COLLEGE OF SCIENCE · UNIVERSITY OF ZAKHO

Abstract Book

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ASSC 2026 · 30 April 2026 · Zakho, Kurdistan Region, Iraq

67 ABSTRACTS · COLOUR KEY

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Department of Biology

23 abstracts · BIO-01 to BIO-23

BIO-01

Prevalence of *Entamoeba* spp. in Children Suffering from Diarrhea at Pediatric and Heevi Hospitals in Zakho and Duhok Cities, Iraq

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Background/Objective: *Entamoeba* species are intestinal protozoan parasites that infect humans worldwide and represent a significant cause of gastrointestinal infections, particularly in developing countries. This study aimed to determine the prevalence of *Entamoeba* spp. among children suffering from diarrhea attending Zakho Pediatric Hospital and Heevi Pediatric Hospital in Duhok Province and to evaluate the influence of selected risk factors on the infection rate.

Methods: A total of 280 stool samples were collected from children presenting with diarrhea and other gastrointestinal symptoms between October 2025 and February 2026. The samples were obtained from two teaching hospitals: Zakho Pediatric Hospital and Heevi Pediatric Hospital in Duhok Province, Kurdistan Region, Iraq. Stool specimens were examined macroscopically and microscopically using the direct wet mount technique to detect the presence of *Entamoeba* spp.

Results: The overall prevalence of *Entamoeba* infection was 15.71% (44/280). Females showed a slightly higher infection rate compared with males (16.51% vs. 15.20%). The highest infection rate was observed in the 8–9 years age group, while the lowest rate (9.43%) was found in the 2–3 years age group. Regarding monthly distribution, the highest prevalence (21.25%) was recorded in November 2025, whereas the lowest prevalence (9.67%) occurred in December 2025.

Conclusion: The study revealed a considerable prevalence of *Entamoeba* infection among children with diarrhea in the study area. Improving sanitation, ensuring access to safe drinking water, and strengthening public health education programs are essential measures to reduce the transmission of this parasite.

Keywords: intestinal parasites; *Entamoeba* species; prevalence; diarrhea; children

BIO-02

Detection of *Helicobacter pylori* Using Non-Invasive Techniques

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Abstract: *Helicobacter pylori* infection remains a major global public health concern, particularly in developing regions, due to its strong association with chronic gastritis, peptic ulcer disease, and gastric cancer. Accurate diagnosis is essential for effective management and prevention, and non-invasive diagnostic methods are increasingly favored due to their safety, accessibility, and cost-effectiveness. This study aimed to evaluate the prevalence of *H. pylori* infection using multiple non-invasive diagnostic techniques and to assess the distribution of infection according to age and gender. A cross-sectional study was conducted using non-invasive diagnostic approaches, including serological detection of anti-*H. pylori* immunoglobulin G (IgG) and immunoglobulin A (IgA), stool antigen testing (SAT), and the urea breath test (UBT). Demographic data were analyzed to explore age- and gender-related patterns of infection. The overall prevalence of *H. pylori* infection was 48.31%. Serological testing showed a higher positivity rate for IgG (48.2%) compared with IgA (34.23%). Detection of active infection revealed positivity rates of 44.42% using the stool antigen test and 39.04% using the urea breath test. Infection was more frequent among females (62.99%) than males (37.01%) and demonstrated an age-related increase, with the highest proportion observed in the 31–40 years age group, followed by 41–50 years. The study confirms that *H. pylori* infection remains prevalent and that non-invasive diagnostic tests provide valuable and complementary information. While serology is useful for epidemiological assessment, SAT and UBT are more appropriate for identifying active infection. Employing a combination of non-invasive methods may enhance diagnostic accuracy and support effective screening and management strategies, particularly in resource-limited settings.

Keywords: *Helicobacter pylori*; non-invasive diagnosis; serology; stool antigen test; urea breath test

BIO-03

Seroprevalence of *Helicobacter pylori* Infection in Zakho, Iraq: An ELISA-Based Study

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Abstract: *Helicobacter pylori* infection is one of the most common chronic bacterial infections worldwide and is associated with several gastrointestinal diseases, including gastritis, peptic ulcer disease, and gastric cancer. This study aimed to determine the seroprevalence of *Helicobacter pylori* infection and its distribution according to age and gender among individuals in Zakho, Iraq. A total of 100 serum samples were analyzed for IgG antibodies against *Helicobacter pylori* using the enzyme-linked immunosorbent assay (ELISA). Results were interpreted according to the manufacturer's reference range and

categorized as positive, negative, or equivocal. Overall, 54% of the samples were positive, 39% were negative, and 7% were equivocal for *H. pylori* antibodies. When analyzed by gender, a higher prevalence of infection was observed among males (69.6%) compared to females (40.7%). Age group analysis showed a gradual increase in infection prevalence with age, with positivity rates of 36% in individuals younger than 20 years, 56% in the 20–29 age group, 57% in the 30–39 age group, 64% in the 40–49 age group, and 82% in individuals aged 50 years and above. These findings indicate a relatively high prevalence of *Helicobacter pylori* infection in the studied population, with higher rates observed in males and older age groups, highlighting the importance of continued epidemiological monitoring and preventive strategies.

Keywords: *Helicobacter pylori*; seroprevalence; ELISA; IgG antibodies; Zakho

BIO-04

Epidemiology and Bacterial Profile of Pediatric Urinary Tract Infections: A Four-Year Study (2022–2025)

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Background: Urinary tract infections (UTIs) are among the most common bacterial infections in children, with significant morbidity if left untreated. Early identification of causative pathogens and understanding demographic risk factors are essential for effective management and prevention of complications.

Objective: This study aimed to investigate the distribution of Gram-positive and Gram-negative bacteria in pediatric UTIs and to examine the association between age, gender, and infection prevalence over a four-year period (2022–2025).

Methods: A total of 470 urine samples from children aged <15 years diagnosed with UTIs were analyzed retrospectively. Samples were cultured and bacterial isolates were identified using standard microbiological techniques. Data on age, gender, and pathogen distribution were collected. Statistical analysis was performed using Chi-square tests, with $p < 0.05$ considered significant.

Results: Gram-negative bacteria were the predominant pathogens, with *Escherichia coli* being the most frequently isolated organism (28.2% in 2022, 31.6% in 2025), followed by *Klebsiella pneumoniae* (20.8–22.6%). Among Gram-positive bacteria, *Staphylococcus aureus* showed an increasing trend over the study period (15.3% in 2022 to 20.6% in 2025). Other organisms (*Pseudomonas* spp., *Proteus* spp., *Streptococcus* spp., *Staphylococcus* spp.) were isolated at lower frequencies. Females (58.3%) were more affected than males (41.7%), and the highest incidence was observed in children <1 year (46.8%). A significant association between age and gender distribution was observed (χ^2 test, $p < 0.05$).

Conclusion: *Escherichia coli* remains the predominant pediatric uropathogen, with a rising trend of Gram-positive bacteria such as *Staphylococcus aureus*. The higher prevalence in female and younger children underscores the need for targeted clinical vigilance. Continuous surveillance and antibiotic stewardship are crucial for the effective management of pediatric UTIs.

Keywords: urinary tract infection; pediatric; *Escherichia coli*; *Klebsiella pneumoniae*; *Staphylococcus aureus*; Gram-positive bacteria; Gram-negative bacteria; antibiotic stewardship

BIO-05

Prevalence of *Staphylococcus aureus* Colonization According to Age and Gender: A Cross-Sectional Study

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Background/Objective: *Staphylococcus aureus* is a significant human pathogen responsible for a wide range of community- and hospital-acquired infections. Colonization patterns may vary according to demographic factors. This study aimed to determine the prevalence of *S. aureus* colonization and assess its distribution according to age and gender.

Methods: A cross-sectional study was conducted among 568 participants. Nasal and skin swabs were collected and cultured to detect *S. aureus* colonization. Data were categorized by age group and gender. Statistical analysis was performed using the chi-square (χ^2) test, with $p < 0.05$ considered statistically significant.

Results: Of the 568 participants, 300 (52.8%) were positive for *S. aureus*. Colonization was significantly higher among females (60.8%) compared to males (44.1%) ($\chi^2 = 15.90$, df = 1, $p < 0.001$). The highest prevalence was observed in younger age groups: ≤10 years (60.8%), 11–20 years (56.9%), and 21–30 years (63.8%). A statistically significant decline in colonization was noted among older age groups ($\chi^2 = 26.12$, df = 5, $p < 0.001$).

Conclusion: *S. aureus* colonization is common in the studied population, particularly among females and younger individuals. These findings highlight the importance of targeted screening and preventive strategies for high-risk demographic groups.

Keywords: *Staphylococcus aureus*; colonization; prevalence; age; gender

BIO-06

Infection of Wounds by Potential Bacterial Pathogens and Their Susceptibility Testing

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Background/Objective: Wound infection is a major cause of morbidity and prolonged hospitalization worldwide. The increasing prevalence and severity of such resistant bacterial strains represent a major problem in the elimination of hospital-acquired infections. This study aimed to identify the etiological agents of wound infection along with their antibiotic susceptibility.

Methods: A cross-sectional study was conducted at Zakho Emergency Hospital and private laboratories from January 2025 to December 2025. These samples were collected from patients of both genders and different ages (1 month–100 years). Wound samples were inoculated onto appropriate media, and pathogens were identified using standard microbiological methods. Antimicrobial

susceptibility patterns were determined by the Kirby-Bauer disc diffusion method following the guidelines of the Clinical and Laboratory Standards Institute (CLSI). Data were analyzed using GraphPad Prism version 9.3.1 (471).

Results: In this study, 78 bacterial isolates were recovered from 100 specimens, showing an isolation rate of 78%. Of all, 42 (34%) were male patients and 58 (44%) were female patients. Among these, 43 (55.13%) were Gram-positive and 35 (44.87%) were Gram-negative. *Staphylococcus aureus* 33 (42.31%) was the most predominant bacterium, followed by *Streptococcus* spp. 10 (12.82%), *Pseudomonas aeruginosa* 10 (12.82%), and *Klebsiella pneumoniae* 10 (12.82%). Vancomycin was the most effective antibiotic against *Streptococcus* spp., showing an efficacy of 80%. On the other hand, meropenem was the most sensitive antibiotic against *Proteus* spp. (100%) and *Pseudomonas aeruginosa* (80%).

Conclusion: The current study identified the leading pathogenic agents of pyogenic wound infection in our locality. Once more, these pathogens are resistant to antibiotics currently in use. Thus, this work may be useful for the establishment of reasonable antibiotic guidelines when using them for prophylaxis or empiric therapy.

Keywords: wound infection; *Staphylococcus aureus*; *Escherichia coli*; antibiotic-resistant bacteria

BIO-07

Antimicrobial Activity and Phytochemical Screening of Freshwater *Cladophora* spp. from the Kurdistan Region of Iraq

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Background/Objective: The rising incidence of antimicrobial resistance underscores the necessity for new natural compounds with bioactive properties. Freshwater macroalgae such as *Cladophora* spp. are recognized for producing secondary metabolites that may possess antimicrobial activity. This study aimed to assess the antifungal and antibacterial properties of aqueous and methanolic extracts of *Cladophora* spp. collected from freshwater habitats along Perekh–Sheransh Road in the Kurdistan Region of Iraq.

Methods: Algal samples were collected and identified based on their morphology and microscopic structures. They were thoroughly washed, air-dried, and extracted using aqueous solvents (1:10 and 1:30 w/v) and methanol. The antifungal activity of the aqueous extract was evaluated against *Fusarium falciforme*, *Alternaria* sp., and *Aspergillus flavus* through agar-based radial growth inhibition assays conducted over five days. Antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* was assessed using disc diffusion and well diffusion methods. Preliminary phytochemical screening was carried out to identify the presence of phenolic compounds, flavonoids, tannins, and saponins using standard qualitative assays.

Results: The aqueous extract exhibited significant antifungal activity, markedly reducing colony diameters compared to controls: *Fusarium falciforme* (control: 4.55 cm, extract: 1.17 cm), *Alternaria* sp. (control: 2.76 cm, extract: 0.70 cm), and *Aspergillus flavus* (control: 4.58 cm, extract: 1.20 cm), resulting in growth inhibitions of 74.3%, 74.6%, and 73.8%, respectively. Phytochemical analysis confirmed the presence of phenolic compounds, flavonoids, tannins, and saponins, which likely contribute to the antifungal effects. Evaluation of methanolic extracts and antibacterial activity is currently in progress.

Conclusion: *Cladophora* spp. exhibit promising antifungal activity, likely linked to their phenolic-rich phytochemicals. These findings emphasize the potential of *Cladophora* spp. as a natural source of antifungal agents and support further bioassay-guided isolation and characterization of active compounds.

