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Spring 2026th Semi-annual Scientific Poster Exhibition of Undergraduate Graduation Projects

ABSTRACTS

Deanship of Graduate Studies & Academic Research
College of Science-King Saud University

Acknowledgment of Appreciation

The Deanship of Graduate Studies & Academic Research at the College of Science, King Saud University, extends its sincere appreciation and profound gratitude to King Saud University, a distinguished institution that has long stood as a pillar of academic excellence, scientific innovation, and intellectual leadership in the Kingdom of Saudi Arabia. For decades, the University has played a vital role in advancing higher education, empowering scientific discovery, and fostering a dynamic environment that nurtures researchers, scholars, and future leaders who contribute meaningfully to national and global development.

The College of Science proudly recognizes the University's unwavering commitment to promoting impactful research, supporting graduate studies, encouraging interdisciplinary collaboration, and strengthening innovation ecosystems aligned with the aspirations of Saudi Vision 2030. Through its continuous support of academic and research excellence, King Saud University continues to shape a sustainable knowledge-based future and inspire generations of scientists and innovators. We are honoured to be part of this esteemed academic community and deeply value the guidance, support, and opportunities provided by the University's leadership, faculty, researchers, administrative staff, and students. Their collective dedication remains instrumental in advancing scientific progress and enhancing the quality of education and research.

May King Saud University continue to flourish as a beacon of knowledge, innovation, and excellence, serving the nation and contributing to a brighter and more sustainable future for society.

Deanship of Graduate Studies & Academic Research

College of Science-King Saud University

Letter from the Dean, College of Science

Dear Students, Faculty Members, Researchers, and Distinguished Guests,

Welcome to the Scientific Poster Exhibition for the Graduation Projects of Undergraduate students at College of Science, King Saud University for the second semester of the academic year 1447 H (2025-2026). This exhibition highlights the creativity, innovation, and research excellence of our undergraduate students as well as reflects the College's commitment to fostering a strong culture of scientific research. academic achievement and skills for undergraduate students as a core for developing future scientists and leaders to support the goals of Saudi Vision 2030.

I extend my sincere congratulations to all participating students for their dedication and outstanding efforts, and my appreciation to their supervisors, and organizing committees for their continued support in making this exhibition a success.

Wishing you all a rewarding and memorable experience.

Prof. Zeid A. AlOthman

Dean, College of Science
King Saud University

Letter from the Vice Dean, College of Science for Graduate Studies and Scientific Research

Dear Students, Faculty Members, Researchers, and Distinguished Guests,

It is my great pleasure to welcome you to the Undergraduate Graduation Research Poster Exhibition at the College of Science, King Saud University. This exhibition showcases the creativity, innovation, and research excellence of our students across a wide range of scientific disciplines, reflecting their outstanding academic potential and promising research capabilities. This event represents the College's ongoing commitment to fostering a vibrant culture of scientific research and innovation, while promoting an academic environment that encourages excellence, critical thinking, and creativity. Undergraduate research plays a fundamental role in developing students' analytical and problem-solving skills, strengthening scientific inquiry, and enabling students to transform theoretical knowledge into impactful research projects that contribute to the advancement of society and support the objectives of Saudi Vision 2030. I would like to take this opportunity to extend my sincere congratulations to all participating students for their dedication, hard work, and remarkable achievements. I also express my deepest appreciation to the faculty members, research supervisors, and organizing committees for their continuous support, guidance, and valuable efforts in making this exhibition a successful and inspiring scientific event. It is our hope that this exhibition will continue to inspire innovation, encourage interdisciplinary collaboration, and motivate our students to pursue excellence in research and scientific discovery.

With best wishes for continued success and future achievements.

Prof. Saad A. Aldawood

Vice Dean, College of Science
for Graduate Studies and Scientific Research
King Saud University

Letter from the Vice Dean of the College of Science for Female Students

Praise be to Allah, Lord of the Worlds, and peace and blessings be upon the noblest of Prophets and Messengers.

