürk University, Erzurum, Türkiye
2 Department of Architecture and Urban Planning, Pasinler Vocational School, Atatürk University, Erzurum, Türkiye

Corresponding Author: *onurtemiz5355@gmail.com*

Abstract

The aim of this thesis is to assess the liquefaction potential of the Aziziye District of Erzurum Province and to determine the region's seismic safety in terms of soil properties. In this context, the aim was to calculate the liquefaction potential of the study area using the methods recommended by Iwasaki et al. (1982) and Sönmez and Gökçeoğlu (2005). As part of the field studies, boreholes were drilled at designated locations and the Standard Penetration Test (SPT) was applied. Additionally, laboratory consistency limits, natural and saturated unit weight, sieve analysis, and hydrometer tests were conducted on disturbed and undisturbed soil samples taken from the research pits. Using all data obtained from the field and laboratory tests, liquefaction potential analyses were conducted according to the criteria of Iwasaki et al. (1982) and Sönmez and Gökçeoğlu (2005). As a result of the evaluation of the data obtained in the study; The average SPT-N value was determined to be 25.36, the natural unit weight was 16.20 kN/m³, and the saturated unit weight was 17.45 kN/m³. Furthermore, the plasticity index was determined to be 13.8%, the clay content was 11.12%, and the fines ratio was 32.34%. In liquefaction analyses conducted using these soil properties, the liquefaction potential at different points in the study area was calculated according to the methods of Iwasaki et al. (1982) and Sönmez and Gökçeoğlu (2005). According to the results obtained from field and laboratory studies, the probability of liquefaction occurring at drilling locations SK-1, SK-4, and SK-7 in the study area was determined to be high, while the liquefaction potential at locations SK-2, SK-3, SK-5, and SK-6 was determined to be very low.

Keywords:

Liquefaction, SPT, Natural and Saturated Volume Weight

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Applications of Carbon Based Nanomaterials in Microwave Devices

Zainab Yunusa[1]

1 Department of Electrical Engineering, University of Hafr Al Batin, Saudi Arabia

Corresponding Author: *zee2yunusa@gmail.com*

Abstract

Nanomaterials are materials in the nanometer scale from 1 to 100 nm. Their numerous advantages which includes miniaturization and enhanced energy efficiency has made them popular to be deployed in many industrial applications including electronics, medicine, energy, environment, materials and consumer products. In this paper, our focus will be how we can use carbon based nanomaterials in microwave devices such as antenna. Carbon based nanomaterials are used in microstrip patch antennas to create conductive films for the patch, ground plane or feedline so as to enhance the bandwidth and return loss. Recent advances in carbon nanomaterials such as carbon nanotubes, graphene, graphene nanoribbons (GNRs) and other green carbon nanomaterials from organic sources such as rice husk and carbon charcoal have shown excellent results when deployed in electronics, bioelectronics, optoelectronics and photonic applications. In this paper we will present some case studies on development of microstrip patch antenna applications that proved to show excellent results with improved antenna performance parameters.

Keywords:

Carbon-Based Nanomaterials, Microwave Devices,

Microcontroller-Based Smart Monitoring Solutions for Critical Communication and Energy Infrastructures

Tuba Çakıcı Can[1]

[1] Department of Electrical and Automation, Technical Science Vocational High School, Ataturk University, 25250, Erzurum, Türkiye

Corresponding Author: *tuba.cakici@atauni.edu.tr*

Abstract

This article presents two complementary microcontroller-based platforms designed to enhance situational awareness and diagnostic capabilities in critical communication and energy infrastructures. The first system is an intelligent interruption detection unit that can distinguish between faults on the feed side and faults on the subscriber side in less than a second. The second system is a modular RF monitoring and active privacy simulation platform designed for portable spectrum analysis, signal direction prediction, and evaluating experimental hidden modes. Both platforms were constructed with cost-effective microcontroller circuit control methods, specifically Arduino Nano and ESP32. These control system topologies provide rapid development, flexible expansion, and seamless connection with sensors and wireless communication interfaces. Experimental results show that the interruption detection unit significantly reduces diagnosis time and operational uncertainty, providing measurable benefits for telecommunications and energy operators. The RF monitoring platform provides lightweight tools for spectrum mapping and fraud testing, which are typically only available with laboratory-grade SDR equipment. This skill opens up new research opportunities in the fields of wireless security, interference reduction, and electronic warfare training. The results indicate that embedded architectures have the potential to offer low-cost, field-deployable solutions for smart infrastructure, smart energy monitoring, and defense industry applications. Future research will focus on the large-scale integration of multi-layered network designs, machine learning-assisted diagnostic systems, and IoT and SCADA-based management frameworks to take measures against previously identified issues.In this context, the proposed platforms highlight the importance of accessible, scalable, and user-friendly embedded technologies that can be adapted to diverse operational environments. By bridging experimental research with real-world deployment needs, this work aims to contribute to more resilient and intelligent infrastructure systems capable of supporting evolving technological demands.

Keywords:

Microcontroller-Based Systems; RF Monitoring; Embedded Systems; Wireless Networks; Smart Infrastructure

A Comparative Study of Optimization-Based Control Strategies for a Two-Tank Liquid Level System

Kaan Can[1]

[1] Department of Electrical and Electronics Engineering, Faculty of Engineering, Ataturk University, Erzurum, Türkiye

Corresponding Author: *kaan.can@atauni.edu.tr*

Abstract

In this study, the parameters of the PI-type linear controller designed to regulate the liquid level in a coupled-tank system were optimized using three nature-inspired algorithms: Fata Morgana (FATA), Fox Optimization (FOX), and Moss Growth (MOSS). First, a nonlinear mathematical model of the coupled-tank system was derived to accurately represent the system dynamics. Subsequently, the transfer function corresponding to the required control configuration was obtained, and the PI controller gains, kp and ki, were optimized by using the FATA, FOX, and MOSS algorithms. For comparative assessment, the PI controller parameters were also tuned using the classical Ziegler–Nichols (Z–N) method, and all controllers were evaluated under two different step + time varying reference signal. The simulation results demonstrated that the controller parameters optimized by the FOX algorithm, have achieved superior reference tracking performance compared to those obtained using the FATA and MOSS techniques. Furthermore, the FOX-based controller has provided approximately 52% better reference tracking performance compared with the controller tuned using the Z–N method.

Keywords:

Linear Control, Optimization-Based Control, Metaheuristic Algorithms, Liquid Level Control, Coupled Tank System

Influence of Low-Temperature Annealing on Copper Iodide as Hole Transporting Layer for Perovskite Solar Cell Applications

Omsri Vinasha Aliyaselvam[1], Faiz Arith [2], Mohd Asyadi Azam [3]

1 Centre for Telecommunication Research & Innovation, Faculty of Electronic and Computer Engineering, Universiti Teknikal Malaysia Melaka, Malaysia
2 Faculty of Electronics and Computer Technology and Engineering, Universiti Teknikal Malaysia Melaka
3 Faculty of Industrial and Manufacturing Technology and Engineering, Universiti Teknikal Malaysia Melaka

Corresponding Author: *p122310011@student.utem.edu.my*

Abstract

Copper Iodide (CuI) thin films synthesized using monoethanolamine (MEA) as a green solvent exhibit high optical transparency and uniform planar morphology, supporting their function as efficient hole transport layers (HTLs) in perovskite solar cells. Using this low-temperature, additive-free method, γ-CuI with a zinc-blende structure was successfully obtained. Despite these promising outcomes, maintaining uniform structural integrity and electrical stability during low-temperature processing remains a key challenge, especially when targeting mechanically flexible perovskite devices. The CuI films were deposited on Indium-doped Tin Oxide (ITO) substrates via solution-processable spin coating and subsequently annealed at temperatures between 60 °C and 120 °C. SEM and XRD analyses indicate that annealing temperature critically governs grain evolution, preferred crystallographic orientation, and structural parameters such as crystallite size, lattice constant, lattice strain, and dislocation density. The film annealed at 80

°C displayed a sharp nanoflower-like morphology with favourable conductivity and a stable band gap. These observations confirm that precise annealing optimization is essential for producing structurally robust CuI thin films suitable for high-performing PSC applications.

Keywords:

Annealing Temperature, Copper Iodide; Hole Transporting Layer; Perovskite Solar Cell

Synthesis and Bioactivities of \inc Oxide (\nO) Nanoparticles from Lactobacillus plantarum

Aysu Kırali[1], Aynur Babagil [2], Esen Taşşin [3], Hayrunnisa Nadaroğlu [4]

1 Graduate Student, Atatürk Üniversity
2 Department of Nano-Science and Nano-Engineering, Institute of Science and Technology, Ataturk University, 25240 Erzurum, Türkiye
3 Department of Nutrition and Dietetics, Faculty of Health Sciences, Atatürk University, Erzurum, Türkiye
4 Department of Food Processing, Vocational School of Technical Sciences, Atatürk University, Erzurum, Türkiye

Corresponding Author: *aysukrali.98@gmail.com*

Abstract

Postbiotics are compounds formed after metabolic processes of probiotic microorganisms and have the potential to exert positive health effects. Nanoparticles are carriers, designed at the molecular level, capable of exerting targeted effects. The food industry utilizes zinc oxide (ZnO), a source of zinc, as an essential micronutrient and is listed as a Generally Recognized As Safe (GRAS) material by the Food and Drug Administration (FDA). The aim of this study was to produce ZnO nanoparticles using a postbiotic obtained from Lactobacillus plantarum ACC54 strain via green synthesis and to determine the antimicrobial and antioxidant activities of the synthesized nanoparticles. In this study,

L. plantarum ACC54 strain was grown in MRS broth and banana peel-enriched medium to obtain two different postbiotics. ZnO nanoparticles were synthesized via hydrothermal green synthesis using postbiotics as reducing agents. The obtained nanoparticles were characterized for their morphological and structural properties by X-Ray Diffraction, Scanning Electron Microscopy, and Fourier Transform Infrared Spectrophotometer analyses. Antimicrobial activity was determined by the Agar Well Diffusion method, and antioxidant activity was determined by the KUPRAK (Cu^{2+}-Cu^{+} Reducing Activity) method and 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging tests. Characterization analyses confirmed that the synthesized ZnO nanoparticles were crystalline, nano-sized, and postbiotic-coated. The bioactivity of the ZnO NPs obtained by enriching the obtained postbiotics with prebiotics was investigated. Antioxidant analyses (DPPH and KUPRAK) showed that the nanolabeling process altered the mechanism of action of the postbiotics, and that the new generation nanocarriers, especially in terms of KUPRAK reducing activity, possessed high antioxidant potential. On the other hand, antimicrobial activity was found to be limited in most of the tested strains. These findings indicate that postbiotics from *L. plantarum* ACC54 can be used as effective reducing biocatalysts in the synthesis of ZnO nanoparticles, and these nanomaterials hold promise for biomedical applications and functional foods.

Keywords:
Postbiyotik, Lactobacillus Plantarum, Zinc Oxide Nanoparticle, Green synthesis

Combining Black Seed Oil with Antibiotics: A Promising Strategy Against Klebsiella pneumoniae and Acinetobacter baumannii

Torkan Haghi[1], Murat Ozdal [2]

[1] Department of Biology, Faculty of Science, Atatürk University, Erzurum, Türkiye
[2] Ataturk University, Science Faculty, Department of Biology, Erzurum

Corresponding Author: *torkan.haghi20@gmail.com*

Abstract

The rapid rise of antibiotic-resistant bacteria and the limited development of new antimicrobial agents highlight the urgent need for alternative therapeutic strategies. One promising approach is the use of synergistic combinations of antibiotics and essential oils, which may enhance antibacterial efficacy through complementary mechanisms. Essential oils, known for their broad-spectrum activity, have gained increasing attention as potential adjuvants capable of improving antibiotic performance and reducing the required drug dose. This study evaluated the synergistic antibacterial effects of Black seed (Nigella sativa) essential oil in combination with two antibiotics—Oxolinic acid (2 µg) and Netilmicin (30 µg)—against Klebsiella pneumoniae ATCC 70063 and Acinetobacter baumannii. Disk diffusion assays were used to measure inhibition zone diameters for antibiotics alone and in combination with black seed essential oil. For A. baumannii, netilmicin alone produced a 2.0 mm inhibition zone, which increased to 2.3 mm when combined with the essential oil. Oxolinic acid showed a 1.0 mm inhibition zone that rose to 1.1 mm with the addition of black seed oil. For K. pneumoniae, netilmicin increased from 2.4 mm to 2.7 mm in the presence of essential oil. Similarly, oxolinic acid increased from 0.9 mm to 1.1 mm when combined with the oil. Overall, black seed essential oil showed limited yet notable synergistic potential with both antibiotics, particularly against Gram-negative bacteria. Such combinations may offer a strategy to enhance antimicrobial activity and help mitigate resistance development.