Keywords: *Cladophora* spp.; antimicrobial activity; freshwater macroalgae; phytochemical screening; natural antimicrobial agents

BIO-08

Prevalence of Anabolic Steroid Use Among Gym-Goers in Duhok Province, Kurdistan Region of Iraq: A Cross-Sectional Study

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Objective: This study aimed to determine the prevalence of anabolic steroid use among gym-goers in Duhok Province, Kurdistan Region of Iraq, and to assess demographic characteristics, motivations, health effects, and sources of information related to steroid use.

Materials and Methods: A cross-sectional survey was conducted among gym-goers in Duhok Province. A total of 498 valid responses were analyzed. Data were collected using structured questionnaires that included demographic information, gym attendance, knowledge and use of anabolic steroids, motivations for use, and reported side effects. Descriptive statistics were used to summarize the data.

Results: The majority of participants were aged 20–29 years, with most having school-level education or no formal education. Gym attendance was highest among students and general employees, with 5–6 visits per week being common. While 89.16% of respondents were familiar with anabolic steroids, only 8% reported usage. Among users, 75% had used steroids for less than six months, primarily to enhance muscle mass and strength. Most users obtained steroids via medical channels. Reported side effects included acne, hair loss, and liver damage, affecting 85% of users. Knowledge about steroids was limited, with media being the primary source of information. Despite acknowledging the performance benefits, 87.95% of users would not recommend anabolic steroids to others due to safety concerns.

Conclusion: Anabolic steroid use among gym-goers in Duhok Province is relatively low; however, users report notable side effects and limited knowledge about safe use. These findings emphasize the need for education and awareness programs on steroid risks and safe practices.

Keywords: anabolic steroids; gym-goers; prevalence; health; awareness

BIO-09

Metabolic Profiles and Determinants of HbA1c Across Glycemic Categories in Adults from Zakho, Iraq

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Background: The dynamic interrelationships between glycemic control, lipid metabolism, and renal function across the dysglycemic spectrum remain understudied in high-burden Middle Eastern populations.

Methods: This cross-sectional analysis of 302 adults in Zakho, Iraq, stratified participants by ADA criteria. Profiles, correlations (Spearman's ρ), and multivariable regression assessed metabolic coupling.

Results: Atherogenic dyslipidemia progressed across glycemic categories: triglycerides (177.0 vs 145.1 mg/dl, p = 0.003) and VLDL-c (35.32 vs 28.93 mg/dl, p = 0.004) increased, while LDL-c decreased (102.8 vs 115.7 mg/dl, p = 0.024). The strong HbA1c–total cholesterol correlation in normoglycemia (ρ = 0.32, p < 0.001) disappeared in dysglycemia (ρ ≈ −0.03), whereas the inverse triglyceride–HDL-c correlation persisted (ρ = −0.39 to −0.46, all p < 0.001). A unique negative HbA1c–creatinine correlation emerged in prediabetes (ρ = −0.21, p = 0.041). Multivariable regression identified age as the sole significant predictor of HbA1c (β = 0.037/year, p < 0.001), accounting for 27.6% of the model's explanatory capacity.

Conclusion: Metabolic coupling exhibits stage-specific evolution with cholesterol–glucose dissociation in dysglycemia, while triglyceride–HDL interdependence persists. Age, not traditional lipids, dominantly predicts HbA1c, supporting age-stratified approaches in high-risk populations.

Keywords: metabolic coupling; diabetic dyslipidemia; HbA1c; age; prediabetes; Iraq

BIO-10

Maternal Obesity and Associated Risk Factors in Children with Autism Spectrum Disorder: A Comprehensive Analytical Cross-Sectional Study in Duhok, Iraq

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Background/Objective: The lifelong neurodevelopmental disorder autism spectrum disorder (ASD) prevalence has risen substantially in recent decades; therefore, this cross-sectional study evaluates the association between maternal obesity and behavioral phenotype in children with ASD, assessing prenatal exposures, nutritional factors, and early developmental indicators.

Methods: About 62 mother-child from Duhok and Zakho autism center between October 2024 and February 2026 were enrolled where children had confirmed ASD diagnoses. Mothers were stratified into non-obese (n = 39) and obese (n = 23) groups based on body mass index. Demographic, prenatal, perinatal, and postnatal variables were collected through structured questionnaires. Categorical variables were analyzed using chi-square tests, continuous variables using independent t-tests or Mann-Whitney U tests, and correlational analyses using Pearson or Spearman coefficients. Binary logistic regression identified independent risk factors for poor eye contact.

Results: The child birth weight (p = 0.024) and younger mother (p = 0.035) were significantly associated with maternal obesity. A strong correlation (p < 0.001) of balanced diet intake was observed with maternal obesity. Notably, association of poor eye contact has been shown during the speech with anxiety (r = 0.776, p < 0.001) and sleep disturbance (r = 0.434, p < 0.001). According to logistic regression analysis, a significant influence of poor eye contact was predicted by the use of folic acid supplements (OR = 0.18, p = 0.04) and by family history (OR = 0.14, p = 0.02).

Conclusions: The current investigation highlighted the importance of early environmental exposures, prenatal nutrition and family history in the complicated behavioral patterns of ASD. The strong association revealed involvement of sleep disturbance, anxiety and poor eye contact underlined the neurobiological process. To definitely identify the most preventive strategies, future investigations should use retrospective longitudinal studies with precise biomarkers and mechanistic investigations.

Keywords: autism spectrum disorder; maternal obesity; prenatal nutrition; folic acid

BIO-11

Epigenetic Landscapes in Cancer: Expression Profiling of Key Regulatory Proteins

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Background: Epigenetic dysregulation, driven by aberrant chromatin-modifying enzymes, is a fundamental hallmark of cancer. While individual epigenetic regulators have been studied in specific malignancies, a comprehensive pan-cancer understanding of their overarching expression patterns remains critical for identifying broad-spectrum therapeutic targets.

Methods: This study conducted a systematic meta-analysis of key histone-modifying enzymes (including writers, erasers, and modifiers of histones H2A, H2B, H3, and H4) using RNA-sequencing data from The Cancer Genome Atlas (TCGA) via the UALCAN analytical portal. Gene expression levels, quantified as Transcripts Per Million (TPM), were compared between primary solid tumors and normal tissues. A comprehensive pan-cancer heatmap was utilized to visualize global expression trends across 21 distinct solid tumor types, allowing for the identification of universal versus tissue-specific epigenetic signatures.

Results: Pan-cancer heatmap profiling reveals stark, coordinate shifts in the epigenetic landscape of malignancies. DNA Damage Response (DDR) kinases (e.g., PRKDC) and specific ubiquitin ligases (e.g., BRCA1, BMI1) demonstrate robust upregulation across a diverse array of carcinomas, notably in gastrointestinal (COAD, READ, STAD)

and squamous (HNSC, CESC) cancers, indicating a strong "epigenetic addiction" required for tumor maintenance. Conversely, the analysis identified a striking, near-universal downregulation of the histone acetyltransferase KAT2B across the vast majority of profiled cancer cohorts. Furthermore, enzymes mediating transcriptional repression, such as HDAC3 and EZH2, show consistent pan-cancer upregulation.

Conclusions: The epigenetic architecture of human cancer is characterized by shared, global signatures of dysregulation, most notably the widespread suppression of KAT2B and the hyperactivation of PRKDC and BRCA1. Visualizing these patterns via pan-cancer heatmaps highlights critical, shared vulnerabilities across disparate tumor origins, underscoring the potential for developing broad-spectrum epidrugs aimed at reversing these fundamental chromatin aberrations.

Keywords: cancer; epigenetics; cancer epigenetics; expression profiling; chromatin modifiers; epigenetic dysregulation; TCGA

BIO-12

Cytogenotoxic and Anticytogenotoxic Effects of *Spirulina platensis* against Boric Acid on *Allium cepa* Root Tips

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Background/Objective: Synthetic food dyes have garnered significant attention due to potential health risks, including cytotoxicity, allergenicity, and even carcinogenicity observed in animal models. The present study aims to evaluate the cytogenotoxic effects of the food additive boric acid on *Allium cepa* root tip cells and to investigate the possible protective role of *Spirulina platensis* against these effects.

Methods: Onion bulbs were divided into four experimental groups: a control group in distilled water, a group treated with boric acid, a group treated with *Spirulina platensis*, and another combined group exposed to boric acid, then to *Spirulina platensis*. After incubation, the roots were harvested, and slides were prepared by the squash method for cytological analysis.

Results: The control group displayed the highest mitotic index (MI) of 9.2. A significant decrease in the mitotic index was observed in the boric acid group, and this food additive induced different mitotic abnormalities: sticky metaphase, C-mitosis, laggard chromosomes, anaphase bridges, and multipolar anaphase, which are strong indicators of potential genotoxicity. The treatment with *Spirulina platensis* recovered the mitotic index and reduced the frequency of the observed mitotic abnormalities, which indicates a protective effect of *Spirulina platensis* against boric acid-induced genotoxicity.

Conclusion: The findings suggest that boric acid negatively affects the plant cells, which highlights the risks of exposure to synthetic food additives. Furthermore, *Spirulina platensis* shows promising protective properties, supporting its potential use as a natural agent to mitigate genotoxic damage.

Keywords: food additives; genotoxicity; *Allium cepa*; chromosomal aberrations

BIO-13

Mitigation of Drought to Enhance Yield Parameters in Two Cultivars of Cotton through Application of Salicylic and Folic Acids

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Abstract: Drought stress is well-known for its detrimental effects on plant growth and development. Physiological activities are also altered due to such stress, which subsequently affects the crop production and yield parameters. Cotton is of great importance in terms of cotton fiber and cotton oil, yet its production is highly affected by water deficit. This research was conducted to minimize the effects of water scarcity on the yield of two cotton cultivars, namely, MAY505 and MAY455. Both cultivars were sown in the same field in late spring, then foliar sprayed twice with different concentrations of salicylic acid (SA) (0, 1, 2 mM) and folic acid (FA) (0, 5, 10 mM) at the four-leaf stage of growth and during the flowering period. Three stages of drought were established in this study: (normal irrigation, 10 days of drought, 15 days of drought). Statistical analysis reveals that both cultivars showed shorter plants with lesser yield with increased drought periods. However, the cultivar MAY505 produced more flowers and bolls and grew taller plants than MAY455. MAY505 yielded more seeds per plant than MAY455. The oil content in MAY505 was by far more than in MAY455. The results of the study reveal that the more plants are subjected to prolonged drought, the shorter and lower-yielding plants will be produced. Furthermore, MAY505 is more resilient to drought and produces healthier crops with better yield than MAY455, especially when plants were treated with a combination of (1 mM SA + 10 mM FA).

Keywords: salicylic acid; folic acid; drought; cotton plant; yield parameters

BIO-14

Identification of *Dina* sp. (Annelida: Hirudinea: Erpobdellidae) from Zakho District, Duhok, Iraq, via COI Barcoding

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Background/Objective: Leeches of the subclass Hirudinea remain underexplored in the Kurdistan Region of Iraq, with limited molecular data available to resolve taxonomic confusion caused by variable morphological traits such as annulation patterns. Although the genus *Dina* is a prominent component of the freshwater fauna in the Northern Hemisphere, its identification in Mesopotamia has historically relied on external features that are often unsuitable for clear diagnosis. This study aims to provide the first molecular identification of a *Dina* sp. from the Zakho District, Duhok Province, to enhance regional biodiversity records.

Methods: Specimens were collected from aquatic environments in Zakho during 2025 and preserved in ethanol. Genomic DNA was isolated from tissue samples, and a 658 bp fragment of the mitochondrial cytochrome c oxidase subunit I (COI) gene was PCR-amplified and sequenced. Sequence data were subsequently

compared with reference sequences from the NCBI GenBank database to infer species-level identity.

Results: Molecular analysis revealed a similarity range of 95–97% between the Zakho isolates and known *Dina* species in existing databases. This level of divergence suggests that the specimens belong to known species.

Conclusion: This research constitutes the first DNA barcode identification for leeches in northern Iraq, addressing a significant geographical gap in scientific literature. The study confirms the efficiency of the standard molecular COI marker for resolving cryptic speciation and highlights the necessity of integrative taxonomy for documenting the genetic diversity of erpobdellid leeches in Mesopotamia.

Keywords: *Dina* sp.; COI barcoding; Zakho District; Erpobdellidae; Iraq

BIO-15 † *prepared from the poster*

Uropathogens and Antibiotic Resistance among Male Patients with Urinary Tract Infections in Duhok, Iraq

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Background/Objective: Urinary tract infections (UTIs) are among the most common bacterial infections worldwide, and rising antimicrobial resistance has reduced the effectiveness of commonly used antibiotics. Infections in males are often complicated, yet region-specific data for Duhok are limited. This study aimed to determine the prevalence of Gram-negative uropathogens and their antimicrobial resistance patterns among male patients with UTIs in Duhok, Iraq.