It is my pleasure to welcome you to the Semi-annual Scientific Poster Exhibition of Undergraduate Graduation Projects at the College of Science, King Saud University. This scientific event reflects the strong support and importance given to scientific research within the College and highlights the outstanding efforts of our students in transforming knowledge into promising research projects and scientific contributions. This exhibition comes as an extension of the College's mission to promote academic excellence and strengthen a culture of research and innovation by empowering students to present the outcomes of their scientific projects and develop critical thinking, analytical, and scientific inquiry skills. These experiences contribute to preparing qualified national talents capable of competing globally and supporting the goals of Saudi Vision 2030. We are also proud of the continuous support and guidance provided by faculty members and research supervisors to our students, as well as the sincere efforts of the organizing committees in presenting this exhibition in a manner that reflects the distinguished reputation of the College of Science and King Saud University. We take great pride in our students and their remarkable scientific achievements, and we hope that this exhibition will serve as an inspiring platform for future creativity, innovation, and scientific excellence.

In closing, I extend my sincere appreciation and gratitude to everyone who contributed to the success of this scientific event, and I pray for continued success and prosperity for all.

Dr. Mona G. Alharbi

Vice Dean of the College of Science for Female Students
King Saud University

Letter from the Assistant Vice Dean, College of Science for Graduate Studies and Scientific Research

Dear Students, Faculty Members, Researchers, and Distinguished Guests,

It is my pleasure to welcome you to the Undergraduate Graduation Projects Scientific Poster Exhibition at the College of Science, King Saud University. This exhibition celebrates the creativity, innovation, and research excellence of our undergraduate students across diverse scientific disciplines. Each poster reflects the dedication, critical thinking, and scientific curiosity of our students, as they transform knowledge into meaningful research contributions while developing valuable academic and professional skills.

The exhibition also reflects the College's commitment to promoting a strong culture of research and innovation and to supporting an inspiring academic environment aligned with the goals of Saudi Vision 2030. Undergraduate research plays a vital role in preparing future scientists, researchers, and innovators who will contribute to scientific advancement and sustainable development. I extend my sincere appreciation to our faculty members, research supervisors, organizing committees, and volunteers for their continuous support and efforts in making this exhibition a success. I also congratulate our students on their outstanding achievements and wish them continued success in their academic and research journeys.

Wishing you all a rewarding and memorable experience at the exhibition.

Prof. Asma A. Alothman

Assistant Vice Dean, College of Science
for Graduate Studies and Scientific Research

Organizing Committee of the Scientific Poster Exhibition for Undergraduate Graduation Projects

On behalf of all its members, the Organizing Committee of the Scientific Poster Exhibition for Undergraduate Graduation Projects at the College of Science, King Saud University, extends its sincere appreciation and deepest gratitude to everyone who contributed to the success of this distinguished scientific event, which truly reflected the spirit of collaboration, excellence, and dedication to scientific research and innovation. We express our profound gratitude to the leadership of the University and the College for their continuous support and generous patronage of scientific and research activities, as well as their ongoing commitment to fostering an inspiring academic environment that enhances students' abilities and strengthens their research skills.

We also extend our heartfelt appreciation to the faculty members and research supervisors for their invaluable guidance, mentorship, and support, which greatly enriched the students' projects and enhanced the quality of their scientific outcomes. We are equally proud of the outstanding research projects presented by our undergraduate students, which demonstrated remarkable creativity, ambition, and scientific excellence, while reflecting their promising potential in research, innovation, and scientific inquiry. We pray that these collective efforts continue to be blessed with success and that this exhibition serves as a platform for further scientific and research achievements, inspiring continued excellence, innovation, and creativity.