Keywords:
Nigella Sativa Essential Oil, Antimicrobial Synergy, Multidrug-Resistant Bacteria, Gram-Negative Pathogens

Synergistic Effects of Rymus Vulgaris Essential Oil Combined with Antibiotics Against MRSA (Methicillin-Resistant Staphylococcus aureus)

Torkan Haghi[1], Murat Ozdal [2]

1 Department of Biology, Faculty of Science, Atatürk University, Erzurum, Türkiye
2 Ataturk University, Science Faculty, Department of Biology, Erzurum

Corresponding Author: *torkan.haghi20@gmail.com*

Abstract

Antibiotic resistance remains one of the most pressing global health challenges, driving the urgent need for innovative strategies that can enhance the effectiveness of existing antimicrobial agents. Essential oils derived from medicinal plants, such as thyme (Thymus vulgaris), contain bioactive compounds with recognized antibacterial potential and may serve as promising adjuvants to conventional antibiotics. This study investigates whether thyme essential oil can improve the antibacterial efficacy of two commonly used antibiotics—erythromycin (15 µg) and amoxicillin (10 µg)—against methicillin-resistant Staphylococcus aureus (MRSA), a clinically important multidrug-resistant pathogen. Disk diffusion assays were performed to determine inhibition zone diameters for antibiotics alone and in combination with 10 µL of thyme essential oil.The results showed that amoxicillin and amoxicillin–clavulanate produced no inhibition zones against MRSA, consistent with the known resistance profile of this organism. However, the addition of thyme essential oil resulted in an inhibition zone of approximately 13 mm, demonstrating a notable improvement in antibacterial performance. Erythromycin alone also exhibited no inhibitory effect on MRSA, whereas its combination with thyme essential oil generated an inhibition zone of approximately 9 mm, indicating enhanced activity attributable to the essential oil. These findings highlight the ability of thyme essential oil to partially restore or augment the antibacterial action of antibiotics that are otherwise ineffective against MRSA in vitro. Overall, the study supports the growing body of evidence suggesting that essential oils can act as effective adjuvants by increasing membrane permeability, facilitating antibiotic entry, or exerting complementary antibacterial effects. The integration of thyme essential oil with conventional antibiotics may contribute to improved treatment outcomes, reduced required antibiotic dosages, and a potential slowdown in resistance development.

Keywords:

Thyme Essential Oil, Thymus Vulgaris, Methicillin-Resistant Staphylococcus Aureus, Antibacterial Activity

INTEGRATED GEOPHYSICAL AND HYDROCHEMICAL ASSESSMENT OF GROUNDWATER CONTAMINATION AND AQUIFER VULNERABILITY IN THE IFEWARA AREA, SOUTHWESTERN NIGERIA

Kamorudeen Alasi[1]

[1] Department of Physics with Electronics, University of Ilesa, Ilesa, Nigeria

Corresponding Author: *taiwo_alasi@unilesa.edu.ng*

Abstract

This study investigates groundwater contamination and aquifer vulnerability in the Ifewara area, Southwestern Nigeria, through an integrated geophysical and hydrochemical approach. Vertical Electrical Sounding (VES) was employed to characterize subsurface stratigraphy, while Atomic Absorption Spectrometry (AAS) analyzed trace metal concentrations in groundwater from five boreholes and five hand-dug wells. Hydrochemical results revealed elevated levels of toxic metals, including manganese (up to 1737 ppm), arsenic, lead, nickel, and copper (up to 94.2 ppm), exceeding WHO permissible limits and posing significant health risks. Health risk assessments using Average Daily Dose (ADD) and Hazard Quotient (HQ) calculations indicated chronic exposure concerns, with manganese exhibiting an ADD of 20.61 mg/kg-day and HQ of 147.22, highlighting neurotoxicity risks. Other metals such as arsenic and lead also showed HQ values far above safe thresholds.

Geophysical data delineated four subsurface layers: topsoil, lateritic hardpan, clayey saprolite, and fractured bedrock aquifers. The clayey saprolite acts as a semi-confining yet permeable layer, facilitating contaminant migration, consistent with hydrochemical contamination patterns. Integration of resistivity profiles with hydrochemical data effectively mapped contamination hotspots and elucidated geohydrological controls on contaminant transport.

The findings demonstrate that both natural geological factors within the Pan-African schist belt and anthropogenic activities, including mining and agriculture, significantly influence groundwater quality and aquifer vulnerability. The study underscores the urgent need for continuous groundwater quality monitoring, targeted remediation, and community education to mitigate health risks. The multidisciplinary methodology provides a robust framework for groundwater contamination assessment in complex tropical basement terrains, supporting sustainable water resource management and public health protection.

Keywords:

Ground Water, Aquifer, Contamination and Geochemical

Development of AI-Machine Learning with the One Health Framework in the Prevention of Foodborne Disease in the "Program Makanan Bergizi Gratis Indonesia"

I Made Dwi Mertha Adnyana[1], Niken Irfa Nastiti [2], Annissa Delfira [3], Zahra Frizki Asty [2], Artka Zildzia Riawan [4], Ni Luh Gede Sudaryati [5]

1 Department of Microbiology and Parasitology, Faculty of Medicine and Health Science, Universitas Jambi, Jambi, 36122, Indonesia
2 Department of Microbiology and Parasitology, Faculty of Medicine and Health Sciences, Universitas Jambi
3 Department of Microbiology and Parasitology, Faculty of Medicine and Health Sciences, Universitas Jambi, Indonesia
4 Undergraduate Program of Medicine, Faculty of Medicine and Health Sciences, Universitas Jambi, Indonesia
5 Department of Biology, Faculty of Information Technology and Science, Universitas Hindu Indonesia

Corresponding Author: *dwikmertha13@gmail.com*

Abstract

Background: Indonesia's Free Nutritious Meals Program (MBG), launched in January 2025, has served more than 40 million recipients through more than 15,000 kitchens throughout Indonesia. As of October 2025, there have been 11,660 cases of food poisoning from 211 incidents in 25 provinces (88 districts/cities), accounting for 48% of all incidents. The massive increase in cases indicates the need for an integrated framework for detection, reporting, and innovative technology-assisted surveillance. Objective: This study proposes an integrated artificial intelligence/machine learning (AI/ML) framework that operationalizes the One Health principle for the prevention of foodborne diseases in the Free Nutritious Meals program. Methods: The designed system is expected to have five main components: machine learning algorithms that can predict which kitchens are at high risk; a data platform that integrates information from various ministries for reporting surveillance results and complaints; a food ingredient tracking system using blockchain and IoT sensors; social media monitoring to detect early signs of outbreaks; and pathogen DNA analysis to quickly trace the source of contamination. Results: Compared with conventional methods, the integration and implementation of AI-machine learning is expected to reduce outbreak detection time from weeks to hours, improve the accuracy of food source attribution, and enable proactive food safety management that integrates human health, animal (animal food sources), and the environment (pathogen sources), as well as integrate the One Health concept into the MBG program policy framework in Indonesia. The government needs to mandate AI-assisted certification and blockchain regulations for risky materials, install IoT sensors in 15,000 kitchens, and train 290,000 food officers to minimize food poisoning as a result of this program. Conclusion: The government and all relevant sectors need to develop an integrated surveillance system from the food source to the completion of the program, which should be carried out daily.

Keywords:

Artificial Intelligence, Machine Learning, One Health Framework, Predictive Surveillance, Outbreak Detection.

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Use of Metal Oxide Nanoparticles in the Food Industry: Toxicological Risks and Effects on Child Nutrition

Behina Asadoghli[1], Esen Taşşin [1]

[1] Department of Nutrition and Dietetics, Faculty of Health Sciences, Atatürk University, Erzurum, Türkiye

Corresponding Author: *behinaasadoghli@gmail.com*

Abstract

Metal oxide nanoparticles (MONPs) have become increasingly used materials in food production and packaging processes in recent years. Titanium dioxide, zinc oxide, and silica nanoparticles, in particular, are preferred for purposes such as extending product shelf life, improving color and texture, and inhibiting microbial growth. However, the nanoscale nature of these particles complicates their interactions with the body and raises new health concerns. There is increasing evidence in the literature that MONPs may affect the intestinal barrier, microbiota balance, the immune system, and some neurological processes. This is an issue that requires careful consideration, especially for vulnerable groups such as children. The aim of this study is to evaluate metal oxide nanoparticles used in the food chain in light of current toxicological findings, summarize their effects on the gastrointestinal system and microbiota, and identify potential risks they may pose to children. Furthermore, current regulatory approaches are reviewed, and gaps in food safety and areas requiring improvement are discussed. Current studies indicate that MONPs can reach humans through migration from both food and packaging materials. These particles have been shown to affect various biological systems through mechanisms such as oxidative stress, inflammation, increased intestinal permeability, and disruption of microbiota structure. Children's increased preference for packaged foods, their higher exposure relative to their body weight, and their greater developmental vulnerability place this group at particular risk. Therefore, it is crucial to reconsider the use of MONPs, particularly in child nutrition, conduct more comprehensive tests related to packaging migration, and increase the number of long-term, child-centered toxicological studies. Furthermore, stricter controls and transparent information are essential for products with potential MONP contact, such as baby products (baby bottles, pacifiers, and storage containers).

Keywords:
Metal Oksit Nanoparçacıkları, Gıda Güvenliği, çOcuk Sağlığı, Toksikoloji.

Data-Driven Quality Control in Iron and Steel Production: Evaluating the Impact of Carbon Content and Process Parameters Using Machine Learning

Hümeyra Ulaş[1], Tuba Irmak [1]

[1] Department of Industrial Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *tuba.adar@atauni.edu.tr*

Abstract

High-quality steel production is influenced by numerous factors, including chemical composition (particularly carbon content), process parameters (heat-treatment durations, charge amounts, preheating values), scrap quality, and the control mechanisms utilized during the production cycle. The relationships among these variables and the impact of process parameters on steel quality can be identified using machine learning methods. This study presents a data-driven approach for determining steel quality classes by using three months of steel production data obtained from a manufacturing company in Türkiye. The operational dataset consists of 39 variables, including preheating values, scrap charge information, process durations, and chemical composition measurements. On the raw dataset, missing-value analysis, removal of inconsistent records, scaling of numerical variables, encoding of categorical variables, and splitting into training (80%) and test (20%) sets were performed. Ultimately, machine learning models—Support Vector Machine (SVM), Light Gradient Boosting Machine (LightGBM), Extreme Gradient Boosting (XGBoost) and Random Forest (RF)—were trained using 3,817 observations to predict steel quality classes (B420 – S220). The results indicated that the quality class was clearly separated by the carbon content in the chemical composition; when carbon analysis values were included in the models, RF, XGBoost, LightGBM, and SVM all achieved 100% accuracy and AUC = 1.00. This finding demonstrates that carbon content is the primary determinant of the quality decision. To further examine the effect of carbon, the carbon variable was removed from the dataset, and the models were retrained using 5-fold cross-validation. In this case, the accuracy of tree-based methods decreased to approximately 86%, while the SVM model achieved 65% accuracy. ROC analyses performed without cross-validation showed that AUC values ranged between 0.93 and 0.95 in the absence of the carbon variable. This indicates that process parameters contribute to quality classification to a certain extent.