Methods: Urine isolates from male patients with UTIs were obtained through a private clinical laboratory in Duhok. Gram-negative bacteria were identified and tested for antibiotic susceptibility by disc diffusion.

Results: A total of 129 isolates were recovered: *Escherichia coli* 61 (47.3%), *Klebsiella pneumoniae* 31 (24.0%), *Pseudomonas aeruginosa* 18 (13.9%), *Proteus mirabilis* 12 (9.3%), and *Acinetobacter baumannii* 7 (5.4%). *E. coli* showed high resistance to ampicillin, cefepime, ceftriaxone, and ciprofloxacin, but low resistance to the carbapenems ertapenem and imipenem. *A. baumannii* was the most resistant organism, with 100% resistance to ampicillin and cefazolin and very high resistance to multiple antibiotics.

Conclusion: Gram-negative bacteria, especially *E. coli*, are the main cause of UTIs in males in Duhok. Resistance to commonly used antibiotics is high, while carbapenems remain relatively effective. Continuous monitoring and antimicrobial stewardship programs are essential to improve treatment outcomes.

Keywords: urinary tract infection; male patients; Gram-negative bacteria; antimicrobial resistance; Duhok

BIO-16 † *prepared from the poster*

Prevalence and Characterization of Hydatid Cysts in Sheep, Goats, and Cattle Slaughtered in Zakho, Kurdistan Region, Iraq

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Background/Objective: Cystic echinococcosis (hydatidosis), caused by the larval stage of *Echinococcus granulosus*, is a zoonosis of major public-health and economic importance. Combined data on organ distribution, cyst fertility, and host factors are scarce for Zakho. This study investigated the prevalence, organ distribution, and fertility of hydatid cysts in slaughtered livestock and the role of host sex.

Methods: A cross-sectional abattoir-based study was conducted in Zakho. A total of 7,579 slaughtered animals were examined: 4,019 sheep (606 females, 3,413 males), 168 goats (23 females, 145 males), and 3,392 cattle (1 female, 3,391 males). The liver and lungs were inspected by visual inspection, palpation, and systematic incision. Cyst fluid was collected aseptically, cysts were examined for degeneration and calcification, and the association between sex and organ infection was tested with the chi-square test.

Results: In sheep, 213 lung infections (189 females, 24 males) and 191 liver infections (170 females, 21 males) were recorded, with infection strongly associated with female sex (lung $\chi^2 = 952.90$; liver $\chi^2 = 855.88$; both $p < 0.001$). Goats showed 6 lung infections (3 females, 3 males; $\chi^2 = 6.94$, $p = 0.008$) and no liver infection, while cattle showed a single lung and a single liver infection. Of 267 cysts, 141 (52.8%) were fertile and 126 (47.2%) sterile. Fertility was highest in sheep liver cysts (74/127, 58.3%) compared with sheep lung cysts (67/136, 49.3%), and all cattle cysts were sterile.

Conclusion: Hydatid cyst infection was highest in sheep, with significantly greater prevalence in females, and the liver was the main site of fertile cysts. Cattle showed minimal epidemiological importance. Control programs should prioritize sheep, especially females, and abattoir inspection should focus on the liver and lungs.

Keywords: cystic echinococcosis; hydatid cyst; *Echinococcus granulosus*; livestock; Zakho

BIO-17 † *prepared from the poster*

Clinicopathological Study of Colorectal Cancer: A Retrospective Analysis from the Duhok Governorate, Kurdistan Region of Iraq

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Background/Objective: Colorectal cancer (CRC) is the most prevalent malignancy of the gastrointestinal tract and the fourth leading cause of cancer-related mortality worldwide, and its incidence in Iraq has risen over the past decade. Prognosis depends on factors such as tumor site, patient age, and histopathological grade. This study aimed to evaluate the clinicopathological characteristics of colorectal cancer among 56 patients in Duhok.

Methods: A descriptive, retrospective observational design was used. Patient records were retrieved from Shrvan Hospital, Vin Hospital,

and Duhok Central Laboratory, covering age, gender, tumor location, and histopathological grade. Data were summarized using frequencies and percentages.

Results: Of the 56 patients, 31 (55.4%) were male and 25 (44.6%) female. Most patients were older than 60 years (32, 57.2%), followed by 41–60 years (18, 32.1%) and 20–40 years (6, 10.7%). Moderately differentiated tumors predominated (35, 62.5%), with 6 (10.7%) well differentiated and 6 (10.7%) poorly differentiated. Tumors were located in the colon in 42 patients (75.0%), the rectum in 8 (14.3%), and the sigmoid in 6 (10.7%).

Conclusion: Age distribution, tumor site, and histopathological grade are key variables in guiding treatment decisions and predicting outcomes. These findings underscore the importance of strengthening screening programs and awareness to improve early detection and prognosis.

Keywords: colorectal cancer; clinicopathological features; tumor grade; retrospective study; Duhok

BIO-18 † *prepared from the poster*

The Prevalence of *Klebsiella pneumoniae* and Its Antibiotic Resistance Patterns among Urine Samples in Duhok City

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Background/Objective: *Klebsiella pneumoniae* is an opportunistic pathogen of the family Enterobacteriaceae that causes nosocomial and community-acquired infections, including urinary tract infections, and its rising antibiotic resistance calls for up-to-date local data. This study aimed to identify *K. pneumoniae* in urine samples from patients at Azadi Hospital and to evaluate the antimicrobial susceptibility of the isolates.

Methods: The study was conducted from October 2025 to March 2026 in Duhok city. A total of 234 urine samples were examined, and isolates were identified by morphological and biochemical characterization. Susceptibility to ten antibiotics was determined.

Results: Seventy *K. pneumoniae* isolates were identified. Most patients were female (48/70, 68.57%) compared with male (22/70, 31.42%). The 41–50 years age group had the highest rate of infection (22/70, 31.42%), followed by those aged 51 years and above (17/70, 24.28%). Resistance was highest to tetracycline (78.57%), followed by amoxicillin (64.28%), gentamicin (62.85%), ampicillin (58.57%), and chloramphenicol (57.14%), whereas only 7.14% of isolates were resistant to imipenem.

Conclusion: Females had a higher rate of *K. pneumoniae* urinary infection than males, and the 41–50 years age group was most affected. Imipenem showed adequate activity against *K. pneumoniae*, while tetracycline was the least effective antibiotic.

Keywords: *Klebsiella pneumoniae*; urinary tract infection; antibiotic resistance; imipenem; Duhok

BIO-19 † *prepared from the poster*

Evaluating the Ecological Consequences of Heavy Metal Contamination on Aquatic Ecosystem Functioning in the Tigris River, Iraq

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Background/Objective: Heavy metals released by human activities, such as chromium, nickel, cadmium, lead, iron, copper, and zinc, accumulate in sediments and organisms and threaten freshwater biodiversity and ecosystem function. This study aimed to determine heavy metal concentrations along a pollution gradient of the Tigris River and to relate them to aquatic biodiversity.

Methods: Three sites were studied: Site I (Misharah), a control site with minimal human interference; Site II (Kherab Dem), influenced by domestic wastewater and urban runoff; and Site III (Khanke), receiving untreated tannery effluents and industrial discharges. Metal concentrations were compared with WHO limits, and biodiversity was assessed with the Shannon–Wiener, Simpson, Margalef, and Pielou indices. Data were analyzed by one-way ANOVA with Tukey's HSD test in SPSS 25.

Results: Concentrations of all seven metals rose from Site I to Site III ($p \leq 0.007$), for example iron from 0.41 to 3.83 mg/L, lead from 0.06 to 1.36 mg/L, cadmium from 0.03 to 0.57 mg/L, and chromium from 0.23 to 1.12 mg/L. Iron, lead, cadmium, chromium, and nickel exceeded WHO limits at all sites, while copper and zinc remained below them. Shannon–Wiener diversity declined from 3.12 at Site I to 2.41 at Site II and 1.71 at Site III, and Margalef richness from 4.22 to 2.88 and 1.61 ($p \leq 0.007$).

Conclusion: Heavy metal contamination has severely harmed the ecological stability of the Tigris River. Strict industrial waste control, regular environmental monitoring, and habitat restoration are needed to preserve aquatic biodiversity.

Keywords: heavy metals; Tigris River; biodiversity; water pollution; ecosystem functioning

BIO-20 † *prepared from the poster*

Smartphone Overuse and Sleep Quality: A Study among University Students

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Background/Objective: University students are vulnerable to poor sleep because of academic pressure, social demands, and widespread technology use, and smartphone use before bedtime disrupts sleep through blue-light suppression of melatonin and cognitive arousal. No such study has yet been reported in Iraq. This study aimed to measure smartphone addiction among students, assess its impact on sleep quality, and examine gender differences in smartphone addiction.

Methods: A cross-sectional study was conducted among 500 undergraduate students at the University of Zakho using convenience sampling. A paper-based, self-administered 32-item questionnaire in Arabic and Kurdish covered demographics and average daily

smartphone use, an adapted 18-item Smartphone Addiction Scale (SAS-SV) on a five-point Likert scale, and eight items on smartphone-related sleep disturbance, social preference for phone use, complaints from others, and physical symptoms. Descriptive statistics, independent t-tests, one-way ANOVA, and multiple linear regression were performed for 125 students in GraphPad Prism 9. Ethical approval and informed consent were obtained.

Results: Smartphone addiction scores were similar in male and female students. Students reported an average daily smartphone use of about 5.5 hours, and sleep-disturbance scores rose with smartphone addiction scores, indicating that heavier smartphone use was associated with poorer sleep quality.

Conclusion: Smartphone overuse is associated with poorer sleep quality among University of Zakho students, regardless of gender. Future work will examine physiological markers such as melatonin and heart rate.

Keywords: smartphone addiction; sleep quality; university students; SAS-SV; Zakho

BIO-21 † *prepared from the poster*

Epidermal Micromorphology Study of Some Taxa of *Prunus* Subgenus *Amygdalus* (Rosaceae) in Kurdistan Region, Iraq

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Background/Objective: Members of *Prunus* subgenus *Amygdalus*, about 24 species, are deciduous shrubs or small trees of north temperate mountain forests, and their classification remains unresolved. Epidermal features such as stomata and trichomes vary between taxa and can be used in plant classification. This study investigated anatomical variation in the leaf epidermis of seven taxa and stomatal differences as indicators of ecological adaptation.

Methods: The leaf epidermis of seven taxa (*P. korshinskyi*, *P. arabica*, *P. webbii*, *P. longispinosa*, *P. carduchorum*, *P. argentea*, and *P. dulcis*) was examined by light microscopy and scanning electron microscopy, measuring epidermal cell size and stomatal size, density, and pore aperture on the adaxial and abaxial surfaces.

Results: *P. carduchorum* had the largest adaxial epidermal cells (length 56.4 µm, width 66.7 µm; $P < 0.001$), and *P. korshinskyi* and *P. argentea* the smallest (24.8 and 26.2 µm). On the adaxial surface, *P. webbii* had the longest (50.87 µm) and widest (21.9 µm) stomata ($P < 0.01$), while *P. carduchorum* had the smallest stomata (18.93 µm) but the highest stomatal density (60%), about twice that of the other taxa, followed by *P. dulcis* (35%). *P. arabica* lacked adaxial stomata entirely. Adaxial pore length was greatest in *P. webbii* and *P. argentea* (24.15 and 24.61 µm) and smallest in *P. dulcis* and *P. carduchorum* (12.56 and 13.2 µm). On the abaxial surface, *P. longispinosa* (20.83 µm) and *P. arabica* (20.41 µm) had the longest pores and *P. dulcis* the smallest (8.82 µm).

Conclusion: Epidermal cell dimensions and stomatal size, density, and aperture differ markedly among the studied taxa, providing useful characters for the systematics of *Prunus* subgenus *Amygdalus*.

Keywords: *Prunus*; *Amygdalus*; leaf epidermis; stomata; micromorphology

BIO-22 † *prepared from the poster*

Assessment of Enzymatic and Histological Parameters in *Capoeta trutta* and *Chondrostoma regium* from the Khabour River in Zakho

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Background/Objective: The Khabour River, a major tributary of the Tigris, supports native fish such as the algal grazer *Capoeta trutta* and *Chondrostoma regium*, while the presence of non-native species signals increasing human impact. Research in Iraqi freshwaters has focused mainly on species inventories, leaving sub-lethal effects of stressors on fish health unexplored. This study aimed to assess enzyme activities and histological alterations in the distal intestine and muscle of both species and to compare responses between species and sites.