Keywords:

Machine Learning, Steel Production, Quality Control, Process Parameters, Carbon Analysis

New Approaches to Microneedle Technology and Alzheimer's Vaccine Applications

Hayrunnisa Nadaroğlu[1]

[1] Department of Food Processing, Vocational School of Technical Sciences, Atatürk University, Erzurum, Türkiye

Corresponding Author: *hnisa25@atauni.edu.tr*

Abstract

The integration of microneedle technology into drug and vaccine delivery systems offers an innovative approach due to its advantages, such as applicability against a wide range of diseases, applicability in the field of immunology, minimally invasive structure, and high bioavailability. Microneedles, which are micron-sized needles designed to penetrate the outer layer of the skin and are widely used and currently in widespread use, offer a minimally invasive method for the administration of therapeutic agents, including vaccines. The microneedles proposed in our project will not only increase the bioavailability of drugs but also improve patient compliance due to their painless application and ease of use. The application of microneedle technology in vaccine development for Alzheimer's disease (AD) represents a promising frontier in immunization strategies. Micro-needles, which are small, minimally invasive devices, facilitate the direct delivery of vaccines into the skin, where they can effectively stimulate immune responses. This method has been shown to increase the immunogenicity of various vaccines, including those targeting neurodegenerative diseases such as Alzheimer's.

Keywords:

Microneedle, Vaccine, Bioavailability, Alzheimer'S Disease (AD)

Eco-Friendly Synthesis of Carbon Quantum Dots for Mycotoxin Detection

Hatice Yüncü[1], Hayrunnisa Nadaroğlu [2]

[1] Department of Nanoscience and Nanoengineering, Institute of Science, Atatürk University, Erzurum, Türkiye
[2] Department of Food Processing, Vocational School of Technical Sciences, Atatürk University, Erzurum, Türkiye

Corresponding Author: *dincarslanhatice@gmail.com*

Abstract

Food contaminants are substances that are not naturally present in food products and can migrate into food through various pathways. Mycotoxins, one of these, are chemical compounds produced by fungi such as Fusarium, Penicillium, and Aspergillus and can have carcinogenic effects on humans. Aflatoxin (AF) contamination, in particular, significantly impacts the economic value of crops. The presence of food contaminants is one of the most critical threats to food safety and human health. In this context, biosensors and environmental monitoring technologies, particularly the synthesis and use of carbon quantum dots (CQDs), have increased interest in nanotechnology. Thanks to their small size (<10 nm) and large surface area, CQDs can be used for the precise measurement of chemical and biological processes in foods; they exhibit enhanced reactivity and novel optical and electrical properties. Due to their exceptional physical and chemical properties, CQDs have emerged as promising materials in the rapidly developing food safety research worldwide in recent years. CQDs with different surface functional groups can detect contaminants such as additives in processed foods, drug residues in honey, and mycotoxins in beer and flour using IFE, PET, and FRET-based sensing mechanisms.

The results of this study demonstrate the utility of CQDs synthesized from plantss as fluorescent probes for the detection of aflatoxins. By leveraging the unique properties of CQDs, a sensitive, rapid, and economical detection platform that can be integrated into food safety monitoring systems has been developed. This not only contributes to the synthesis of carbon dots from sustainable sources but also addresses a significant need in food safety and environmental monitoring.

Keywords:

Carbon Quantum Dots (CQDs), Mycotoxin, Aflatoxin (AF), Fluorescent Probe

Sustainable Nanomaterial Production: Carbon Quantum Dots Synthesized from Biological Waste

Taha Yasin Bayram[1]

[1] Department of Molecular Biology and Genetics, Institute of Science, Ataturk University, Erzurum, Türkiye

Corresponding Author: *tahayasin.bayram20@ogr.atauni.edu.tr*

Abstract

Carbon quantum dots (CQDs) have garnered significant attention in recent years due to their strong fluorescent properties, high water solubility, and biocompatibility. These characteristics make them valuable in biomedical fields such as sensing, bioimaging, diagnosis, and treatment. Various materials, ranging from pure organic compounds to waste products, have been used as precursors in CQD synthesis. Cell culture studies generate significant amounts of waste, primarily from culture media, which is often discarded without further evaluation. Therefore, innovative approaches are needed to convert culture medium waste into high-value-added products. This study proposes a new procedure for producing CQDs using DMEM-based cell culture medium waste. The aim is to evaluate whether biological waste can be used as a functional precursor in CQD synthesis and to characterize the optical and biological properties of the obtained nanostructures. The synthesis was carried out using an environmentally friendly hydrothermal method under different conditions. The produced CQDs were examined for their absorption properties using UV-vis spectroscopy to determine their absorption characteristics, and their emission behavior was confirmed using fluorescence spectroscopy. Optical stability was monitored for 30 days in dark and light conditions, and no significant decrease in emission intensity was detected. Structural characterization was performed using TEM imaging. For biological evaluation, cytotoxicity studies were performed on different cell lines using the MTT assay. Cell viability was measured at varying concentrations, and the results indicated no significant toxicity at low and moderate doses. These findings point to the potential for safe use of waste-based CQDs in biomedical applications. Overall, the findings demonstrate that CQDs with strong optical stability and low cytotoxicity can be successfully synthesized from cell culture waste. This approach contributes to sustainable nanomaterial production by reducing material costs, minimizing waste, and decreasing environmental impact.

Keywords:
Carbon Quantum Dots, Cell Culture Waste, Fluorescence, Cytotoxicity, Sustainable Nanomaterials.

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Perceptions of Artificial Intelligence in Turkey: A Descriptive Analysis of TGSS Data

Esra Çelik[1]

[1] Department of Industrial Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *esraaclk64@gmail.com*

Abstract

This study examined public perception of artificial intelligence across Türkiye using open-access data from the 2024 Turkish General Social Survey (TGSS). To this end, the increasing role of artificial intelligence in every field was addressed, and studies on artificial intelligence perception across the country were reviewed. In this context, the analysis and presentation of the data used with a large sample distinguishes the study from other studies. The study then provides information about the participants, dependent, and independent variables, utilizing the TGSS platform and the Veri Analiz Okulu (Data Analysis School) lecture notes where the data is shared. To evaluate the results, firstly frequency and percentage distributions were analyzed, then variance analysis, chi-square analysis, t-test, post hoc, and Tukey tests were conducted to examine how perceptions of artificial intelligence varied across independent variables and whether significant differences emerged. Based on the results, the general trend in perceptions of artificial intelligence and its differences across independent variables were interpreted. Accordingly, significant differences in perceptions of artificial intelligence were observed across demographic variables. Finally, the study's similarities and differences with other studies in the literature, as well as its limitations and strengths, are discussed.

Keywords:

Artificial Intelligence, Perception, Statistical Analysis, TGSS

Optical and Biological Properties of Carbon Quantum Dots Synthesized from Daucus Carota Ssp. Sativus Var. Atrorubens Extract

Aslı Yılmaz[1], Ezo Palavan[2], Mehmet Yılmaz[3]

1 Departmant of Chemical Engineering, University of Michigan, Ann Arbor, MI // Department of Molecular Biology And Genetics, Faculty of Science , Atatürk Üniversity, Erzurum, Türkiye
2 Department of Molecular Biology and Genetics, Faculty of Science, Atatürk University, Erzurum, Türkiye
3 Departmant of Chemical Engineering, University of Michigan, Ann Arbor, MI // Department of Chemical Engineering, Faculty of Engineering, Atatürk Üniversity, Erzurum, Türkiye

Corresponding Author: *ezo.palavan19@ogr.atauni.edu.tr*

Abstract

Carbon quantum dots (CQDs) are carbon-based new class of fluorescence materials with a particle size of less than 10 nm. CQDs represent strong fluorescence properties, chemical inertness, high solubility in water, and biocompatibility. With these unique properties, they have been employed in various applications including the bioimaging, biosensing, diagnosis and treatment. A myriad of materials, from pure organic compounds to waste products, have been utilized as initiators in the synthesis of CQDs. Despite the recent progress, novel initiators and procedures are highly demanded fort he fabrication of CQDs. Daucus carota ssp. sativus var. atrorubens is the botanical name for the black carrot, commonly known as "purple carrot" or "black/purple cultivar of the edible carrot." This variety is especially rich in anthocyanins, giving it the deep purple/black color. It is nutritionally superior to typical carrots due to high anthocyanin content and strong antioxidant properties. The black carrot provides unique characteristics in cardiovascular, anti-inflammatory, anti-diabetic, neuroprotective, and anticancer applications. The primary objective of this study is to evaluate the extract obtained from the black carrot plant, a natural and sustainable resource, as a carbon source in CQD synthesis. The aim is to thoroughly investigate the optical properties and interaction with biological systems of the CQD obtained through the green synthesis process using the hydrothermal method.The structural and optical properties of the CQD synthesized within the scope of the study were determined using characterization techniques such as UV-vis spectroscopy, TEM, fluorescence spectroscopy, and zeta potential measurements. Subsequently, the biocompatibility, cytotoxic effect, and intracellular localization potential of these particles were evaluated through cell culture studies. CQDs demonstrated high fluorescence activity with high biocompatibility and low cytotoxicity. In conclusion, black carrot-based CQDs via an environmentally friendly green synthesis provided high potential in the biological applications.

Keywords:

Carbon Quantum Dot, Black Carrot, Green Synthesis, Biological Applications

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Effect of Using a Vertical Heat Exchanger on Performance in a Vapor Compressıon Heat Pump Using R417a Gas as an Alternatıve to R22

Fadime Şimşek[1]

[1] Department of Mechanical Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *fadimesimsek@atauni.edu.tr*

Abstract

In this study, a vertical shell-type heat exchanger was used as the superheating-cooling unit in a vapor-compression heat pump. R417A gas was selected as the refrigerant, requiring no additional modifications to the system. The ambient temperatures of the condensers and evaporators used in the system were 22℃ and 15℃, respectively, and the airflow velocities were 3.7 m/s and 4.6 m/s, respectively. After the system stabilized, the calculated COP values from the obtained data were examined. It was observed that using a vertical heat exchanger with a 6 mm finned spaced evaporator increased system performance by 16.43% compared to using a vertical heat exchanger with an 8 mm finned spaced evaporator.

Keywords:

R417A, Shell Type Heat Exchanger, COP

Performance Assessment of Rermoelectric Cooling Applied to Photovoltaic Panels

Muhammet Harun Osta[1]

[1] Department of Mechanical Engineering, Faculty of Engineering, Ataturk University, Erzurum, Türkiye

Corresponding Author: *harun.osta@atauni.edu.tr*

Abstract

This study experimentally investigates the performance of a finned thermoelectric cooling structure designed to mitigate power losses in photovoltaic (PV) panels caused by temperature rise, as well as the effect of forced airflow applied to enhance heat dissipation from its hot side. Under standard test conditions, PV panels generate maximum power at a cell temperature of 25 °C, and any increase beyond this value leads to power degradation. Accordingly, the effects of the finned thermoelectric cooling system on panel temperature and power output were evaluated over 18-minute test periods. The results indicate that cooling provided by the thermoelectric module and fins can only delay the onset of power loss, while the addition of forced airflow over the fins offers a limited further improvement by enhancing heat rejection. Nevertheless, the overall cooling capacity remained insufficient to fully counteract the thermal load on the PV panel, and the power loss could not be completely prevented. These findings demonstrate that thermoelectric-based cooling alone is inadequate for PV applications and highlight the need for further optimization of fin geometry and airflow conditions.

Keywords:

Thermoelectric Cooling, Photovoltaic Panel, Heat Sink, PV Power, Wasted Heat

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Synthesis and Characterization of Ni-Doped \nO Nanorods for Potential Use in Solar Cells

Thanies Murugan[1], Faiz Arith [2]

1 Graduate Student, Universiti Teknikal Malaysia Melaka
2 Faculty of Electronics and Computer Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, 76100, Melaka, Malaysia

Corresponding Author: *thaniesscout@gmail.com*

Abstract

Perovskite solar cells (PSCs) are a leading candidate for next-generation photovoltaic technology, offering high-power conversion efficiency (PCE) and cost-effective fabrication. While is conventionally used as the electron transport layer (ETL), its required high-temperature crystallization (450) severely limits its integration into flexible devices built on heat-sensitive substrates. The growing demand for flexible and wearable energy harvesters necessitates the development of alternative low-temperature ETL materials. Zinc oxide nanorods (ZnO NRs) are a promising substitute due to their low-cost, low-temperature synthesis, high electron mobility, and aligned nanostructure. However, pristine ZnO often suffers from intrinsic defect states that hinder charge extraction and reduce PCE. To address this, we investigated nickel (Ni) doping as a strategy to modify the electrical and structural properties of ZnO. In this study, Ni-doped ZnO NRs were synthesized via a low-temperature hydrothermal growth method with varying Ni concentrations (0, 1, 3, and 5 mol%) and growth durations (5 and 9 hours) at 100C. Their structural, morphological, and optical properties were thoroughly analyzed using XRD, EDX, FESEM, and UV–Vis spectroscopy. Photovoltaic performance was assessed via current–voltage (I–V) characterization. The results demonstrate that controlled Ni incorporation successfully improved crystallinity, suppressed defect density, and significantly enhanced electron transport. This led to a marked increase in PCE compared to devices utilizing undoped ZnO. This research establishes Ni-doped ZnO NRs as a promising, low-temperature, and cost-effective ETL material for high-efficiency flexible PSCs. These findings offer valuable insights for developing scalable and energy-efficient photovoltaic devices critical for advancing flexible electronics and sustainable energy applications.

Keywords:
Nickel, Zinc Oxide, Nanorods, Nanowalls, Nanoflower, Nanostrctrue, Hydrothermal

Re Study and Methodological Support for the Development of Natural Science Competencies in 5th-Grade Students of Secondary School No. 117 Named After Ch. Aitmatov in Bishkek

Gulnara Sharshenalieva[1], Almagul Tursunbek Kyzy [1], Nurzhamal Omurzakova [2]

1 Department of General Biology and Technology of its Teaching, Institute of Natural Sciences, Kyrgyz State University named after I. Arabaev, Bishkek, Kyrgyz Republic

2 Faculty of Sciences Department of Biology, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *sharshenalieva@mail.ru*

Abstract

This study addresses the urgent necessity of creating effective pedagogical and methodological tools to enhance students' thinking structures and natural science competencies (NSCs) within modern education. Highlighting contradictions between National Education Standards and students' low competency levels, the research aims to provide a theoretical justification and experimental verification of a new methodological support system for 5th-grade students.

The research conducted diagnostic, formative, and control experiments involving 56 students (Control Group, n=28; Experimental Group, n=28) at Ch. Aitmatov Secondary School No.

117 in Bishkek. Initial diagnostics revealed that a majority of students across both groups possessed medium to low levels of cognitive activity and environmental culture. To address this, the study developed and implemented a new methodological framework centered around the "situational–event participation" method. This four-stage model focuses on integrating topics into real-life events, creating motivational engagement, promoting productive (interactive) activity, and concluding with analytical reflection. Post-experiment results demonstrated a significant positive dynamic in the Experimental Group compared to minimal changes in the Control Group. Specifically, the number of students in the Experimental Group demonstrating a high level of competence development increased dramatically (from 18% to 36%), while the number of students at the low level decreased by 41% (from 46% to 7%). The study successfully clarified the concept of NSCs for 5th graders and proved the high effectiveness of the event-participation method in enhancing student engagement, subject knowledge, and ecological awareness. The developed materials offer a practical resource for biology teachers and are adaptable for other middle and upper grades.

Keywords:

Natural Science Competencies, Methodological Support, Event-Participation Method, 5th Grade Education, Inquiry Skills

Zinc Oxide Nanostructure Buffer Layers for Improved Charge Transport and Efficiency in DSSC

Juraina Md Yusof[1], Suhaidi Shafie [2], Mohd Ali Mat Nong [3], Ismayadi Ismail [4], Yusnita Yusuf [5]

1 Functional Nanotechnology Devices Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, Malaysia
2 Departmentof Electrical and Electronics, Faculty of Engineering, Universiti Putra Malaysia, Malaysia
3 Functional Nanotechnology Devices Laboratory (FNDL), Institute of Nanoscience and Nanotechnology Universiti Putra Malaysia, Serdang, Selangor, Malaysia.
4 Nanotechnology Synthesis and Characterization Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, Malaysia
5 Functional Nanotechnology Devices Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, Malaysia

Corresponding Author: *juraina@upm.edu.my*

Abstract

Dye-sensitized solar cells (DSSCs) are among the most promising low-cost alternatives to silicon-based solar cells, offering substantial power conversion efficiency due to their compact size, ease of preparation, and high resistance and sensitivity to weather changes. Recent technological advancements have shifted toward flexible, versatile, and portable electronics, as well as simpler device fabrication. A DSSC consists of a photoanode that includes a transparent conducting material and a semiconducting layer. The semiconducting layer, which adsorbs dye molecules, plays a crucial role in determining the power conversion efficiency. Its efficiency strongly depends on optimal charge transport and sufficient surface area for dye adsorption within the photoanode. One of the key challenges is engineering zinc oxide (ZnO) nanostructured buffer layers that simultaneously enhance electron mobility, increase dye-loading capability, and reduce recombination losses. In this work, zinc oxide nanorods (ZNRs) were synthesized using buffer layer patterning times of 4 and 8 minutes to investigate the influence of deposition duration on the resulting morphology, crystallinity, and photovoltaic performance of DSSCs. The growth of the nanorods was mediated by a plasma induced buffer layer for growth patterning. The ZNRs exhibit excellent properties such as high porosity, large surface area, surface roughness, and high electrical conductivity which are suitable for improving dye adsorption and enhancing charge transfer mobility. Current and voltage measurements under 1000 W/m² illumination show that the DSSC fabricated with the 4 minutes ZnO buffer layer achieves a higher efficiency than the 8 minutes sample. These results demonstrate that optimizing the ZnO buffer layer deposition time, particularly through shorter durations, can significantly improve charge transport and overall DSSC performance.

Keywords:

Dye Synthesized Solar Cells, Zinc Oxide Nanostructures, Semiconductive Layer, Solar Cell Photoanode

Analysis of the RL Circuit Using Physics-Informed Neural Network (PINN) Method

Peruzet Aydın[1], Bilal Usanmaz [2]

1 Department of Computer Engineering, Institute of Science, Atatürk University, Erzurum, Türkiye
2 Department of Computer Engineering, Faculty of Engineering, Ataturk University, Erzurum, Türkiye.

Corresponding Author: *peruzetaydin@gmail.com*

Abstract

Physics-Informed Neural Networks (PINNs) are a deep learning approach that directly integrates the differential equations governing physical systems into the learning process of artificial neural networks. This method is increasingly preferred in engineering applications due to its low data requirements and its ability to produce more consistent results by embedding physical laws within the model. An RL circuit, on the other hand, consists of a resistor (R) and an inductor (L) connected in series, where the current responds to sudden changes due to the influence of the magnetic field. Accurately modeling how the current changes over time in such circuits is crucial for understanding their dynamic behavior. In this study, current–time data obtained from simulation results were used. The PINN method was applied to predict the time-dependent current response of a DC-powered RL circuit. The differential equation describing the circuit was directly incorporated into the PINN model's loss function; both the ODE loss and the initial condition loss (i(0) = 0) were employed to ensure the model's accuracy. The regular decrease of the loss function throughout the training process indicated that the model increasingly approached the analytical solution with each iteration. Notably, by the 5000th epoch, the loss value had dropped to 0.11, demonstrating that the PINN achieved a stable solution. The initially high error gradually decreased and approached minimum values, confirming that the model successfully learned the physical behavior of the system. During training, the model was first trained using the Adam optimization algorithm and then further optimized with the LBFGS method to obtain a more precise solution. This two-stage process enabled the model to reach the correct solution more quickly and reliably. The findings show that PINNs reliably model physical systems and can be effective for analyzing complex circuits or dynamic systems.

Keywords:
RL Circuit, Physics-Informed Neural Networks (PINN), Neural Networks

Remediation of Heavy Metal and Dye Pollution in Kyrgyzstan Using Nanotechnological and Biological Methods

Fatma Melike Yeşilyurt[1]

[1] Department of Biology, Faculty of Science, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyz Republic

Corresponding Author: *melikeyesilyurt08@gmail.com*

Abstract

Industrial and mining industries cause heavy metal and chemical pollution in many regions around the world. Synthetic dyes are an example of chemical pollutants and pose a threat to the environment due to the aromatic rings, azo bonds or metal complexes they contain. Kyrgyzstan is a country in Central Asia consisting largely of mountainous areas. Since the Soviet era, it has become a significant center for minerals such as gold, uranium and mercury. The chemical processing agents used in these mines contain synthetic reagents, metal complex dyes and heavy metals. The country's economy currently relies heavily on mining. Inadequate treatment means that the textile and leather industries can release azo and reactive dyes directly into the environment. Regional water systems, which are mountainous and composed of closed basins, cannot sufficiently dilute these pollutants, thereby increasing the environmental risk. These pollutants degrade very slowly in the natural environment, forming toxic by-products. New, sustainable, environmentally friendly biological and nanotechnological methods can eliminate these pollutants that accumulate in nature. Biological methods such as biosorption, bioaccumulation, microbial reduction and bioremediation can eliminate accumulated chemical pollution via environmentally friendly processes. These methods work by actively absorbing pollutants into cells, converting toxic substances into harmless ones or accumulating them within organisms. Additionally, nanomaterials can bind metal ions due to their large surface area, reduce heavy metals using light energy, or convert them into less toxic forms. Nanotechnological methods, such as nanoadsorbents, nanocomposite filters, nanophotonics and photocatalytic applications, can clean aqueous environments. Biological and nanotechnological applications are expected to contribute to environmental sustainability

Keywords:

Heavy Metals, Dye Removal, Biotechnology, Nanotechnology, Kyrgyzstan

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Traditional Arts and Mathematics

Aydan Akkök[1]

1 Department of Traditional Handicrafts, Vocational School of Technical Sciences, Atatürk University, Erzurum, Türkiye

Corresponding Author: *aydan.akkok@atauni.edu.tr*

Abstract

When we look at traditional arts, we see that throughout history, they have been shaped not only by aesthetic concerns but also by specific mathematical principles and ratio systems, creating a unique field of expression where science and art intertwine. The concepts of rhythm, repetition, symmetry, proportion, and order seen in Turkish-Islamic arts such as calligraphy, illumination, miniature, tile-making, marbling, and geometric ornamentation are concrete examples of the invisible yet decisive influence of mathematics on the visual field. The purpose of this paper is to uncover the mathematical structure underlying traditional arts and to evaluate the aesthetic and technical functions of these structures in artistic production. In calligraphy, the measurements, angles, and line arrangement of letters are based on strict rules. The proportions between letter lengths, particularly in Thuluth and Naskh script, are created according to a specific geometric system. In illumination art, the construction of hatai, rumi, penç, and geometric interlaced motifs is shaped by the Golden Ratio, axes of symmetry, and polygonal-based divisions. Circle, star, and polygonal arrangements are transformed into repetitive surfaces that evoke a sense of infinity through digital multiplication methods. The concept of multiple perspective used in miniature art is created by placing figures and spatial distributions within a mathematical order. In tile art, octagonal, decagonal, and hexagonal interlaces create geometric systems that provide surface continuity through a fractal-like growth logic. The techniques of division, folding, symmetry transformations, and proportioning used in the creation of traditional patterns parallel contemporary design mathematics. Consequently, mathematics in our traditional arts is not only a creator of order but also an aesthetic and visual language. This study aims to reveal the scientific structure behind artistic production by evaluating the fundamental formations of traditional arts and mathematics from an interdisciplinary perspective.