Methods: Fish were sampled from three sites: Cham-Simo (upstream, low pollution), Zakho Center (urban, moderate pollution), and Qarawilla (downstream, higher pollution). *C. trutta* (n = 5) and *C. regium* (n = 10) were transported alive to the University of Zakho fish laboratory. GOT, GPT, ALP, and LDH activities in the distal intestine and white muscle were measured with a FUJIFILM DRI-CHEM NX500 analyzer. Tissues were fixed in 10% neutral-buffered formalin, embedded in paraffin, sectioned at 4–5 µm, and stained with hematoxylin and eosin. Data were analyzed by ANOVA ($p < 0.05$).

Expected outcomes: Variation in enzyme activities between species and sites, evidence of tissue alterations due to environmental stress, and baseline biomarker data for ecological monitoring of northern Iraqi rivers.

Keywords: *Capoeta trutta*; *Chondrostoma regium*; Khabour River; enzyme activity; histopathology

BIO-23 † *prepared from the poster*

Evaluation of *Xanthium strumarium* on *Cyprinus carpio* Growth, Wellness, and Physiological Responses

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Background/Objective: Aquaculture supplies over half of the fish consumed by humans, and common carp (*Cyprinus carpio*) is one of the most widely farmed species, but intensive systems expose fish to chronic stress. *Xanthium strumarium* (cocklebur, Asteraceae) has a long history in traditional medicine owing to its bioactive compounds. This study aimed to determine the effect of dietary *X. strumarium* on the growth, feed efficiency, and haematological and biochemical profile of *C. carpio*.

Methods: Thirty-six common carp (mean initial weight 100.66 g) were fed diets containing 0 (control), 2.5, 5, or 7.5% *X. strumarium* for 45 days. Growth (weight gain, daily weight gain, relative and

specific growth rates, Fulton condition factor), feed utilization, haematological parameters, leukocyte counts, and serum glucose and lipid profile were measured.

Results: Supplementation at moderate levels (2.5–5%) significantly enhanced growth performance, feed efficiency, immune function, and lipid metabolism. The highest dose (7.5%) induced nephrotoxicity and microcytic anemia, as shown by elevated creatinine and reduced haemoglobin concentrations.

Conclusion: *X. strumarium* is a promising phytogenic feed additive for sustainable aquaculture when used at conservative levels, with careful monitoring of haematological and renal parameters.

Keywords: *Xanthium strumarium*; *Cyprinus carpio*; growth performance; haematology; phytogenic feed additive

Department of Chemistry

6 abstracts · CHE-01 to CHE-06

CHE-01

Rapid Adsorptive Removal of Congo Red Using Green-Synthesized MnO_2 Nanoparticles Derived from Biowaste *Vigna unguiculata* Leaves

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Abstract: The rapid and efficient removal of toxic dyes from wastewater remains a critical environmental challenge, motivating the development of sustainable and high-performance adsorbent materials. In this paper, manganese dioxide nanoparticles (MnO_2 NPs) were fabricated through an environmentally friendly approach using leaf extract from *Vigna unguiculata*. The plant extract, rich in various phytochemical constituents, served as both a natural reducing agent and a stabilizing (capping) agent during the nanoparticle formation process. This green synthesis produced nanocrystals with near-spherical shapes measuring 10–25 nm, exhibiting high purity and a microporous framework. The material showed a surface area of 74.14 $m^2\ g^{-1}$, a pore volume of 0.027 $cm^3\ g^{-1}$, and an average pore size of 1.46 nm. Surface characterization revealed a point of zero charge at pH 6.1 and a zeta potential of −20 mV, indicating excellent colloidal stability. These MnO_2 NPs displayed outstanding adsorption performance for Congo Red, achieving 99.5% dye removal within only 9 minutes at 298 K using 15 mg of adsorbent, with a maximum adsorption capacity of 17.9 mg/g. Equilibrium data were best described by the Langmuir model (qmax = 25.13 mg/g, KL = 0.203 L mg^{-1}, R^2 = 0.9909), indicating monolayer adsorption on relatively uniform active sites. Kinetic analysis revealed that the adsorption closely obeyed a pseudo-second-order model, with an excellent fit (R^2 = 0.9963). Thermodynamic evaluation showed a negative enthalpy change ($\Delta H°$ = −14.56 kJ mol^{-1}) and Gibbs free energy values below zero ($\Delta G° < 0$), confirming the process is both spontaneous and releases heat. The modest $\Delta H°$ magnitude implies that physical interactions, rather than chemical bonding, are the primary drivers of adsorption. The rapid adsorption kinetics, high removal efficiency, and simple green synthesis without dopants or hazardous reagents highlight the strong potential of these MnO_2 nanoparticles for scalable, energy-efficient, and environmentally sustainable dye remediation applications.

Keywords: Congo red; MnO_2 nanoparticles; green synthesis; *Vigna unguiculata*; adsorption

CHE-02

Green-Synthesized CuO Nanoparticles from *Vigna unguiculata* Leaf Extract for Adsorptive Removal of Congo Red: Characterization, Kinetics, Isotherm, and Mechanistic Insights

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Abstract: In this study, a green synthesis approach using aqueous leaf extract of *Vigna unguiculata* was employed as both a reducing and stabilizing agent to fabricate copper oxide nanoparticles (CuO NPs), which were subsequently applied as an adsorbent for the removal of Congo red (CR) dye from aqueous solutions. The synthesized adsorbent was characterized using SEM, EDX elemental composition and mapping, XRD, zeta potential, optical analysis, and N_2 adsorption/desorption analysis, confirming successful formation with a surface area of 23.959 m^2/g and an average crystallite size of 15.2 nm. Batch adsorption experiments revealed that the optimum conditions for CR adsorption onto CuO NPs were achieved at a solution pH of 5.0, an adsorbent dosage of 16 mg, and an initial dye concentration of 28.0 mg/L, with a contact time of 15.0 min at 65 °C. Under these conditions, a maximum adsorption capacity of 35.33 mg/g was achieved, with adsorption following the Langmuir isotherm and pseudo-second-order kinetics, indicating monolayer chemisorption. Thermodynamic analysis confirmed that the process was spontaneous and endothermic. Furthermore, the adsorbent exhibited good reusability, maintaining removal efficiencies from 99.03% to 78.93% over five adsorption–desorption cycles. Mechanistically, adsorption is primarily governed by electrostatic interactions, in which the CuO NP surface becomes positively charged at pH 5.0 (below pHpzc = 6.1), promoting strong attraction to anionic Congo red molecules, as evidenced by the measured zeta potential (−12.9 mV), along with possible π–π and hydrogen-bonding interactions. These findings demonstrate that the green-synthesized CuO NPs provide a cost-effective, efficient, and sustainable adsorbent material with high potential usage for wastewater treatment and encourage further studies on their large-scale application and regeneration performance.

Keywords: Congo red; CuO nanoparticles; green synthesis; *Vigna unguiculata*; adsorption isotherm

CHE-03

Eco-Friendly Adsorbents Derived from Willow Tree Trunk: Preparation, Characterization, Dye Removal Efficiency and Theoretical Study

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Abstract: The growing release of dye-contaminated wastewater has become an important environmental concern, creating a need for low-cost and sustainable treatment materials. In this study, an eco-friendly adsorbent derived from willow tree trunk was prepared and evaluated for its ability to remove dye from aqueous solution. The adsorbent was produced from willow trunk biomass as a natural and abundant precursor, offering a simple and environmentally friendly alternative to more expensive conventional materials. Its performance was investigated through adsorption experiments supported by calibration-curve analysis using UV-Vis spectrophotometry. The dye concentration before and after treatment was calculated using a linear calibration equation, which made it possible to precisely track the adsorption behavior. The findings demonstrated that the willow-derived adsorbent successfully removed dye over the measured concentration range, with the greatest removal effectiveness seen at lower and intermediate dye concentrations and a decrease as the starting concentration rose. These results mean that the adsorbent surfaces have active sites which are crucial to the absorption process. In addition, the theoretical interpretation of the adsorption results supported the practical results that the dye molecules interact with the adsorbent surface through surface binding. Overall, the study demonstrates that willow tree trunk can serve as a promising green adsorbent and applied for dye removal from water and may provide useful low-cost and sustainable wastewater treatment systems.

Keywords: willow tree trunk; eco-friendly adsorbent; dye removal; UV-Vis spectrophotometry; wastewater treatment

CHE-04

Green Synthesis of Ag–Fe Co-Doped ZnO Nanoparticles for Environmental and Catalytic Applications: A Review

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Objective: This review aims to critically estimate recent progresses in the environmentally friendly synthesis of Ag–Fe co-doped ZnO nanoparticles by focused on the effluence of iron and silver co-doping on structural, optical, and catalytic properties. Understanding bio-mediated synthesis methods improve ZnO performance for catalytic and environmental remediation applications is the aim of the study.

Methods: A thorough analysis of existing peer-reviewed literature was supported with an emphasis on environmentally friendly synthesis approaches that use biopolymers, microorganisms, and plant extracts as stabilizing and reducing agents. Utilizing methods like XRD, SEM/TEM, FTIR, UV-Vis spectroscopy, photoluminescence (PL), and BET surface area analysis, the analysis comparations numerous co-doping concentrations and preparation conditions and looks at how they affect physicochemical properties.

Results: According to the reviewed studies, Ag–Fe co-doping meaningfully changes the ZnO crystal structure, reductions bandgap energy, rises absorption of visible light, and prevents electron–hole recombination. Silver improves charge separation and surface plasmon resonance effects, while iron aids in bandgap narrowing and redox activity. Green synthesis approaches afford additional assistances by incorporating natural capping agents that improve the stability and distribution of nanoparticles.

Conclusion: Green-synthesized Ag–Fe co-doped ZnO nanoparticles are a supportable and effective multifunctional nanomaterial for environmental and catalytic applications. Co-doping ZnO with iron and silver improves its optical, electrical, and catalytic properties in a synergistic manner, increasing its efficacy in visible light. Despite capable laboratory-scale results.

Keywords: green synthesis; ZnO nanoparticles; Ag–Fe co-doped; water treatment; catalytic application

CHE-05

Recent Advances in Green Synthesis of Fe-Doped TiO_2 Nanoparticles: Mechanisms, Characterization, and Environmental Applications: A Review

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Background/Objective: The purpose of this review is to disapprovingly assess recent progresses in the environmentally friendly synthesis of Fe-doped TiO_2 nanoparticles, as well as the properties of iron combination on structural and optical modifications, advanced characterization techniques, and their possible applications in environmental remediation.

Methods: A comprehensive literature analysis was directed in order to estimate the most recent progresses in the ecologically friendly synthesis of Fe-doped TiO_2 nanoparticles, concentrating on green synthesis techniques with plant extracts and microorganisms. This review carefully studies synthesis methods, doping strategies, physicochemical characterization techniques (XRD, SEM/TEM, FTIR, UV-Vis DRS, PL), and photocatalytic act assessment approaches.

Results: The examined studies constantly prove that Fe doping effectively decreases the bandgap of TiO_2, characteristically from ~3.2 eV to 2.3–2.8 eV. Dependent on the synthesis conditions and Fe content, photocatalytic degradation efficacies for organic pollutants (like dyes and phenolic compounds) under visible light exposure frequently exceeded 80–95%. Recombination centers were created to be produced by extensive Fe doping, which was said to negatively impact performance. The results also highlight the lack of large-scale validation across studies and variations in repeatability.

Conclusion: Green synthesis is an applied and effective method to produce Fe-doped TiO_2 nanoparticles with improved structural and optical properties appropriate for environmental cleanup. Iron addition significantly increases visible light-driven photocatalytic activity, making these nanomaterials attractive choices for wastewater treatment and antimicrobial applications.

Keywords: green synthesis; TiO_2 nanoparticles; Fe doped; water treatment; mechanisms of nanoparticles

CHE-06

Theoretical Comparison of Composition and Performance Characteristics of Gilsonite and Petroleum Asphalt: Insights from High-Viscosity Local Gilsonite

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Abstract: Gilsonite and petroleum asphalt are hydrocarbon-derived substances of significant industrial relevance, often assessed for their use in paving, coatings, and the energy sector. This study offers a theoretical comparison of their compositions and performance features, focusing on gilsonite samples obtained from Duhok–Akre–Bosil. The findings showed that the local gilsonite has an unusually high viscosity, making practical processing and experimental performance evaluation impractical. As a result, the research relies on analytical characterization, literature comparisons, and theoretical modeling to examine differences in composition, rheological behavior, and potential industrial applications. The outcomes reveal that while petroleum asphalt has manageable viscosity and stable mechanical properties, gilsonite exhibits distinctive structural characteristics that may limit direct application but offer opportunities for modification through blending or chemical treatment. This research establishes a theoretical foundation for comprehending the compositional distinctiveness and industrial prospects of gilsonite in comparison to petroleum asphalt, emphasizing both the challenges and avenues for future enhancement.

Keywords: gilsonite; petroleum asphalt; viscosity; hydrocarbon composition; Duhok

Department of Computer Science

11 abstracts · CS-01 to CS-11

CS-01

A Comparative Study of Deep Convolutional Neural Networks for Facial Attribute Recognition

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Abstract: Facial Attribute Recognition (FAR) is an important task in computer vision because of its applications in biometric systems, surveillance, multimedia retrieval, and human-computer interaction. This study aims to compare the performance of several deep convolutional neural network architectures for recognizing multiple facial attributes from images. A subset of 20,000 images from the CelebA dataset was used, and five facial attributes were selected for evaluation: Male, Attractive, Young, Smiling, and Eyeglasses. Five pretrained models, namely ResNet18, ResNet50, DenseNet121, MobileNetV2, and EfficientNet-B0, were fine-tuned and evaluated using accuracy, precision, recall, F1-score, and area under the ROC curve (AUC). The experimental results showed that DenseNet121 and ResNet50 achieved the strongest overall performance among the tested architectures. DenseNet121 obtained the highest average accuracy of 92.48%, while ResNet50 achieved an average accuracy of 92.39%. The findings also showed that attribute recognition performance varied depending on the type of attribute, with Eyeglasses being easier to classify than more subjective attributes such as Attractive. The study concludes that deep convolutional models, particularly ResNet50 and DenseNet121, are effective choices for facial attribute recognition and provide a strong basis for future real-time applications.

Keywords: facial attribute recognition; deep learning; convolutional neural networks; CelebA dataset; computer vision

CS-02

Ensemble Learning for Skin Lesion Classification

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Abstract: Skin cancer is one of the most common diseases worldwide and can be life threatening. Melanoma is responsible for a large number of skin cancer deaths. Early and accurate identification of skin lesions is important for proper treatment and better patient outcomes. Skin cancer diagnosis relies heavily on visual examination, which can be subjective and dependent on clinical expertise. Automatic skin lesion classification is difficult because lesions vary greatly in shape, color, and appearance, and available labeled data are limited. Variations in image quality, lighting conditions, and acquisition devices further increase the complexity of this task. Single models often fail to perform consistently well across different lesion types and imaging conditions. In this research, we developed and implemented an ensemble learning framework to address these challenges. By strategically combining the predictive strengths of multiple deep learning architectures, our proposed approach effectively reduces individual model bias and variance. The experimental results of our work demonstrate that our ensemble model significantly outperforms single-model configurations in terms of accuracy and reliability. Our findings confirm that this integrated method enhances robustness and generalization across diverse datasets and complex lesion characteristics, providing a more dependable solution for automated skin lesion classification.

Keywords: skin lesion classification; ensemble learning; deep learning; melanoma; medical image analysis

CS-03

Drone Surveillance System

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Abstract: The rapid expansion of unmanned aerial vehicles (UAVs) creates serious security challenges in sensitive areas like airports and military bases. Traditional surveillance systems primarily address ground-based threats, and while conventional radar can monitor low-altitude airspace, such systems are often prohibitively expensive for widespread deployment. To address this, this research develops an intelligent, low-cost drone detection and tracking prototype, designed as a scalable framework intended for future integration with long-range thermal cameras. The proposed system utilizes a standard camera to capture continuous video streams, which are processed on a computer using computer vision algorithms to identify drone-like objects while filtering out environmental false alarms. Once a threat is detected, the processing unit directs an Arduino-controlled servo mechanism to physically track the target in real time while triggering automated alerts. Results show the system effectively detects and tracks drones, successfully bridging PC-based processing power with affordable embedded hardware. Ultimately, this prototype provides a reliable, cost-effective alternative to expensive radar systems, laying the groundwork for advanced, thermal-based protection of restricted airspace.

Keywords: drone detection; computer vision; UAV surveillance; embedded systems; real-time monitoring

CS-04

Autonomous Fire Detection and Suppression Robot Using Arduino and Flame Sensors

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Abstract: Fire outbreaks remain a significant global safety concern, causing extensive loss of life and property each year. Traditional firefighting methods often expose personnel to hazardous environments, including extreme temperatures and toxic smoke. This study presents the design and evaluation of a low-cost autonomous fire detection and suppression robot capable of identifying fire sources, navigating toward them, and extinguishing flames without human intervention. The system is built around an Arduino Uno microcontroller integrated with three infrared (IR) flame sensors arranged at 120° to provide 180° detection coverage, eliminating blind spots. The system is designed to monitor ambient heat levels for improved proximity assessment. The robot employs a differential drive mechanism powered by DC motors and controlled via an L298N motor driver for precise navigation. Fire suppression is achieved using a DC water pump connected to a servo-controlled nozzle for targeted spraying. Experimental evaluation was conducted under controlled laboratory conditions using standardized flame tests. The system achieved 96% detection accuracy across 50 trials, with an average detection delay of 1.5 seconds and a total response time of 11.9 seconds from ignition to extinguishment. A 100% extinguishing success rate was recorded when the robot successfully reached the fire source. The results demonstrate that effective autonomous fire response can be achieved using affordable components, making the system suitable for residential, educational, and small industrial applications while contributing to advancements in autonomous safety robotics.

Keywords: Arduino Uno; fire detection robot; autonomous robotics; IR flame sensors; fire suppression

CS-05

Design and Implementation of an ESP32-S3 Based Smart Gas Monitoring and Emergency Alert System with GSM Notification and Web-Based Control

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Abstract: Gas leakage in residential environments remains a major safety concern due to the risk of fire, explosion, and health hazards. Early detection and rapid response are essential to minimize damage and ensure occupant safety. This paper presents a smart Internet of Things (IoT)-based multi-room gas leakage detection system using the ESP32-S3 as the main controller. The proposed system integrates multiple MQ-series gas sensors installed in different rooms to detect gas concentration and determine the leakage location. Real-time gas levels are displayed through a Wi-Fi-based local web server, enabling users to monitor conditions without relying on external cloud services. When gas concentration exceeds a predefined safety threshold, the system automatically activates a buzzer alarm, sends SMS notifications, and initiates a phone call via a GSM module. Additionally, a solenoid valve is triggered to shut off the gas supply, and a smart window mechanism can be controlled through a mobile application to provide ventilation. Experimental testing demonstrated reliable gas detection performance with fast response time and stable wireless communication. The proposed system offers a low-cost, scalable, and reliable solution for smart home safety applications and enhances real-time monitoring and automated hazard prevention.

Keywords: gas leakage detection; ESP32-S3; Internet of Things; GSM alert system; smart home safety

CS-06

AI-Powered Smart Glass for Real-Time Language Translation

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Abstract: In multilingual regions such as Kurdistan, communication between speakers of different languages remains a major challenge, compounded by limited technology supporting Kurdish and the difficulties faced by hearing-impaired individuals. This project presents an AI-powered smart glass designed for real-time language translation and visual display on an integrated OLED screen. The device connects via Bluetooth and Wi-Fi, enabling versatile use in various scenarios. The prototype employs LILYGO T-Glass smart glasses integrated with an ESP32 microcontroller, capturing audio primarily through the built-in microphone. To ensure reliability under diverse conditions, an alternative approach allows audio input via a mobile application, which transmits data to the microcontroller for processing. Speech is converted to text, translated using AI algorithms, and displayed instantly on the OLED screen. Initial testing indicates that the system can successfully capture, process, and translate spoken language in real time, providing immediate visual feedback. While comprehensive evaluation is ongoing, preliminary results suggest that both native microphone input and application-mediated audio can be utilized effectively. The proposed system demonstrates potential to enhance multilingual communication, offering benefits to students, professionals, and individuals with hearing impairments. Future work will focus on optimizing audio capture, OLED display configuration, translation accuracy, and system reliability to improve usability and accessibility across environments. By integrating AI, flexible audio acquisition, and real-time visual output, this smart glass technology aims to bridge language barriers and support inclusive communication in educational, professional, and social settings.

Keywords: AI-powered smart glasses; real-time language translation; ESP32 microcontroller; multilingual communication; assistive technology

CS-07

A Web and Mobile Integrated Platform for Cosmetic Sales, Offers, and Delivery Management

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Abstract: Point of sale systems (POS) are vital tools that help in the management of cash flow, inventory, and customer relationships in the retail industry. However, many cosmetic organizations still operate with non-integrated POS that are not connected to mobile and online platforms, resulting in fragmented operations, labor-intensive promotion management, and suboptimal dispatch coordination. The proposed system uses a system development research methodology, which includes requirement analysis, system design, implementation, and testing. The backend of the POS system is developed using the Laravel framework, with MySQL as the database management system. The web interface supports product management, offer creation, and sales processing, while RESTful APIs enable seamless integration between the POS system and the mobile application. The findings of the study show that the integrated system can improve efficiency, reduce errors, and increase customer engagement and satisfaction while providing a cost-effective solution for small- and medium-sized cosmetic retailers to remain competitive in the modern e-commerce environment. Furthermore, the system provides an executive dashboard for accurate financial monitoring, real-time API connectivity for instant order processing, and fleet management features for monitoring delivery performance. Overall, the study provides an effective, cost-efficient integrated solution that combines sales management, promotion management, and dispatch coordination for small- and medium-sized cosmetic retailers operating in the modern e-commerce environment.

Keywords: point of sale system; web and mobile integration; cosmetic retail management; inventory management; enterprise resource planning; logistics delivery management

CS-08

Desktop-Based Customs Clearance Management System

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Abstract: Customs clearance offices often rely on manual paperwork and calculations to manage invoices, fees, and financial records, which can lead to errors and inefficiencies. This project proposes the development of a desktop-based Customs Clearance Management System designed to digitize and automate clearance operations. The application allows users to register companies, customs clearances, and workers, enter invoice details such as item type and shipment weight, and automatically calculate customs fees, charges, income, and expenses. The system is designed to be simple, user-friendly, and efficient while ensuring accurate and fast data processing. Its main objective is to assist accountants and clearance staff in recording financial transactions and performing calculations with less manual effort. All records are stored in a centralized database, eliminating the need for paper-based documentation and organizing financial data in a clear and systematic manner. Additionally, the system provides monthly and yearly reports to help monitor transactions and revenues. Overall, the application makes managing customs clearance accounting easier, faster, and more reliable.

Keywords: customs clearance; desktop application; financial management; database; reporting

CS-09 † *prepared from the poster*

Arduino-Based Two-Wheel Self-Balancing Robot

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Abstract: Self-balancing robots behave like an inverted pendulum: they are naturally unstable and need constant corrections to stay upright, which makes them a common model for studying control systems. Many existing solutions rely on advanced mathematics that beginners find difficult, so students often use ready-made code without understanding how the system works. This project designed and built a simple, low-cost two-wheel self-balancing robot that clearly demonstrates the main control concepts. The robot uses an Arduino Uno or Nano, an MPU6050 motion sensor, an L298N motor driver, and two DC gear motors. The tilt angle is estimated with a complementary filter and corrected by a PID controller that adjusts motor speed through PWM signals, programmed in the Arduino IDE. When properly tuned, the robot maintained an upright position for short periods with continuous small corrections, recovered its balance after small pushes, and demonstrated a working real-time feedback loop between sensor input and motor output. The project shows that complementary filtering gives reliable angle estimation, that PID control can stabilize the system, and that a simple Arduino design can bridge control theory and practical learning.

Keywords: self-balancing robot; Arduino; PID control; complementary filter; inverted pendulum

CS-10 † *prepared from the poster*

Pharmacy Management System

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Abstract: Many small pharmacies still handle medicines, prescriptions, and daily transactions manually, which is time-consuming and error-prone: stock levels and expiry dates are hard to track, and billing is slow during busy hours. This project developed a pharmacy management system that organizes pharmacy work in one secure database, built with web technologies and a MySQL database. Its features include adding and updating medicines, tracking stock and

expiry dates, generating bills, storing prescription information, and producing reports. The system made it easier to monitor available medicines and to identify low-stock and near-expiry items; billing became faster and more accurate, with fewer calculation mistakes; prescriptions could be stored and retrieved quickly; and simple reports such as daily sales helped the pharmacist follow business performance. Although basic, the system shows how digital tools can make daily pharmacy work simpler and more organized. Future work includes a mobile version, cloud storage, and prediction of medicine demand.

Keywords: pharmacy management system; inventory management; billing; MySQL; database

CS-11 † *prepared from the poster*

Arduino-Based Automated Rain Detection and Response System

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Abstract: Unexpected rainfall can damage property and waste resources when no one is present to respond. This project designed an Arduino-based embedded system that detects rainfall and responds automatically in real time without human intervention. A rain sensor module detects water droplets through changes in electrical conductivity and signals an Arduino Uno, programmed in the Arduino IDE, which then triggers pre-programmed actions such as activating alerts, controlling connected devices like windows or outdoor equipment, or stopping irrigation. The system detected rainfall quickly and reliably, executed its responses immediately after detection, performed consistently under different weather conditions, and removed the need for constant manual monitoring. Built from affordable, widely available components, the design is cost-effective and can be expanded with more sensors or smart-device integration for homes, agriculture, and industry.