Keywords:

The Art, Aesthetics, Harmony, Golden Ratio, the Mathematics

Effect of Temperature on the Structural and Rermal Properties of Perna Viridis Shells

Rosnah Nawang[1], Mohd Zobir Hussein [2]

1 Nanomaterial Syntesis and Characterization Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, Serdang Selangor, Malaysia
2 Faculty of Dentistry, Brawijaya University, Malang, Indonesia

Corresponding Author: *rnawang@upm.edu.my*

Abstract

This study investigates the structural, compositional, and thermal transformations of Perna viridis (PVS) shells heated at 100, 500, and 1000 ℃ using FTIR, XRD, and TGA/DTG analyses. The FTIR spectra of the raw shell reveal the presence of adsorbed water, organic matrix components, and calcium carbonate in the aragonite form. Heating at 500 ℃ induces a clear phase transition from aragonite to calcite. Calcination at 1000 ℃ results in the appearance of CaO, $Ca(OH)_2$, and residual $CaCO_3$, reflecting the decomposition of $CaCO_3$ followed by the rapid rehydration and re-carbonation of CaO upon exposure to atmospheric moisture and CO_2. XRD patterns corroborate these observations, showing predominantly aragonite in the raw sample, calcite at 500 ℃, and portlandite as the major phase at 1000 ℃, with a minor amount of calcite. TGA/DTG analysis reveals three main weight-loss events corresponding to the release of adsorbed water, the decomposition of organic components, and the major thermal decomposition of $CaCO_3$ between 531–916 ℃. Overall, the combined FTIR, XRD, and TGA findings demonstrate significant mineralogical transformations in Perna viridis shells upon high-temperature treatment, highlighting their potential as a biogenic precursor for CaO production and related calcium-based material applications.

Keywords:

Perna Viridis; Calcium Carbonate; Phase Transformation; FTIR; XRD; Thermogravimetric Analysis

Classification of Biomaterials and Reir Biomedical Applications

Abbas Razmi[1]

1 Independent Researcher, Erzurum, Türkiye

Corresponding Author: *abbasrazmi@hotmail.com*

Abstract

Biomaterials are extensively employed in medical implants owing to their remarkable biocompatibility and resistance to corrosion. These materials offer a robust foundation for various coating applications, among which hydroxyapatite is particularly notable due to its close chemical similarity to natural bone tissue, ensuring superior biocompatibility. A wide array of materials is currently developed or utilized as biomaterials for tissue regeneration and replacement in the human body. For instance, metal-based biomaterials such as stainless steel, titanium, and cobalt alloys are widely applied for bone restoration. Similarly, ceramic biomaterials are used in dental applications, including crowns, cements, and dentures. Synthetic polymers such as PEG, PLGA, and PMMA are employed in soft biomaterial applications, ranging from facial prostheses and tracheal tubes to contact lenses and medical adhesives. Moreover, natural polymers including collagen, fibrinogen, hyaluronic acid, and elastin demonstrate high efficacy in soft tissue engineering due to their specific amino acid sequences that interact with host cells, thereby initiating biochemical signals responsible for cell migration, proliferation, and differentiation that facilitate tissue repair and integration. Additionally, composite materials, such as fiber-reinforced and carbon nanotube-polymer composites, are increasingly explored for their lightweight nature and customizable mechanical properties, making them ideal for applications at the hard-soft tissue interface. The primary consideration in selecting suitable biomaterials lies in their compatibility with human physiology, ensuring long-term functionality without inducing adverse immune responses. Thus, biomaterials must be free from harmful effects such as injury, cytotoxicity, genotoxicity, mutagenicity, carcinogenicity, or immunogenicity, while effectively fulfilling their intended therapeutic role and eliciting a favorable cellular or tissue response.

Keywords:

Biomaterials, Biocompatibility, Cytotoxicity

Demand Prediction in Textile Production: A Machine Learning-Based Approach

Mucize Beldek Tomuk[1], Şerafettin Alpay [1]

[1] Department of Industrial Engineering, Department of Production and Service Systems, Faculty of Engineering and Architecture, Eskisehir Osmangazi University, Eskişehir, Türkiye

Corresponding Author: *mucizebeldek@gmail.com*

Abstract

Demand fluctuations and increasing product variety make production planning a significant challenge in the textile industry. In environments where parallel machines operate with varying capacities and sequence-dependent setup requirements, accurate demand forecasting becomes essential for establishing realistic schedules and improving resource utilization. This study focuses on developing a reliable machine learning–based demand forecasting model to support these planning decisions. The research uses monthly sales data obtained from a textile manufacturer in Türkiye. Several regression algorithms, including Random Forest, Gradient Boosting and CatBoost, were examined to determine the most effective method for predicting future demand. The dataset was enriched through feature engineering by incorporating seasonal indicators, lagged demand variables and trend components. All models were evaluated using repeated cross-validation to ensure stable performance and to prevent overfitting. Model accuracy was assessed through widely used metrics such as RMSE, MAE and R^2. The results indicate that the CatBoost algorithm provides the highest prediction accuracy among the tested models. Its superior performance contributes to clearer demand visibility and supports planners in making more consistent capacity allocations. Improved forecasts also help reduce bottlenecks related to setup times and enable more balanced machine loading. Overall, the proposed model offers a practical, data-driven approach for textile manufacturers to improve production planning. It also lays the groundwork for a broader study, where the demand forecasts will be used as inputs in developing an optimization model for parallel machine scheduling with sequence-dependent setup times. By integrating accurate forecasts into scheduling decisions, this approach helps reduce bottlenecks, ensures more balanced machine utilization, and strengthens overall planning reliability.

Keywords:

Machine Learning, Demand Forecasting, Textile Industry, Regression Models, Production Optimization

Alternative Wing Designs for UAVs

Hüseyin Gündüz[1], Hamit Akbulut [1]

[1] Department of Mechanical Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *gunduz28huseyin@gmail.com*

Abstract

Composite materials have become increasingly important in aerospace and automotive applications due to their high specific strength, corrosion resistance, superior fatigue properties, and inherent vibration damping capabilities. These advantages make them particularly suitable for lightweight structural components where performance, durability, and efficiency are critical design factors. In unmanned aerial vehicles (UAVs), the use of composite structures is particularly attractive because weight reduction directly contributes to increased flight time, improved maneuverability, and reduced energy consumption. This study investigates the structural behavior of a hybrid composite-metallic UAV wing configuration using finite element analysis in the ANSYS Workbench environment. The wing model integrates carbon fiber reinforced polymer (CFRP) coatings with metallic beams and ribs to provide an optimized balance between stiffness, strength, and manufacturability. Static loading, aerodynamic pressure distributions, and material-specific failure criteria are evaluated to assess the overall structural integrity of the design. Modal analysis is also performed to determine the inherent frequencies and potential resonance risks associated with UAV operational conditions. The results provide information on stress concentration regions, deformation characteristics, and the contribution of composite layers to the overall stiffness increase. Comparisons between fully metallic and hybrid configurations highlight the performance advantages and weight savings achieved through composite integration. The findings demonstrate that the hybrid composite-metallic architecture increases structural efficiency while maintaining rigidity under expected service loads. This study contributes to the development of lightweight, high-performance UAV structures and provides guidance for future design optimization and material selection.

Keywords:

Composite Materials UAV (Unmanned Aerial Vehicle) ANSYS Workbench Structural Analysis Mechanical Behavior

Hydrogeochemistry, Petrography, and Groundwater Quality in the Waru–Apo Area (Abuja FCT, Nigeria)

Hairat Abubakar[1], B.S Jatau [1], I.Y. Tanko [1], Sadiq Abdulmaliqq [1]

[1] Department of Geology and Mining, Nasarawa State University, Keffi, Nigeria

Corresponding Author: *hairatbanaru@hotmail.com*

Abstract

This study presents an integrated geologic, petrographic and hydrogeochemical assessment of groundwater resources in the Waru area of Apo (FCT), Abuja, North-Central Nigeria. The objective was to characterize lithological units, evaluate groundwater chemistry, determine heavy metal concentrations and assess potential environmental and health implications. Field mapping and petrographic analyses established migmatite, granite gneiss, biotite gneiss and anatectic granite as the dominant basement lithologies, with deformation features such as joints, folds and quartz veins promoting groundwater circulation and enhancing aquifer vulnerability. Twenty-two groundwater samples obtained from streams, hand-dug wells and boreholes were analysed using Atomic Absorption Spectroscopy in order to quantify major cations, anions and trace metals. The concentrations of chromium (0.046–0.236 mg/L), cadmium (0.034–0.121 mg/L) and lead (0.003–0.023 mg/L) exceed World Health Organization (WHO) and Nigerian Standard for Drinking Water Quality statutory limits in several locations, indicating localized contamination. Hydrochemical evaluation revealed Na–SO4, and Na–Mg–SO_4 water types, which reflect dominant ion-exchange processes, sulphate dissolution and contributions from rock weathering. Application of Nemerow's Pollution Index, Contamination Factor and Pollution Load Index indicated low-to-moderate pollution levels in most samples, although localized anomalies were observed particularly in areas proximal to abattoir and domestic waste zones. Elevated trace-metal values correlate with both geogenic release from basement rock weathering and anthropogenic inputs associated with abattoir effiuent, agricultural practices and waste disposal. The health implications of observed Cr, Cd and Pb levels include carcinogenic and neurotoxic risks, especially for vulnerable populations dependent on shallow wells. The study underscores the need for improved groundwater monitoring, stricter regulation of abattoir waste disposal and the provision of safer potable-water alternatives in rapidly expanding peri-urban settlements of Abuja.

Keywords:
Groundwater Quality, Hydrogeochemistry, Petrography, Heavy Metals, Pollution Indices, Waru, Abuja

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Prevention and Mitigation Strategies for Sinkholes Using Soil Improvement Techniques

Hamed Niroumand[1]

[1] Department of Geotechnical and Hydraulic Engineering, Faculty of Civil and Environmental Engineering, Gdansk University of Technology, Gdansk, Poland.

Corresponding Author: *niroumand.mrud@gmail.com*

Abstract

Sinkholes are a global challenge, and several countries are affected by them. Timely identification of sinkholes and monitoring of subsurface soil conditions are highly important. However, the main challenge for different countries lies in the methods of preventing and mitigating sinkholes. Accordingly, considering the distribution of sinkholes in various countries, this paper addresses the methods of sinkhole prevention and mitigation. The main approach in this paper is the use of soil improvement techniques in relation to sinkholes.

Keywords:

Sinkholes, Soil Improvement, Prevention Strategy

Unim-R Polyherbal Oil: Efficacy and Safety Assessment in Carrageenan and CFA-Induced Arthritis with Cytokine Profiling

Pawan Sharma[1], Binita Mandal [1], Falek Bamme [1], Nikhat Shaikh [2], Tabassum Khan [3], Ahmad Ali [4]

[1] Department of Life Sciences, University of Mumbai, Vidyanagari, Mumbai 400098, India
[2] Regional Research Institute of Unani Medicine, Kharghar, New Mumbai 410210, India
[3] Department of Pharmaceutical Chemistry & Quality Assurance, SVKM's Dr. Bhanuben Nanavati College of Pharmacy, Vile Parle(W), Mumbai 400056, India
[4] Department of Life Sciences, University of Mumbai, Vidyanagari, Mumbai, India

Corresponding Author: *ahmadali@mu.ac.in*

Abstract

Arthritis is a chronic inflammatory condition that demands safer and more effective therapeutic alternatives. The present study investigated the anti-arthritic potential of UNIM-R, a polyherbal dermal oil formulated using Eucalyptus globulus oil, Ferula asafoetida resin, Matricaria chamomilla stem, Styrax benzoin resin, and Sesamum indicum seeds. The formulation was evaluated in carrageenan-induced paw oedema and Complete Freund's Adjuvant (CFA)-induced arthritis models in rats. Acute and chronic dermal toxicity studies were conducted in accordance with OECD guidelines to assess safety. In the CFA model, post-treatment profiling of key inflammatory biomarkers included TNF-α, IL-10, IFN-γ, hyaluronic acid, and PGE2. UNIM-R significantly attenuated carrageenan-induced oedema and improved clinical and biochemical indicators of inflammation in the CFA model. Cytokine analysis revealed marked suppression of pro-inflammatory mediators (TNF-α, IFN-γ, PGE2, hyaluronic acid) alongside an increase in the anti-inflammatory cytokine IL-10. The therapeutic response was comparable to standard diclofenac gel, demonstrating robust anti-inflammatory and immunomodulatory activity. Toxicity evaluations confirmed the absence of adverse dermal reactions, supporting its safety for topical application. These findings position UNIM-R as a promising polyherbal dermal intervention for arthritis management.