Keywords: Arduino; rain sensor; automation; embedded systems; smart home

Department of Mathematics

4 abstracts · MAT-01 to MAT-04

MAT-01

New Conjugate Gradient Method for Non-Linear Optimisation

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Abstract: In this paper, we propose a new conjugate gradient (CG) algorithm for solving nonlinear unconstrained minimization problems by incorporating a sigmoid activation function into the update formula for the conjugate parameter β_k. This modification dynamically scales the contribution of the previous search direction, which helps prevent direction degradation and enforces a strict descent property at each iteration. We theoretically prove that the proposed method satisfies the sufficient descent condition under both exact and inexact Wolfe line searches. The performance of the new algorithm is rigorously evaluated against the classical Hestenes–Stiefel (HS) method using standard benchmark test functions across dimensions ranging from 4 to 5000. Numerical experiments demonstrate that the proposed approach consistently reduces computational effort, lowering the average number of iterations and function evaluations by approximately 30.43% and 20.75%, respectively. Furthermore, the new algorithm successfully converges on ill-conditioned test problems where the HS method fails entirely. These results confirm that embedding a sigmoid function into the CG framework effectively accelerates convergence, improves numerical robustness, and provides a reliable alternative for large-scale unconstrained optimization.

Keywords: conjugate gradient method; nonlinear optimisation; sigmoid function; Hestenes–Stiefel method; descent condition

MAT-02

An Enhanced Zebra Optimization Algorithm Featuring Cosine Adaptive Scaling for Global Optimization Tasks

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Abstract: The Zebra Optimization Algorithm (ZOA) is a recently developed metaheuristic inspired by the foraging and predator-defense behaviors of zebra herds. Although ZOA has shown potential in solving optimization problems, its reliance on a fixed scaling factor (R) during the defense phase may affect the balance between exploration and exploitation, which can sometimes lead to premature convergence.

In this study, an improved variant, the Cosine Adaptive Zebra Optimization Algorithm (CASZOA), is proposed. The main modification replaces the static scaling constant with a Cosine Adaptive Scaling (CAS) model, enabling a gradual adjustment of the search step size. This allows broader exploration in early iterations and more refined search in later stages.

The performance of CASZOA is evaluated using 23 standard benchmark functions, including unimodal, multimodal, and fixed-dimension multimodal problems. Statistical analysis, such as the Wilcoxon rank-sum test, is also conducted. The results show that CASZOA achieves competitive performance compared to the standard ZOA, with improvements observed in several test cases in terms of convergence behavior and solution quality.

Keywords: Zebra Optimization Algorithm; metaheuristic optimization; adaptive scaling; global optimization; benchmark functions

MAT-03

Mathematical Modeling of Blockchain Network Resilience

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Background/Objective: Blockchain networks are increasingly vulnerable to 51% majority attacks that arise from uneven node power distribution. Existing security frameworks rely on qualitative assessments, leaving a critical gap: no rigorous, closed-form mathematical measure of blockchain network resilience. This study aims to develop an analytical model that quantifies network resilience and attack probability using tools from Information Theory and Probability Theory.

Methods: A closed-form analytical resilience model was developed based on three components: (1) Shannon Entropy $H(P) = -\Sigma\, x_i \cdot \log(x_i)$ as a decentralization measure, where x_i denotes the power share of node i; (2) the objective function $R = H(P) \times N / T$, maximizing resilience R with respect to active node count N and transaction load T; and (3) a Poisson stochastic attack model $P_attack = \Sigma(\lambda^k \cdot e^{-M} / k!) \cdot g(k)$, where λ is the attack rate parameter and g(k) is the per-attack success probability. The model is subject to four constraints: $\Sigma x_i = 1$, $x_i \geq \varepsilon$, $T \leq T_max$, and $d \geq 6$. Simulations were conducted using Python 3.11 with NumPy and SciPy on synthetically generated network distributions with $N \in \{100, 500, 1000, 5000\}$ nodes.

Results: Simulation results demonstrate that uniform power distribution across N = 4 nodes yields maximum Shannon Entropy H(P) = 1.386 nats and resilience R = 0.277 (H(P) = 1.386, N = 1000, T = 5000). In contrast, a centralized configuration with $x_1 = 0.97$ produces $H(P) \approx 0.168$, representing an 88% reduction in entropy compared to the uniform case. Under the Poisson attack model with $\lambda = 0.1$ attacks/month, P(attack ≥ 1) = 9.05%, while increasing node count exponentially reduces attack probability. Sensitivity analysis confirms

that R is most responsive to transaction load T (a 20% increase in T reduces R by 12%), moderately sensitive to node count N (ΔR = +18% for a 50% increase in N), and minimally affected by confirmation depth d.

Conclusion: This study establishes a rigorous, computationally lightweight framework for quantifying blockchain network resilience through the integration of Shannon Entropy and Poisson stochastic modeling. The model requires no protocol modifications and operates via direct closed-form computation, making it applicable to live networks. Findings confirm that decentralized, uniform node power distribution is both mathematically optimal and empirically superior for network security. Future work will extend this framework to dynamic node topologies, validate the model against historical Bitcoin and Ethereum network data, and integrate Byzantine fault tolerance parameters for a more comprehensive resilience measure.

Keywords: blockchain security; Shannon entropy; network resilience; Poisson stochastic model; decentralization

MAT-04 † *prepared from the poster*

Wave Solutions of the KdV Equation via the (1/G′)-Expansion Method

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Abstract: Solitons are stable waves formed by the balance between nonlinearity and dispersion, most famously modeled by the Korteweg–de Vries (KdV) equation, $u_t + u\,u_x + u_{xxx} = 0$. Exact solutions of this equation matter for applications such as fiber-optic telecommunications and plasma dynamics, but methods such as the Hirota and Riccati expansions are limited in the variety of wave structures they reveal. This study applied the (1/G′)-expansion method to the KdV equation. Using the travelling-wave variable $\xi = x - ct$, the equation was reduced to the ordinary differential equation $-cU' + UU' + U''' = 0$, and the solution was expanded as a finite series in powers of $1/G'(\xi)$, where G satisfies the auxiliary equation $G'' + \lambda G' + \mu = 0$. For $\lambda^2 - 4\mu > 0$, exact hyperbolic soliton solutions were obtained, together with a complexiton solution. Three-dimensional, two-dimensional, and contour plots illustrate the characteristics of these solutions. The results show that the (1/G′)-expansion method is an effective and straightforward approach for constructing exact solutions of nonlinear evolution equations.

Keywords: KdV equation; (1/G′)-expansion method; soliton; exact solutions; nonlinear evolution equations

Department of Physics

19 abstracts · PHY-01 to PHY-19

PHY-01

Density Functional Theory: Fundamentals and Applications in Quantum Mechanics

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Abstract: Density Functional Theory (DFT) is a fundamental theoretical framework in quantum physics that provides a rigorous description of many-electron systems. The theory reformulates the complex many-body Schrödinger equation by expressing all ground-state properties as functionals of the electron density rather than the many-electron wavefunction. This conceptual shift significantly reduces the complexity of the problem while preserving the essential physics of the system. The foundation of DFT is established by the Hohenberg–Kohn theorems. The first theorem states that the external potential, and hence all properties of a quantum system, are uniquely determined by the ground-state electron density. The second theorem introduces a variational principle, asserting that the correct ground-state density minimizes the total energy functional. Building on this framework, the Kohn–Sham formalism replaces the interacting electron system with an equivalent non-interacting system that reproduces the same electron density, allowing for a practical representation of the kinetic energy component. A central concept in DFT is the energy functional, which includes contributions from kinetic energy, external potential, classical electron–electron interaction, and exchange-correlation effects. The exchange-correlation term encapsulates the complex many-body interactions and remains formally exact but not explicitly known, making it a key theoretical challenge.

In conclusion, DFT provides a consistent and powerful formalism for describing quantum systems at the ground-state level. Its theoretical structure forms the basis for a wide range of developments in quantum physics and continues to be an area of active conceptual research.

Keywords: density functional theory; Hartree method; Hartree–Fock; Hohenberg–Kohn theorems

PHY-02

Ab Initio Insights into the Structural Stability, Optoelectronic, and Thermodynamic Properties of $LiInI_3$ Perovskite Structure

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Abstract: A first-principles investigation of the structural stability, optoelectronic, and thermodynamic properties of cubic $LiInI_3$ perovskite structure is presented through the framework of density functional theory (DFT). The structural optimization of this study confirms that $LiInI_3$ crystallizes in the Pm-3m space group with a lattice constant of 6.19 Å and a unit-cell volume of 240.66 $Å^3$. The computed negative formation energy (Ef) of −1.53 eV/atom indicates feasible experimental synthesis and strong thermodynamic stability. The calculated bulk modulus (B) of 17.68 GPa suggests a soft yet stable halide structure. The analyzed electronic band structure of the studied perovskite reveals that $LiInI_3$ is a fundamental direct band-gap semiconductor with a minimum band gap of 0.42 eV located at the R symmetry point, where optical transitions are promising. Density of states (DOS) analysis shows that the valence band (VB) is contributed by I-p states, while the conduction band (CB) is mostly formed by In-s and In-p orbitals. The optical calculations of $LiInI_3$ indicate a moderate static refractive index n(ω) of around 2.1 and strong ultraviolet (UV) absorption, with an obvious absorption peak near 13 eV. The dielectric response exhibits a negative real part at high photon energies, demonstrating plasmonic behavior confirmed by a distinct peak in the energy loss function L(ω). Thermodynamic analysis based on the quasi-harmonic Debye model reveals smooth pressure- and temperature-dependent performance of volume (V), free energy, heat capacity (CV), and Debye temperature (θD), confirming excellent vibrational and thermal stability. The results of this research establish $LiInI_3$ as a strong, Pb-free structure with promising potential for photonic and optoelectronic applications.

Keywords: $LiInI_3$; DFT; lead-free halide perovskites; structural stability; electronic band structure; optical properties; dielectric function; thermodynamic properties; ab initio calculations; optoelectronic materials

PHY-03

DFT-Based Study of the Structural, Electronic, Optical, and Thermodynamic Characteristics of $KInI_3$ Perovskite Material

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Abstract: This study investigates the structural, electronic, optical, and thermodynamic properties of $KInI_3$ perovskite using Density Functional Theory (DFT). The primary aim is to evaluate its potential as a lead-free material for high-efficiency solar cells. The methodology employs the GGA-PBE functional for structural optimization and a hybrid functional for accurate electronic calculations. Results confirm that $KInI_3$ is mechanically stable and exhibits a direct bandgap, which is essential for efficient light absorption. Optically, the material shows a high absorption coefficient and low reflectivity across the visible spectrum. Thermodynamic analysis further verifies its stability under varying thermal conditions. In conclusion, the favorable electronic and optical profiles of $KInI_3$ make it a promising candidate for next-generation photovoltaic devices.

Keywords: $KInI_3$; perovskite; density functional theory; optical properties

PHY-04

Imperfections in Solids

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Abstract: Imperfections in solids play a fundamental role in determining the structural and physical characteristics of real-world materials. This study aims to investigate and classify various crystalline defects while analyzing their influence on the physical, mechanical, electrical, and optical properties. The research approach involves a theoretical analysis of crystallographic structures, where defects are categorized based on their dimensionality. This work examines point defects (such as vacancies, interstitials, substitutional atoms, Schottky, and Frenkel defects), linear defects (edge and screw dislocations), surface defects (grain boundaries), and volume defects, focusing on how these irregularities deviate from the ideal lattice. The analysis reveals that imperfections significantly alter material behavior. For instance, point defects like Schottky and Frenkel defects in ionic crystals act as scattering centers for phonons, which directly reduces lattice thermal conductivity. Additionally, the study finds that dislocations impact mechanical strength, while other specific imperfections modify electrical conductivity and create optical effects. In conclusion, understanding crystalline imperfections is essential for materials science. These defects are not merely structural flaws but are critical factors that allow for tailoring material properties to meet specific technological requirements in physics and engineering.

Keywords: crystalline imperfection; point defects; line defects; lattice defects

PHY-05

Oxide-Semiconductor Thin-Film Transistors: A Review

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Abstract: Oxide-semiconductor thin-film transistors (TFTs) have emerged as key enabling devices for next-generation electronic and optoelectronic applications due to their high electron mobility, optical transparency, and compatibility with low-temperature processing. This review critically surveys recent progress in oxide-semiconductor TFT technologies, emphasizing material systems, fabrication techniques, device performance, and reliability considerations. Particular focus is given to indium–gallium–zinc oxide (IGZO), zinc oxide (ZnO), and related multicomponent metal-oxide semiconductors.