Keywords:

Polyherbal Formulation, Anti-Arthritic, CFA Model, Cytokine Modulation, OECD Toxicity Assessment

Optical Properties of a Novel Pyrazoline Derivative in Diverse Micelle Systems

Ebru Bozkurt[1], Halise Inci Gül[2], Cem Yamali[3], Turgut Seckin Gül[4]

1 Department of Occupational Health and Safety, Vocational School of Technical Sciences, Atatürk University, 25240, Erzurum, Türkiye
2 Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Ataturk University, Erzurum, Turkey
3 Department of Basic Pharmaceutical Sciences, Faculty of Pharmacy, Cukurova University, Sarıçam, Adana, Turkey
4 Department of Pharmacology, Faculty of Medicine, Ataturk University, Erzurum, Turkey

Corresponding Author: *ebrubozkurt@atauni.edu.tr*

Abstract

Pyrazoline is an important heterocyclic compound containing two adjacent nitrogen atoms and an endocyclic double bond. These derivatives possess a broad spectrum of biological activity, including antibacterial, anticancer, antitumor, anti-HIV, and anti-inflammatory activities. They generally exhibit blue fluorescence with high quantum yield in solution due to their intramolecular charge transfer properties. These strong fluorescence properties have led to their widespread use in materials science applications such as hole transfer materials, organic light-emitting diodes, dye-sensitized solar cells, electroluminescence, and optical limiters. Micelles are supramolecular structures formed by the spontaneous aggregation of surfactant molecules, particularly in aqueous environments. In a typical micelle structure, hydrophilic head groups interact with water, while hydrophobic tails are located in the interior, leading to the formation of nano-aggregates of various sizes and morphologies. These aggregates are mostly spherical, but ellipsoidal, cylindrical, or bilayer structures are also observed. In general, micelle systems are microheterogeneous two-phase colloidal systems and appear macroscopically homogeneous due to their colloidal dimensions. Aggregation occurs only under critical micelle concentration (CMC) and Kraft temperature conditions. In this process, hydrophobic interactions are considered the primary driving force, and these effects arise from the competition between hydrogen bonds of the interface and bulk water. In this study, a novel pyrazoline derivative, 4-(5-phenyl-3-(thiophen-2-yl)-4,5-dihydro-1H-pyrazol-1-yl) benzenesulfonamide (**TP1**), was synthesized and its optical behavior was investigated in different micelle structures. For this purpose, micelles were prepared using cationic (Cetyltrimethylammonium bromide, CTAB), anionic (Sodium dodecyl sulfate, SDS), and nonionic (Tween 80, T80) surfactants at different concentrations. Absorbance and fluorescence measurements of **TP1** were performed in all micelle structures prepared at room temperature.

Keywords:
Pyrazoline, CTAB, SDS, T80, Flourescence

A Nature-Based Healing Approach: Horticultural Rerapy Gardens

Aslihan Esringü[1], Feyza Gündoğdu[2]

[1] Department of Landscape Architecture, Faculty of Architecture and Design, Atatürk University, 25249 Erzurum, Türkiye
[2] Graduate Student

Corresponding Author: *esringua@atauni.edu.tr*

Abstract

Today, with increasing urban life and the isolation brought about by digitalization, the number of physical and mental illnesses is rapidly increasing. Furthermore, the fact that the proportion of disabled individuals in the global population is approximately 16%, and in Turkey it is at 10-13% level, clearly demonstrates the need for innovative, inclusive, and accessible landscape designs that support the development of physical, cognitive, emotional, and social skills of individuals with special needs. In this context, horticultural therapy gardens (HTGs), which are among nature-based solutions, have an important role to play. HTGs utilize the healing power of interaction with nature through a systematic approach. Through processes such as plant cultivation, contact with soil, interaction with sensory stimuli, and participation in garden activities, HTGs reduce stress levels, increase psychological resilience, and encourage social participation. While HTGs are not widely used in many institutions and spatial planning processes today, they can be applied in a wide variety of settings, from rehabilitation centers and educational institutions to hospitals and nursing homes. This study aims to reveal the role of horticultural therapy gardens in nature-based healing processes, evaluate their design principles, and scientifically examine their therapeutic effects on different user groups. The study evaluates how HTGs should be designed for a wide variety of purposes, the benefits they provide to different user groups (individuals with disabilities, the elderly, chronic patients, individuals receiving psychological support, stress-related risk groups, etc.), and which components enhance the therapeutic effect, through a literature review and national and international case analyses. In conclusion, this study demonstrates that HTBs are not only an aesthetic landscape element but also a critical landscape component supporting physical, mental, and social health in cities. The goal is to strengthen public health, improve quality of life, and create sustainable, inclusive healing spaces by promoting this approach.

Keywords:

Horticultural Therapy Garden, Nature-Based Healing, Individuals with Disabilities, Landscape Planning, Healthy City

Examination of the Effect of Genistein on CD36 Lipid Receptor and Lipid Profile in Liver Cancer Cell Line

Ebru Kılıç[1], Fatma Betül Özgeriş[1]

[1] Faculty of Health Sciences, Department of Nutrition and Dietetics, Atatürk University, Erzurum, Türkiye

Corresponding Author: *ebru.kilic@atauni.edu.tr*

Abstract

This study aimed to evaluate the effects of Genistein, an isoflavone antioxidant found in soy, on liver cancer (HepG2) and healthy (HDF) cells by assessing its influence on antioxidant activity, cell viability, and CD36-mediated lipid transport. Cells were cultured and prepared for treatment. Cell viability was measured using the MTT assay. CD36 levels were quantified with a CD36 ELISA kit. Antioxidant parameters—including SOD, GSH, MDA, MPO, and GPx—were analyzed using corresponding biochemical assays. Genistein treatment (6.25–200 µg/mL, 48 h) showed a dose-dependent reduction in HepG2 cell viability. Although low concentrations (6.25–25 µg/mL) did not reduce viability below 50%, higher concentrations (50–200 µg/mL) demonstrated significant anticancer activity, decreasing viability below 50% (IC50: 35.34 ± 0.924 µg/mL). Methotrexate (MTX), used as a positive control, showed a similar pattern with an IC50 of 24.35 ± 0.681 µg/mL. ELISA results revealed that Genistein more effectively increased CD36 expression in HepG2 cells compared to MTX ($p=0.002$) *and the control* ($p<0.001$). *MTX also showed increased CD36 expression versus control* ($p<0.001$). *In HDF cells, both Genistein* ($p=0.002$) *and MTX* ($p=0.048$) elevated CD36 levels relative to control. Antioxidant analyses showed that MTX significantly elevated MDA levels in HepG2 cells ($p=0.031$), *whereas Genistein significantly increased GPx levels in HDF cells* ($p<0.001$*). Genistein exhibits therapeutic potential in HepG2 liver cancer cells. It modulates CD36 and MDA expression, reducing lipid accumulation, while in HDF cells it affects CD36 and GPx activity. These findings suggest that Genistein may contribute to lipid regulation and oxidative balance in both cancerous and healthy cells.

Keywords:

cancer, liver, phenolic compound, CD36, lipids

Purification of Exopolysaccharides from Rermophilic Bacillus licheniformis SO2 Strain by Rree-Phase Separation (TPP) System and Determination of Reir in Vitro Biological Activities

Afranur Timur[1], Melda Şişecioğlu [2]

[1] Graduate Student, Atatürk Üniversity
[2] Department of Molecular Biology and Genetics, Faculty of Science, Ataturk University, Erzurum, Türkiye

Corresponding Author: *afranurtimur.uni@gmail.com*

Abstract

Exopolysaccharides (EPS) are macromolecules with structural diversity that play important roles in various biological processes. EPSs obtained from natural sources such as plants, algae, fungi, and bacteria exhibit a broad pharmacological spectrum, including antitumor, immunomodulatory, and antioxidant effects. Microbial polysaccharides offer significant advantages over plant or animal polysaccharides due to their sustainable production, rapid proliferation, controllable fermentation conditions, and high purity. In recent years, three-phase separation (TPP) has gained importance as a faster, more economical, and more effective alternative to traditional purification techniques. In this study, EPSs were extracted from grape waste using TPP with the thermophilic Bacillus licheniformis SO2 strain, which was isolated and identified in our laboratory. The antioxidant properties of the extracted polysaccharides were investigated using DPPH and ABTS analyses. TPP conditions were optimized using Response Surface Method (RSM) to obtain the highest yield. EPS was obtained under the following conditions: 40% ammonium sulfate, a homogenate/tert-butanol ratio of 1.0:1.25, and pH 7. Under these optimal conditions, EPS at a concentration of 1 mg/ml demonstrated 88.7% radical scavenging activity against DPPH radicals and 65.7% against ABTS radicals. Based on these data, it is shown that thermophilic, bacterially produced exopolysaccharides isolated using a TPP-based extraction method possess strong antioxidant potential. It is thought that these biomolecules could be used in future pharmaceutical and nutraceutical applications.

Keywords:
Exopolysaccharide, TPP, Response Surface Method (RSM), Bioactive Compounds

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Risk Assessment of Occupational Hazards in Asphalt Production Plants Using the Fine-Kinney Method

Nursu Koyunoğullarından[1], Emine Coruh [2]

1 Institute of Graduate Education, Gumushana University, Gumushane, Türkiye
2 Faculty of Health Sciences, Department of Occupational Health and Safety, Gümüşhane University, Gümüşhane, Türkiye

Corresponding Author: *coruhemine@gmail.com*

Abstract

Occupational accidents have long been recognized as a major social issue. This issue becomes even more pronounced in the industrial and construction sectors, where dynamic workflows, heavy equipment, and hazardous materials create inherently elevated levels of risk. Asphalt plants, where hot-mix asphalt is produced, involve multiple hazards such as high temperatures, bitumen fumes, heavy machinery, and noise. The necessity for effective occupational health and safety (OHS) management in this sector is therefore essential. The objective of this study is to ascertain the potential hazards that could result in occupational accidents within asphalt production facilities, to evaluate the risk levels, and to propose control measures that would enhance the safety of workers. For this purpose, risk analyses were conducted in the asphalt production plant of Erzurum Palandöken Inc. The Fine-Kinney method was employed for risk assessment, which is a process that involves identification, evaluation, and management of potential hazards or risks. Using probability, frequency of exposure, and severity, risks are quantified by this method, with a clear prioritization of unacceptable hazards being provided and safety improvements being guided. The findings suggest that specific operational stages and workplace conditions require enhanced control measures due to their potential to cause serious or undesirable outcomes if adequate preventive action is not taken. These situations may cause severe or even fatal injuries during asphalt production processes. The study is expected to contribute to the development of effective risk control strategies and support the establishment of safer working environments for asphalt industry workers.

Keywords:

Asphalt Production, Fine-Kinney Method, Occupational Health and Safety (OHS), Risk Assessment

Characterization of Annealed and Unannealed Iron-Doped Tungsten Oxide Rin Films Grown by Co-Sputtering

Hilal Kübra Sašlam[1], Sevda Saritaş [2]

1 Department of Electrical and Electronics Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye
2 Department of Electricity Generation, Transmission and Distribution, İspir Hamza Polat Vocational School, Ataturk University, Erzurum, Türkiye

Corresponding Author: *hilalk.saglam@atauni.edu.tr*

Abstract

Nanostructured materials provide high mechanical stability, high strength, and excellent thermal conductivity. However, preparing coherent nanostructures presents challenges. Furthermore, morphological properties vary depending on preparation techniques and experimental parameters. In this study, the structural, optical, and surface properties of iron-doped WO3 structures grown by the RF-DC co-sputtering method were investigated. The sputtering technique was chosen because it is a repeatable, relatively low-cost, and low-surface-roughness film growth technique, and the optical and structural properties of the grown film can be more easily controlled. In spray application, the rate of contamination is lower due to the vacuum environment, and higher quality binary and ternary compounds are produced. Iron-doped WO3 structures were grown using a simultaneous sputtering method. The sputtering technique involves growing a thin film of ions, atoms, and molecules detached from a metal target on a heated substrate that has been chemically cleaned, with the aid of inert gas. To detach the material to be grown from the metal target, argon is converted into an inert gas carrier plasma using an RF or DC power source, and the plasma beats against the surface of the target metal, performing the detachment process.XRD graphs show that the crystal structure is uniform in both structures. However, an improvement in crystal structure quality was observed after annealing at 560°C. Absorption graphs support the XRD analyses. The film structure annealed at 560°C is more stable because absorption was measured even at low energies, i.e., high wavelengths, in the Fe:WO3 film not subjected to annealing. Optical band gap (Eg) values were calculated from the commonly known Tauc equation. The band gap of the unannealed thin film is 3.3 eV, while the band gap of the annealed film is approximately 3.15 eV. A decrease of approximately 0.15 eV was measured after annealing, which is an improvement in the electro-optical conductivity of the material. SEM data do not show a regular structure before annealing. Nanostructures were observed on the film surfaces after annealing.

Keywords:

Tungsten Oxide, Thin Film, Iron Oxide, Magretron Sputtering, Optical Analysis

Occupational Health and Safety Practices in the Solar Energy Sector

Selçuk Sincar[1], Hüseyin Güllüce [2]

1 Department of Machinery and Metal Technologies, Vocational School of Technical Sciences, Ataturk University, Erzurum, Türkiye
2 Machinery and Metal Technologies, Vocational School of Technical Sciences, Atatürk University, Erzurum, Turkiye

Corresponding Author: *ssincar@atauni.edu.tr*

Abstract

This study evaluates the importance of occupational health and safety (OHS) practices in the rapidly growing solar energy sector and examines preventive strategies for sector-specific risks. Although renewable energy technologies have environmental and economic advantages, occupational risks faced by workers, especially during photovoltaic (PV) panel installation, maintenance processes, and electrical operations, are increasing. This study emphasizes the necessity of developing a safety culture and adopting systematic OHS management approaches in solar energy projects. The study first classifies the hazards commonly encountered in solar energy applications. These hazards include risks of working at height, electric shock, thermal burns, cuts and injuries due to panel breakage, musculoskeletal disorders due to heavy lifting, and long-term health problems related to UV radiation. The analysis shows that most of these risks can be eliminated or minimized with appropriate training, the use of protective equipment, and a systematic risk assessment approach. This study comparatively examines the policies and procedures that should be implemented in solar energy projects within the framework of the Occupational Health and Safety Law No. 6331, international OHS standards (ISO 45001), European Union directives, and relevant legislation in Turkey. The findings reveal that effective OHS management should not be limited to technical measures alone; a holistic approach, including employee participation, regular training programs, field inspections, and emergency planning, is essential. In conclusion, the study shows that ensuring safe working conditions in the solar energy sector is directly related to sustainable production goals. That well-planned OHS practices significantly reduce both work accidents and operational costs. Therefore, it is recommended that sector stakeholders give importance to safety culture as much as technological progress.

Keywords:
Renewable Energy, Solar Energy, Occupational Health and Safety Practices

Interdisciplinary Session / 180

Re Critical Role of Rare Elements in Renewable Energy Systems and Türkiye

Hüseyin Güllüce[1]

1 Machinery and Metal Technologies, Vocational School of Technical Sciences, Atatürk University, Erzurum, Turkiye

Corresponding Author: *hgulluce@atauni.edu.tr*

Abstract

The global shift toward renewable energy has become a cornerstone of strategies to reduce greenhouse gas emissions and achieve climate resilience. While technologies such as solar, wind, geothermal, hydroelectric, and bioenergy dominate the visible landscape of this transition, their efficiency and scalability fundamentally depend on advanced materials with highly specific functional properties. Among these, rare earth elements (REEs) are indispensable due to their exceptional magnetic, optical, and electronic characteristics, which remain largely irreplaceable. Neodymium (Nd), praseodymium (Pr), and dysprosium (Dy) are critical for producing NdFeB permanent magnets, enabling high torque density, reduced electrical losses, and improved reliability in direct-drive wind turbines and electric vehicle powertrains. Likewise, gallium (Ga), indium (In), and germanium (Ge) are essential for high-efficiency photovoltaic (PV) devices through band-gap engineering and enhanced photon absorption. Lanthanum (La) and cerium (Ce) play key roles in hydrogen storage alloys, catalytic converters, and solid oxide fuel cells, offering superior oxygen storage capacity and thermal stability. Despite their technological importance, REE supply chains remain geographically concentrated, creating strategic vulnerabilities, price volatility, and geopolitical tensions. These challenges highlight the need for diversified sourcing, circular material use, and environmentally responsible extraction technologies. Turkey presents significant opportunities in this context, supported by its world-leading boron reserves and emerging REE-bearing deposits in regions such as Eskişehir-Kızılcaören and Malatya-Hekimhan. Strengthening domestic processing capabilities, advancing research and development, and integrating recycling infrastructure into national energy strategies will be essential to reduce external dependency and enhance competitiveness. Ultimately, sustainable and strategic management of rare earth resources is vital for secure, efficient, and resilient renewable energy systems, reinforcing the broader objectives of the global energy transition.

Keywords:

Renewable Energy; Rare Earth Elements; Critical Raw Materials; Energy Transition; Sustainable Mining

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Fabrication and Characterization of Functionally Graded A356 Alloy and Its Composite

Prathap Singh S[1]

[1] Department of Mechanical Engineering, St. Joseph's Institute of Technology, CHennai, India

Corresponding Author: *prathap.singh50@gmail.com*

Abstract

The primary goal of the study is to create an Aluminium A356 Functionally Graded alloy (A356 FG alloy) by vertical centrifugal casting after stir casting. After T6 heat treatment at various aging temperatures, the optimal aging temperature was determined to be 165°C. Using Vickers' microhardness instrument, the hardness was determined to be 50% greater in the higher hardness zone (Outer zone) for the sample aged at 165°C compared to the as-cast Aluminum functionally graded alloy. Also, the tensile strength evaluation showed the highest tensile strength of 101.487 N/mm² in the 165°C aged higher hardness zone. The microstructure was analyzed, and it was discovered that the heat-treated condition contained spheroidized eutectic silicon and magnesium silicide particles. The secondary investigation spatially dispersed high-hardness silicon nitride particles with Aluminium A356 alloy via vertical centrifugal casting to reinforce A356 with 10 wt.% Si_3N_4 Functionally Graded Composite (A356-10 wt.% Si_3N_4 FG Composite). On the fabricated FG composite, the optimal T6 heat treatment conditions obtained from the A356 FG alloy were implemented. Using Vicker's microhardness instrument, the hardness behavior was assessed. It was determined that the exterior surface exhibited a superior microhardness of 182 HV, which constituted a 73% increase compared to the interior surface. Also, the tensile strength evaluation showed the highest tensile strength of 131.067 N/mm² in the wealthy ceramic zone. The phase analysis and particle dissemination of the gradient were validated in the radial direction.

Keywords:

Aluminium Functionally Graded Composites, Centrifugal Casting Technique, Vicker'S Microhardness

Re Impact of Amorphous Boron Waste on the Long-Term Mechanical Properties of Steel Fiber-Reinforced Concrete

Meral Oltulu[1], Emrah Turan[1]

[2] Department of Civil Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *mroltulu@atauni.edu.tr*

Abstract

This study investigates the long-term mechanical performance of high-strength steel fiber-reinforced concrete (SFRC) incorporating calcined boron waste with increased amorphous content. Calcined waste was used as a partial cement replacement at ratios of 5%, 10%, and 15% to prepare the mixtures. The mechanical behavior was monitored over a three-year period through compressive, flexural, and splitting tensile strength tests. Results indicate that calcined boron waste significantly enhances long-term mechanical properties, with the 5% replacement ratio yielding the highest strength values. Consequently, calcined boron waste is identified as a high-potential additive for improving SFRC characteristics

Keywords:

Fiber Concrete, Boron, Mechanical Properties, Long-Term

Urban Water Management Approaches for Resilient Cities

Senanur Seher Ağbaba[1], Aslihan Esringü [2]

[1] Graduate Student, Ataturk Üniversity
[2] Department of Landscape Architecture, Faculty of Architecture and Design, Atatürk University, 25249 Erzurum, Türkiye

Corresponding Author: *s.seheragbaba@gmail.com*

Abstract

The rapid population growth in urban areas, increasing construction, and the rise in flood events due to climate change are altering the quality and quantity of water resources. Therefore, rainwater management in cities has become a multi-dimensional planning and resilience issue. The increasing fragility of water resources in cities further complicates urban rainwater management. Nature-based solutions contribute to the urban water cycle by reducing surface runoff, lowering flood risk, and managing rainwater in situ. The aim of this study is to examine nature-based solutions used to increase the resilience of cities against extreme rainfall caused by climate change and to reveal the environmental, social, and economic benefits these solutions will provide. In this context, the effects of nature-based solutions such as rainwater harvesting, green infrastructure systems, permeable surfaces, bio-swales, rain gardens, and urban wetlands on the water cycle have been examined using the literature, and successful national and international applications have been compared and evaluated. When the findings are evaluated, it is seen that nature-based practices reduce flood risk, improve water quality, contribute to climate adaptation, and increase the long-term resilience of cities, thus offering a holistic solution. Therefore, by widespread adoption of urban green infrastructure systems, water is retained at its source. Consequently, to increase urban resilience to water management in cities, it is necessary to rapidly implement green infrastructure systems. For successful implementation, local governments must develop mandatory strategic plans, include them in infrastructure investments, and address spatial planning, landscape design, and climate adaptation policies with an integrated approach. Urban water management is not only a matter for landscape architecture but also a strategic planning tool that should be considered multidisciplinarily, involving various professional disciplines.

Keywords:

Urban Resilience, Landscape Architecture, Urban Green Infrastructure, Nature-Based Solutions, Urban Water Management

Bioprinted Scaffolds Incorporated by Functional Nanoparticles

Behnaz Ashtari[1], Fatemeh Barati[1], Maryam Khosravi[1], Parvaneh Naserzadeh[4]

1 Department of Medical Nanotechnology, Faculty of Advanced Technologies in Medicine, Iran University of Medical Sciences, Tehran, Iran
2 Endocrine Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran

Corresponding Authors: *fatemehbarati.h@gmail.com, ashtaribeh@gmail.com*

By incorporating functional and stimuli-responsive nanoparticles, passive bioprinted scaffolds can be transformed into controllable and adaptive material systems. Such particles impart chemical, electrical, magnetic, and light-responsive behavior while reinforcing polymer networks and improving rheology. These nanoparticles create nanoscale domains that convert external stimuli into localized thermal, mechanical, or chemical outputs, enabling conductivity tuning, photothermal heating, magnetic actuation, and sustained ion exchange. Together, these effects shift scaffolds from static structures to dynamic, stimulus-regulated platforms designed for next-generation responsive biomaterials.