Deposition approaches, including sputtering, solution processing, and atomic layer deposition, are examined with respect to their influence on microstructure, defect density, and carrier transport properties. Key electrical parameters such as field-effect mobility, threshold voltage stability, subthreshold swing, and bias-stress reliability are comparatively analyzed. The role of defect engineering, interface optimization, and passivation strategies in improving operational stability and environmental robustness is also discussed.

Compared with conventional amorphous silicon TFTs, oxide-semiconductor devices demonstrate superior mobility and enhanced transparency, enabling high-resolution displays, flexible electronics, and transparent integrated systems. Despite significant advancements, challenges remain in achieving long-term stability, large-area uniformity, and scalable manufacturing. Continued efforts in compositional tuning and process optimization are essential to facilitate reliable, high-performance device integration for industrial applications.

Keywords: oxide-semiconductor TFTs; IGZO; metal-oxide semiconductors; device stability; flexible electronics

PHY-06

Structural and Physical Properties of Carbon Nanotubes and Their Applications

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Abstract: Carbon nanotubes (CNTs) are low-dimensional carbon nanomaterials with exceptional physical and electronic properties, making them a key focus in modern nanophysics. This study aims to investigate the structural and physical characteristics of single-walled and multi-walled carbon nanotubes and to examine their applications in advanced technologies.

A descriptive and analytical approach was used based on reviewing recent scientific literature related to carbon nanotubes. The study focused on nanotube structure, electronic band structure, charge transport properties, and thermal conductivity, as well as reported applications and challenges.

The reviewed studies show that nanotube chirality and diameter strongly influence whether CNTs behave as metals or semiconductors. CNTs exhibit excellent electrical conductivity and high thermal conductivity, making them suitable for nano-electronic devices, field-effect transistors, high-sensitivity sensors, energy storage systems, and thermal management applications. However, challenges remain in synthesis control, scalability, and material stability.

Carbon nanotubes play a critical role in advancing applied physics and nanotechnology. The findings emphasize their strong potential for future nanoscale devices, while highlighting the need for improved fabrication techniques and sustainable production methods.

Keywords: carbon nanotubes; nanophysics; electronic properties; thermal conductivity; nanoelectronics

PHY-07

Investigation of the Physical Properties of Green-Synthesized ZnO Nanoparticles

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Abstract: This review explores the physical characteristics of zinc oxide (ZnO) nanoparticles synthesized through environmentally friendly biological methods. It focuses on their structural, morphological, and optical features, which commonly exhibit a nanoscale hexagonal wurtzite structure with adjustable band gap properties. These features enable their use in areas such as electronics, photocatalysis, and biomedical applications.

Keywords: ZnO nanoparticles; green synthesis; physical properties; XRD; nanotechnology

PHY-08

Sol-Gel Method

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Abstract: This study focuses on the sol–gel method, a chemical technique used to create nanomaterials. The goal is to transform a liquid solution (sol) into a solid network (gel) to control the material's properties at a very small scale. The process uses chemical precursors (like TEOS) through two main steps: hydrolysis and polycondensation. The study focused on how changing pH, catalysts, and temperature can improve the final material. This method works at lower temperatures than older methods and produces high-purity nanopowders and thin films. The sol–gel process is highly effective for nanotechnology. It is essential for making advanced materials used in electronics and medical drug delivery systems.

Keywords: sol-gel method; nanomaterials; chemical synthesis; nanotechnology

PHY-09

Biomass-Derived Carbon Quantum Dots: Green Synthesis, Photoluminescence Mechanisms, and Applications in Heavy-Metal Sensing and Bioimaging

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Abstract: Biomass-derived carbon quantum dots (BCQDs) became known as useful nano-fluorophores, characterized by low cost, eco-friendly production, and superior photophysical characteristics. These carbonate nanoparticles, generally quasi-spherical, size-adjustable (1–10 nm) sp^2-carbon cores covered by multiple surface functional groups, have demonstrated improved fluorescence quantum yields, frequently higher than 10%, and solubility in water. Recent studies emphasize their benefits compared to conventional semiconductor quantum dots, such as non-toxic preparations, reduced toxicity, and ease of massive production. The present review carefully analyzes biomass-derived carbon quantum dots (CQDs), highlighting synthesis methodologies (top-down versus bottom-up: hydrothermal, microwave, pyrolysis, etc.); heteroatom doping and surface passivation; as well as essential photoluminescence (PL) processes (core and surface state emission, excitation dependence, and up-conversion). Further examine double applications in metal-ion detection and bioimaging. For any specific target ion (Fe^{3+}, Cu^{2+}, Hg^{2+}, Cr^{6+}, Pb^{2+}), the sensing methods (PET, static/dynamic quenching, FRET, and inner-filter effect) along with detection limits were examined, as demonstrated by typical cases. Finally, bioimaging efficiency for both in vitro and in vivo, such as organelle selectivity and cytotoxicity, has been examined to identify correlations between structure and function and highlight potential applications for environmental and medicinal nanotechnology.

Keywords: green synthesis; carbon quantum dots; ion detection; bioimaging

PHY-10

Green Synthesis of Carbon Quantum Dots from Mustard Plant for Antimicrobial Application

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Abstract: Carbon quantum dots (CQDs) synthesized via green routes have attracted significant attention due to their tunable optical properties, low toxicity, and potential biomedical applications. This study aims to investigate the effect of hydrothermal reaction temperature on the structural, optical, and antibacterial properties of CQDs derived from mustard plant precursors.

CQDs were synthesized through a one-step hydrothermal carbonization process at three different temperatures (140, 170, and 200 °C) without the use of toxic chemicals or surface passivation agents. The optical properties were characterized using photoluminescence spectroscopy, while structural analysis was performed via X-ray diffraction (XRD). Surface charge and colloidal stability were evaluated using zeta potential measurements. Antibacterial activity was assessed against *Staphylococcus aureus* and *Pseudomonas aeruginosa* using standard inhibition assays.

The CQDs synthesized at 200 °C exhibited pronounced excitation-dependent photoluminescence behavior, with a maximum emission peak at 597 nm under 550 nm excitation. XRD analysis revealed a broad diffraction peak centered at approximately 25°, indicating the formation of amorphous graphitic carbon structures. The zeta potential value of +16.5 mV suggested moderate colloidal stability. Notably, CQDs produced at 200 °C demonstrated superior antibacterial activity against both tested strains compared to those synthesized at lower temperatures. The hydrothermal reaction temperature plays a critical role in tailoring the physicochemical and biological properties of CQDs. Higher synthesis temperatures enhance carbonization degree, improve surface functionalization, and significantly increase antibacterial efficacy. These findings highlight the potential of mustard-derived CQDs as sustainable nanomaterials for antimicrobial and biomedical applications.

Keywords: carbon quantum dots; hydrothermal synthesis; photoluminescence; antibacterial activity; green nanomaterials

PHY-11

Cold Atmospheric Pressure Plasma Jet

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Abstract: Cold atmospheric pressure plasma jet (CPPJ) is a type of discharge that occurs at atmospheric pressure, allowing it to operate under normal atmospheric pressure without using a vacuum system to create the gas discharge. These jets have many uses, including in medicine, materials, as well as for cleaning and killing living cells on the surfaces of materials.

This paper describes a study of CAPPJ generated in He gas via a 28 kHz AC power supply, with peak-to-peak voltage ranging from 0–10 kV. Voltage and current recorded at atmospheric pressure demonstrated smooth sinusoidal behavior, with no current spikes, indicating stable operation of the discharge. The investigation was conducted on the effect of applied voltages and He gas flow rates on the electrical characteristics of the CPPJ, length of plasma jet produced, and gas temperature. The voltage-current character displayed a linear plane, indicating a normal glow discharge with positive resistance. The relationship between voltage, current, power and plasma jet length was linear; an increase in the applied voltage, discharge current, and input power produced longer plasma jets. Additionally, at a constant voltage, the increase in gas flow rate produced longer plasma jets. The measured temperatures at the nozzle exit with a type K thermocouple showed an increase in temperature with increased applied voltages and gas flow rates. The increase in temperature was attributed to the increase in energy supplied to the plasma. The conclusions presented in this paper provide additional information regarding the controllability of electrical and thermal properties for APPJs, in terms of their potential applications.

Keywords: cold atmospheric pressure plasma jet; helium gas flow; plasma jet length; gas temperature; applied voltage

PHY-12

Design of Aperture Antennas Based on Cavity Resonators

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Abstract: This article presents a novel antenna design based on the resonance structure of all gaps. The secondary array is physically implemented utilizing two band X circuit waveguide space resonators, and a novel architecture with just two resonators is suggested for its layout. The first resonator is a TE101 mode conventional half-directed resonator. The second resonator, which is based on a big TE102 resonator, has been altered to keep the TE101 mode in order to spread over the bandwidth of interest and make it easier to connect to the radiating port's two circular ports. The computation is done using the proposed coupling matrix technique. With the addition of the filtering function for the secondary-order realized gain response, the intended frequency response is a typical second-order Chebyshev response. The computation results are validated by simulation data from two simulation programs (CST and Ansoft HFSS). The reflection coefficient (S11 = 10 dB) yields a relatively broad impedance bandwidth of 27.571% at the center frequency of 9.63655 GHz. 7.2 dBi is the peak gain value at 10.75 GHz. Due to the existence of tiny nonradiative regions, radiation techniques have extremely low lateral lobe levels, especially in the E plane. Compared to ours and its predecessor, the suggested architecture offers the benefits of a larger bandwidth and low profile.

Keywords: filtering antennas; waveguides; coupling matrices; aperture antennas; cavity resonators

PHY-13

Solar Energy for Producing Distilled Water

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Abstract: Clean water availability is limited due to pollution and climate change, and conventional purification methods require high energy or complex technologies. To overcome these challenges, solar energy offers an environmentally friendly and sustainable solution through solar distillation, which mimics the Earth's hydrological cycle to produce pure distilled water. This research aims to explore how solar energy can be used to produce distilled water and to compare different methods to find which one is more efficient and practical. This theoretical research involves a comparative analysis between two categories of solar distillation systems: (Passive and Active). For the passive systems, the Pyramid Solar Still and the Simple Solar Still are evaluated. For the active systems, the study examines Solar Collector-integrated Distillers (CID) and Multi-Effect Distillation (MED) Solar systems. The comparison focuses on key performance parameters, including design complexity, evaporation efficiency, and water output, based on existing scientific data and theoretical models. The results of this theoretical comparison indicate that active solar distillation systems, specifically Multi-Effect Distillation (MED), achieve significantly higher freshwater output and evaporation efficiency compared to passive systems. However, passive systems like the Pyramid and Simple Solar Stills demonstrate superior cost-effectiveness and operational simplicity, making them more suitable for individual use in remote rural areas with limited resources. In conclusion, while active systems are more efficient for large-scale water production, passive solar stills remain a practical and sustainable alternative for clean water access in developing regions. This study suggests that the choice of solar distillation method should be based on a balance between the required water volume and the available economic and technical resources.

Keywords: solar distillation; passive vs active systems; water purification; renewable energy; sustainability

PHY-14

Evolution of Dose Equivalent Rate in the Nuclear Laboratory at the University of Zakho

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Abstract: This study aims to study and assess radiation levels at the Nuclear Laboratory at the University of Zakho, during active student experiments, to ensure radiation is safe for the students and staff. A systematic radiation survey was based on measurement of Dose Equivalent Rates H*(10), in units of μSv/hr, as a function of different fixed locations inside the Laboratory. In addition, the data were taken at different distances from the storage shield surface at different angles during active student laboratory sessions at different times of day (9:00, 12:00, 15:00) over two weeks. The preliminary results indicate that dose equivalent rates decrease significantly with increasing distance from the storage box, as we expected. Our results show that the radiation levels (0.1–0.3 mSv/hr) at our laboratory were within or below radiation limitations for members of the public, as determined by the International Commission on Radiological Protection (ICRP), to be under 1 mSv/hr. But unfortunately, we have found a high radiation level, reaching up to 3.5 mSv/hr, at one location inside the laboratory, and this is due to the use of a radioactive source of gamma (Cs-137) with high activity at that location and experiment. While the temporal analysis revealed minimal variation across different days and weeks, minor fluctuations were observed at different times of day corresponding to peak laboratory usage. In conclusion, this study provides a radiation level evaluation and map for the laboratory during the students' usage, which can contribute to improved safety awareness and guide future protective measures.

Keywords: ambient dose equivalent; H*(10); radiation safety; spatial mapping; nuclear laboratory

PHY-15

Radiation Dose and Biological Effects on Humans

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Abstract: Human beings are continuously exposed to background radiation originating from both natural and anthropogenic sources. While low levels of radiation are a normal part of the environment, exposure to ionizing radiation poses significant biological risks due to its ability to penetrate tissues and disrupt cellular structures. This study aims to explain the relationship between radiation dose and its biological effects on the human body. The extent of biological damage depends on the radiation dose absorbed by specific tissues, with highly radiosensitive cells such as those in the bone marrow, gastrointestinal lining, gonads, and epithelial tissues being particularly susceptible. Ionizing radiation exerts its harmful effects through direct and indirect mechanisms. Direct interaction involves ionization of DNA molecules, leading to strand breaks and mutations, while indirect effects occur through the generation of reactive free radicals that damage proteins, lipids, and nucleic acids. The study was conducted using a qualitative descriptive approach based on previously published scientific literature. The findings indicate that radiation effects depend on dose–response relationships and may be classified as deterministic or stochastic, leading to outcomes such as tissue damage, acute radiation syndrome, or increased cancer risk. In conclusion, understanding radiation dose–response relationships and mechanisms of biological damage is essential for improving radiation protection strategies and minimizing potential health risks.

Keywords: ionizing radiation; biological effects; DNA damage; acute radiation syndrome; free radicals

PHY-16

A Theoretical and Practical Study of MRI: A Descriptive Comparison

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Abstract: Magnetic Resonance Imaging (MRI) is a powerful, non-invasive imaging modality widely used for diagnosing and evaluating various anatomical regions and pathological conditions. Despite extensive theoretical knowledge of MRI physics, sequence types, and imaging planes, discrepancies often exist between theoretical principles and practical clinical application. This study aimed to investigate the relationship between theoretical MRI concepts and their practical use across multiple body parts. A combined theoretical and analytical approach based on practical scan data was employed. Relevant scientific literature was identified through electronic databases. Practical data were collected from about 90 MRI scans at the Zakho Emergency Hospital and Shiryan Hospital in Duhok, covering the brain, spine, knee, prostate, and other regions, by recording sequences used, planes applied, and total sequences per body part. Data analysis included visualization of average sequences per body part and plane usage using bar and stacked bar charts. Results indicated that shoulder scans required an average of 6 sequences, while Diffusion-Weighted Imaging (DWI) brain scans used only 1 sequence. Axial and sagittal planes were most commonly applied, whereas coronal planes were used selectively. Regions requiring high anatomical detail consistently employed multiple sequences and planes, aligning with theoretical expectations, while limited-plane scans, such as lumbar and cervical spine, reflected practical constraints and considerations of clinical efficiency. These findings highlight the importance of integrating theoretical MRI knowledge with practical scanning strategies to optimize image quality, reduce scan time, and improve diagnostic accuracy. Standardizing sequence protocols tailored to specific body parts may further enhance MRI efficiency and clinical utility.

Keywords: magnetic resonance imaging; MRI sequences; imaging planes in MRI; MRI protocols

PHY-17

Understanding and Practicing the Principles and Operation of Magnetic Resonance Imaging

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Abstract: Magnetic resonance imaging (MRI) is a medical imaging technique that uses a magnetic field and computer-generated radio

waves to create detailed images of the organs and tissues in the body. Most MRI machines are large, tube-shaped magnets used for diagnosing a wide range of diseases. This project focused on the understanding and practice of the fundamental operation principles of MRI in a simplified and practical manner. In addition, the research explains the basic physics behind MRI and introduces the main components of the MRI system, including the main magnet, gradient coil, RF coil, and the computer processing unit. Moreover, practical learning activities include simulation-based demonstration, safety considerations, patient preparation, and basic operating procedures.

Keywords: magnetic resonance imaging (MRI); nuclear magnetic resonance; T1 imaging; T2 imaging; RF coil

PHY-18

Study of Skin Temperature Changes Before and After Physical Therapy

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Abstract: This study aimed to evaluate changes in temperature and pain levels (both at rest and during movement) after far infrared physical therapy. We also sought to investigate the relationship between temperature changes and pain reduction, as well as the differences between male and female participants.

A total of 80 participants were included (30 males and 50 females). Skin temperature, pain at rest, and pain during movement were assessed before and after treatment. Statistical analysis was performed using paired samples t-test, independent samples t-test, and Pearson correlation analysis.

Skin temperature significantly increased after treatment (34.27 ± 1.68 vs 36.83 ± 1.50, $p < 0.001$). Pain at rest decreased from 7.41 ± 1.53 to 4.31 ± 1.49 ($p < 0.001$), and pain during movement decreased from 6.45 ± 1.12 to 3.43 ± 1.17 ($p < 0.001$). There were no significant differences between male and female participants ($p > 0.05$). Furthermore, no significant correlation was found between the change in temperature and the reduction in pain ($p > 0.05$).

Far infrared physical therapy was associated with a significant increase in skin temperature and a decrease in pain levels. However, the change in temperature was not significantly correlated with the reduction in pain, and no gender differences were observed.

Keywords: skin temperature; physical therapy; gender differences; non-invasive treatment

PHY-19

Air Pollution: Causes, Health Effects, and Sustainable Solutions

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Abstract: Air pollution is a major environmental and public health challenge caused by both natural processes and human activities, including industrial emissions, vehicle exhaust, burning of fossil fuels, deforestation, and agricultural practices, which release harmful pollutants such as particulate matter (PM), nitrogen oxides, sulfur dioxide, carbon monoxide, and volatile organic compounds into the atmosphere. These pollutants significantly degrade air quality and contribute to climate change while posing serious risks to human health, leading to respiratory diseases, cardiovascular conditions, lung cancer, and premature mortality, particularly among vulnerable populations such as children, the elderly, and individuals with pre-existing health conditions. In addition to its health impacts, air pollution also damages ecosystems, reduces biodiversity, and affects agricultural productivity. Addressing this issue requires a combination of sustainable solutions, including the transition to renewable energy sources, implementation of stricter emission regulations, promotion of energy efficiency, adoption of clean transportation systems, urban green planning, and increased public awareness. Collaborative efforts between governments, industries, and communities are essential to mitigate air pollution and ensure a healthier and more sustainable future for both people and the planet.

Keywords: air pollution; environmental health; particulate matter; fossil fuels; respiratory diseases; sustainable solutions; renewable energy; emissions control

College of Medicine

2 abstracts · MED-01 to MED-02

MED-01

Seroprevalence of Anti-Tissue Transglutaminase Antibodies (tTG) IgA and IgG among General Population in Zakho City, Iraq: A Retrospective Study

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Background: Celiac disease is a chronic immune-mediated disorder triggered by gluten ingestion and is often underdiagnosed due to silent or atypical presentations. Serological markers, particularly anti-tissue transglutaminase (anti-tTG) antibodies, are central to screening and early detection. Limited epidemiological data are available regarding celiac seroprevalence in the Kurdistan Region of Iraq. This study aimed to estimate the seroprevalence of anti-tTG antibodies and evaluate associations with age and gender in a laboratory-based population in Zakho City.

Methods: This retrospective cross-sectional study included data from 1,037 participants who were evaluated for anti-tTG IgA and IgG antibodies. The data were obtained from a private laboratory in Zakho, Kurdistan Region of Iraq, between June 2020 and July 2025. Serum samples were analyzed using enzyme-linked immunosorbent assay (ELISA), and results were interpreted according to manufacturer-defined cut-off values. Associations between seropositivity and demographic variables were analyzed statistically.

Results: A total of 1,037 participants (580 females, 457 males; mean age 13.47 ± 12.49 years) were included in the analysis. Anti-tTG IgA positivity was detected in 7.43% of participants, while anti-tTG IgG positivity was observed in 4.73%. Combined IgA and IgG positivity was identified in 2.31% of individuals. Anti-tTG IgA seropositivity was significantly associated with increasing age, with the highest prevalence among individuals aged >45 years ($p = 0.0001$). No statistically significant associations were observed for the remaining variables.

Conclusion: A notable proportion of individuals tested in Zakho demonstrated seropositivity for anti-tTG antibodies, suggesting a potential burden of undiagnosed or subclinical celiac disease. Increasing age was significantly associated with IgA seropositivity, whereas gender showed no significant association. These findings highlight the need for targeted screening strategies and increased clinical awareness to improve early detection and management.

Keywords: celiac disease; anti-tTG antibodies; seroprevalence; ELISA; Kurdistan Region; Iraq

MED-02

Evaluation of Medical Students' Knowledge, Attitudes, and Practices Toward Artificial Intelligence: A Cross-Sectional Study

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Background/Objective: Artificial intelligence (AI) has been recognized as the Fourth Industrial Revolution, fundamentally transforming the work environment. Its applications have extended beyond computer sciences into diverse sectors including education, training, and medicine. This study aims to explore knowledge, attitude, practice and perceived barriers of medical students toward AI.

Methods: This cross-sectional study was conducted among Zakho and Duhok medical students in Iraqi Kurdistan. Data were collected from 575 students between 10 October 2025 and 16 January 2026. A self-administered questionnaire comprising 41 items, divided into five distinct sections, was distributed among students either electronically or via pen and paper. A five-point Likert scale was used to assess participants' responses and statistical analysis was performed using IBM SPSS version 27 software.

Results: The mean age of the participants was 21.31 ± 1.7 SD years. The ratio of pre-clinical and clinical students was approximately equal. Only 19.7% of students had attended a workshop regarding the role of AI in education and healthcare. The majority of participants (77.7%) reported social media as their main source of AI information. Furthermore, only 8.9% of the students did not know what AI is and about two-fifths (38.1%) of students were aware of subtypes of AI. About half (53.2%) strongly agreed and agreed that AI will revolutionize educational systems. In terms of practice, students most commonly utilized AI for homework/assignments (56.5%) and exam preparation (55.8%). The most common barrier for AI utilization was the fear of over-reliance on AI (21%). Better AI knowledge and attitude scores were significantly associated with male gender ($p < 0.001$ and $p = 0.003$, respectively).

Conclusion: A substantial defect was observed in terms of AI education and application in our study. Incorporation of AI into the university curriculum and training emerges as an important step in order to enhance students' skills, capabilities and optimize learning outcomes.

Keywords: artificial intelligence; university; education; curriculum; students

Other Universities

2 abstracts · OTH-01 to OTH-02

OTH-01 † *prepared from the poster*

The Effect of Noise Pollution on the Physiology of the Human Body in Residential Areas

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Background/Objective: Environmental noise in rapidly urbanizing regions is a growing public-health concern, linked to sleep disturbance, elevated blood pressure, and cardiovascular and metabolic effects. Houses and apartments differ in their exposure to noise, but the role of housing type has received little attention. This study examined the effect of environmental noise on physiological and cardiovascular indicators in men and women living in houses versus apartments in Duhok city.

Methods: The study was conducted in Duhok Governorate with 40 participants: 20 living in houses (10 men, 10 women) and 20 living in apartments (10 men, 10 women). Minimum, maximum, and mean sound pressure levels were measured in the dwellings, together with body composition (body fat, muscle mass, body mass index, body water), blood pressure, heart rate, and oxygen saturation (SpO_2).

Results: Housing type and noise exposure levels did not significantly affect the physiological or cardiovascular parameters of participants living in houses or apartments.

Conclusion: Noise exposure did not contribute notably to physiological or cardiovascular effects in this sample, underscoring the importance of broader environmental and lifestyle factors related to housing. Future studies should use longitudinal designs, larger samples, and continuous noise and air-quality monitoring.

Keywords: noise pollution; sound pressure level; blood pressure; housing type; Duhok

OTH-02 † *prepared from the poster*

Prevalence and Clinical Manifestations with Different Methods for Detection of *Helicobacter pylori* Infection in Gastrointestinal Disorders in Duhok, Iraq

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Background/Objective: *Helicobacter pylori* infection is strongly related to gastroduodenal diseases, including peptic ulcer, chronic gastritis, MALT lymphoma, and gastric cancer, yet accurate prevalence data for Iraq remain limited. This study aimed to determine the prevalence of *H. pylori* infection among dyspeptic patients using serology (ELISA) and the urea breath test (UBT), and to identify the most appropriate test across ages and genders.

Methods: A total of 320 patients with gastrointestinal symptoms referred to Shriyan and Vin private hospitals in Duhok were enrolled from October 2024 to December 2024 and tested by serum ELISA and UBT. Patients who had received antimicrobials, proton pump inhibitors, or non-steroidal anti-inflammatory drugs in the month before testing were excluded.

Results: *H. pylori* infection was detected in 88 of 320 patients (27.5%). Infection was more frequent in patients older than 30 years (53/88, 60.2%) than in those younger than 30 (35/88, 39.7%; $p = 0.0104$), and in females (59/88, 67.0%) than in males (29/88, 32.9%; $p < 0.001$). ELISA identified 56 (63.6%) of the positive cases and UBT 32 (36.3%) ($p = 0.00053$).

Conclusion: The prevalence of *H. pylori* among dyspeptic patients in Duhok was 27.5%. Because UBT is fast, relatively inexpensive, and non-invasive, it may be recommended as a primary screening tool where advanced equipment is unavailable.

Keywords: *Helicobacter pylori*; ELISA; urea breath test; prevalence; Duhok

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