Keywords:

Smart Biomaterials, 3D Bioprinting, Nanoparticles

Rerapeutic Effect of the SN-38–FeO Nanoparticle Combination Targeting Dopamine Receptors in Colorectal Cancer Cells

Özlem Utme[1], Ali Taghizadehghalehjoughi[1], Sıdıka Genç [1]

[1] Department of Medical Pharmacology, Faculty of Medicine, Şeyh Edebali University, Bilecik, Türkiye

Corresponding Author: *ozlemutme@gmail.com*

Abstract

In recent years, the link between cancer pathogenesis and neurotransmitter systems has gained increasing attention, particularly the regulatory role of dopamine in tumor biology. Dopamine, a monoamine neurotransmitter, can enhance antitumor responses through dopamine receptors (DRs). The Caco-2 colorectal adenocarcinoma cell line serves as a suitable model for studying DR-mediated signaling and anticancer agents interacting with these pathways. Among therapeutic molecules, SN-38 (the active metabolite of irinotecan) exerts strong cytotoxicity via DNA topoisomerase I inhibition, while iron oxide nanoparticles (FeO NPs) exhibit anticancer activity through ROS generation, modulation of intracellular stress responses, and selective uptake by cancer cells. This study evaluated the anticancer effects of SN-38 and FeO NPs on Caco-2 cells and explored the potential involvement of dopaminergic signaling in these responses. Materials and Methods: Caco-2 cells were cultured under standard cell culture conditions. Once optimal conditions were achieved, the SN-38 anticancer agent encapsulated within nanoparticles was administered at defined doses (SN-38 10 nM + FeO 25 µg/mL and SN-38 10 nM + FeO 50 µg/mL). After 24 hours of treatment, cells and media were collected for analysis. Cell viability was assessed by MTT assay; oxidative stress parameters were evaluated using TAS and TOS assays; and the gene expression levels of dopamine receptor 1 and dopamine receptor 2 were examined. Results: The findings showed that the combined application of both molecules significantly reduced cell viability (approximately 25–40%) and disrupted oxidative stress balance to the detriment of tumor cells. The increase in TOS levels and decrease in TAS levels supported the conclusion that the treatment combinations enhanced pro-oxidant activity. Conclusion: This study demonstrates that the combination of SN-38 and iron oxide nanoparticles produces a pronounced anticancer effect in Caco-2 cells. The SN-38/FeO nanoparticle combination appears to be a promising therapeutic approach for colorectal cancer.

Keywords:

Anticancer, Caco-2, Dopaminergic receptors, FeO nanoparticles, SN-38

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Harnessing Interface Engineering to Unlock Performance in Lead-Free, ETL-Free Perovskite Solar Cells: a SCAPS-1D Defect Tolerance Study

Nabilah Ahmad Jalaludin[1], Faiz Arith [2], Fauziyah Salehuddin [3]

1 Faculty of Electronics and Computer Technology and Engineering, Universiti Teknikal Malaysia Melaka
2 Faculty of Electronics and Computer Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, 76100, Melaka, Malaysia
3 Faculty of Technology & Engineering Electronic and Computer (FTKEK), Universiti Teknikal Malaysia Melaka, Melaka, Malaysia

Corresponding Author: *p022220006@student.utem.edu.my*

Abstract

Perovskite solar cells (PSCs) have rapidly advanced in recent years, achieving impressive power conversion efficiencies. However, challenges such as sensitivity to heat, moisture, and the need for high-temperature processing hinder their long-term stability and commercialization. Traditional PSCs typically use electron transport layers (ETLs) alongside hole transport layers (HTLs) to facilitate efficient charge extraction, but these ETLs often require complex and costly fabrication steps. Specifically, the device structure studied, as shown in Figure 1, consists of the following layers: fluorine-doped tin oxide (FTO), formamidinium tin triiodide (FASnI3) as the absorber layer, doped polyanilinine/graphene oxide (PANI/GO) as the hole transport layer (HTL), and silver (Ag). This study focuses on lead-free, ETL-free perovskite solar cells, which simplify device architecture and enable low-temperature, cost-effective manufacturing suitable for large-area applications. Eliminating the ETL and using lead-free absorber materials results in devices that are more environmentally friendly and scalable. SCAPS-1D simulation software was used to analyze the impact of interface defect densities and defect tolerance on device performance. The results highlight the critical importance of interface engineering, especially at the FTO/absorber interface, which has a stronger influence on device parameters than the absorber/HTL interface. Reducing the interface defect density to around 1×1011 cm-2 is essential to minimize charge recombination and energy losses, leading to significant improvements in power conversion efficiency (PCE), fill factor, and stability. This work demonstrates that careful management of interface quality and defect passivation allows ETL-free, lead-free PSCs to achieve performance comparable to more complex architectures without relying on toxic elements or high-temperature processes. These insights pave the way for developing stable, efficient, and eco-friendly perovskite solar cells with simpler fabrication routes, supporting the future of sustainable photovoltaic technology.

Keywords:
Interface Defect, Doped PANI/GO, ETL-Free, Perovskite Solar Cell

Rerapeutic Potential of Ginseng Against Cancer Exosome–Induced Toxicity in Neuronal and Endothelial Cells

Ali Taghizadehghalehjoughi[1], Yunus Emre Aydın[1], Sıdıka Genç[1]

[1] Department of Medical Pharmacology, Faculty of Medicine, Şeyh Edebali University, Bilecik, Türkiye

Corresponding Author: *yunus.husnu@gmail.com*

Abstract

Exosomes released from cancer cells are nano-vesicles that play a critical role in reshaping the tumor microenvironment and disrupting the functions of distant cellular targets. Through their cargo—oncogenic miRNAs, pro-inflammatory proteins, tumor-specific metabolites, and DNA/RNA fragments—they alter intercellular communication pathologically. Exosome-mediated damage compromises both central nervous system barrier integrity and neuronal function, thereby providing an indirect yet significant contribution to cancer progression. Current therapeutic approaches remain insufficient in reducing this toxicity and inflammation. In recent years, studies on Panax ginseng have revealed notable effects, particularly in suppressing oxidative stress and apoptosis. Moreover, ginseng has been shown to attenuate responses to pro-inflammatory mediators such as IL-6 and TNF-α induced by exosomes, and to exert anti-inflammatory activity by reducing intracellular NF-κB activation. More realistic evaluation of exosome-mediated toxicity and treatment effects is achievable through co-culture models that physiologically reflect neuron–endothelial interactions. A co-culture model was established using HUVEC and SH-SY5Y cells. Following incubation, cancer-derived exosomes obtained from the T98G cell line (40 ng/mL) were applied to the co-culture system to induce exosome-mediated toxicity. Ginseng was then administered as a therapeutic agent at doses of 200 ng/mL and 400 ng/mL. At the end of the treatment period, cellular viability (MTT assay) and oxidative stress markers (TAC and TOS) were evaluated. Treatment with 400 ng/mL ginseng reduced oxidative stress and inflammation compared with the exosome control group and increased cell viability by approximately 30%. Our study shows that ginseng may serve as a therapeutic agent capable of counteracting the harmful effects of cancer-derived exosomes on neuronal and endothelial cells. This highlights its potential in mitigating exosome-mediated toxicity within the context of neuro-oncological damage.

Keywords:

Exosome, HUVEC, SH-SY5Y, Oxidative damage

Oxidation Mechanism in Vegetable Oils and Methods for Increasing Oxidation Stability

Büşra Aydın[1], Saliha Erentürk[1]

[1] Department of Chemical Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *busra.ayd12@gmail.com*

Abstract

Vegetable oils are a fundamental energy source in human nutrition, as well as important components for the transport of fat-soluble vitamins and sensory quality. However, all vegetable oils, especially corn oil which is rich in polyunsaturated fatty acids, are quite susceptible to oxidation. Oxidation consists of chain radical reactions that lead to deterioration of taste, odor, and color, as well as a decrease in nutritional value. The aim of this study is to present the oxidation mechanism in vegetable oils, the methods used to determine oxidative stability, and the natural and technological approaches developed to increase stability, based on the literature. As a methodological approach, the chemical basis of the initiation-progression-termination steps of the oxidation process is explained; and the analytical methods used in the evaluation of oxidative stability are defined. In line with the findings reported in the literature, it is stated that some methods delay oxidation by chelating metal ions and interrupting chain reactions. Studies have shown that natural antioxidants significantly increase oxidative stability, especially in oils with a high degree of unsaturation; This is confirmed by the prolongation of the induction period and the decrease in reaction rate. Consequently, the literature shows that natural and synthetic antioxidants increase the oxidation stability of oils, and are effective in extending shelf life, preserving sensory quality, and improving consumer safety. In this context, the study contributes to a better understanding of the oxidation processes of vegetable oils and the development of strategies to increase their stability.

Keywords:

Natural Antioxidants, Lipid Oxidation, Oxidative Stability, Rancimate, Edible Oils

Re Impact of Multi-Tagger Consistency on Semi-Supervised Natural Language Processing Models: A Bert-Based Tagging Approach

Aleyna Karaosman[1], Yasemin Gültepe [2]

[1] Department of Software Engineering, Institute of Science, Atatürk University, Erzurum, Türkiye
[2] Department of Software Engineering, Faculty of Engineering, Atatürk University, Erzurum, Türkiye

Corresponding Author: *karaosmanaleyna@gmail.com*

Abstract

Manual annotation of large text datasets is both time- and cost-intensive, leading to a growing need for semi-supervised learning methods. Furthermore, inconsistencies among human labelers directly impact the quality of synthetic label generation due to the sensitivity of semi-supervised models to initial labels. This study examines the impact of multi-labeler consistency on BERT-based semi-supervised learning models and proposes a holistic framework for statistically modeling labeler reliability, establishing a core training set, and optimizing the synthetic labeling process. The proposed approach involves calculating labeler consistency using methods such as Cohen’s Kappa and Dawid-Skene, generating a core dataset of reliable examples, training the BERT model on this dataset, generating synthetic labels for unlabeled data, and redirecting low-confidence examples back to the labeler. Furthermore, the process is enhanced with consistency adjustment and noise reduction techniques, and a labeling interface is developed for practical use. In conclusion, the study demonstrates that multi-labeler consistency plays a critical role on the stability and accuracy of semi-supervised BERT models and provides a scalable, reliable and cost-effective automatic labeling infrastructure on large text datasets.

Keywords:

Advances in Albumin-Based Nanocarriers: Novel Engineering Strategies and Functional Enhancements

Ferdane Danışman Kalındemirtaş[1], Betül Çiçek [2]

[1] Department of Physiology, Faculty of Medicine, Erzincan Binali Yildirim University, Erzincan, Türkiye
[2] Department of Physiology, Faculty of Medicine, Erzincan Binali Yildirim University, Erzincan, Turkey

Corresponding Author: *betulll.cicekk@gmail.com*

Abstract

Albumin-based nanocarrier systems are increasingly gaining attention in cancer treatment due to their biocompatibility, long circulation times, and tumour-specific targeting capabilities. Albumin nanocarriers can be naturally taken up into tumour tissue via gp60 and SPARC-mediated mechanisms. Three-dimensional tumour models and in vivo studies demonstrate that albumin nanocarriers distribute within tumour tissue like a natural biomaterial, and conjugation with RGD, folate, transferrin, and aptamers significantly enhances cellular uptake. Furthermore, albumin nanocarriers enable tumour-specific drug delivery and significantly reduce systemic toxicity by exploiting their sensitivity to the tumour microenvironment (pH, ROS, and enzyme-sensitive nanocarriers). These controlled release strategies also offer advantages in overcoming multidrug resistance (MDR). Furthermore, albumin is highly successful in drug delivery in 3D tumour models and, when combined with imaging agents, becomes a multi-purpose carrier. All these features make albumin-based nanocarriers a strong clinical candidate for targeted, controlled drug delivery with reduced side effects and safe drug delivery systems.

Keywords:

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