With sincere appreciation and gratitude,

Organizing Committee of the Scientific Poster Exhibition
for Undergraduate Graduation Projects

Poster Index

Statistics & Operations Research Department

Mathematics Department

Chemistry Department

Biochemistry Department

Department of Physics and Astronomy

Botany & Microbiology Department

Geology and Geophysics Department

ABSTRACTS

Statistics & Operations Research Department

Evaluating Digital Financial Services in Saudi Arabia using a Multi-Criteria Decision Approach

Fahad Ibrahim Shbabb Alharbi

Dr. Ibrahim M Hezam Al Mishnanah

The study aims to evaluate digital financial services in Saudi Arabia using Multi-Criteria Decision-Making (MCDM) methods by analyzing 12 services based on a set of main and sub-criteria. The methods (BWM) and (AHP) were used to determine criteria weights, while (CoCoFISo) and (EDAS) were applied to rank the alternatives. The results showed that regulatory compliance, anti-money laundering, and security are the most influential factors, whereas personalization has the least impact. The study also found that STC Bank ranks as the best service, confirming the Effectiveness of MCDM models in supporting decision-making in the FinTech sector.

Study of some deterministic and stochastic models in facility location

Abdulaziz Fahad Abdulrahman Alshedi

Dr. Abdelaziz Mokhtar Foul

Facility location constitutes one of the most significant and well-established areas within Operations Research, owing to its wide-ranging relevance to strategic planning and optimal decision making in both public and private sectors. At its core, facility location is concerned with determining the most appropriate site, or set of sites, for the establishment of facilities such as warehouses, manufacturing plants, hospitals, emergency service centers, distribution hubs, and service stations. The present project is motivated by the theoretical depth and practical significance of facility location modeling. It seeks to examine selected deterministic and stochastic models of facility location, with particular attention to their mathematical structure, objective functions, distance measures, and solution methodologies. The study further explores the differences between network-based and planar models, while emphasizing the role of uncertainty in shaping model behavior and influencing optimal decisions. By incorporating illustrative numerical examples and computational approaches, this project also demonstrates how abstract mathematical models can be effectively employed to solve realistic planning and allocation problems.

Project Portfolio Management Selection in Operations Research

Meshal Mohammad Alshammari

Adel Fahad Alrasheedi

The study tackles Project Portfolio Management (PPM) — specifically, how to pick the best combination of projects when money is limited. Traditional methods like NPV ranking or IRR evaluate projects one by one, which doesn't guarantee the best overall portfolio. So the researchers built a 0-1 Integer Linear Programming model where each project is either fully selected or fully rejected, maximizing total NPV within a fixed budget — essentially the classic Knapsack Problem. Applied to 6 candidate projects competing for an $18,000 budget, the model selected Projects 1, 2, 4, and 5 — delivering a maximum total NPV of $57,000. Interestingly, Project 6 was excluded despite its high individual NPV, because smaller projects together yielded more value. This proves portfolio-level thinking beats project-by-project ranking. The model was then extended to handle precedence constraints (project dependencies), and the study discussed future additions like resource constraints, mutual exclusivity, and AI-based risk scoring. The end result is a practical, transparent decision-support tool built in Excel Solver, bridging OR theory with real managerial decision-making.

Statistical modeling of the behavior of shares in some Saudi real estate sectors in light of some key variables

Khaled Yousef Al-Mahmoud

Mahmoud Ibrahim

This research aims to study and analyze stock price movements in the Saudi stock market using statistical methods, in order to understand the nature of price changes and the factors associated with them over a specific time period. This study comes in light of the increasing importance of quantitative analysis in interpreting the behavior of financial markets and supporting investment decisions based on scientific and methodological foundations. The Saudi stock market is one of the most prominent financial markets in the Middle East region, characterized by its large size, the diversity of listed companies, and its high level of liquidity. The market also witnesses continuous development at both the regulatory and economic levels, which has contributed to enhancing its efficiency and increasing its attractiveness to local and foreign investors. This development has led to the availability of rich financial data that can be used to conduct statistical studies and analyze stock price trends. Among the sectors listed on the market, the real estate sector is of particular importance due to its close connection to economic activity, development projects, and urban expansion. Shares in this sector are also characterized by a significant degree of price volatility, resulting from their susceptibility to multiple economic and regulatory factors, making them suitable for statistical analysis and the study of relationships between their various variables. This research relies on studying historical price data to analyze the relationship between certain price variables and track price behavior over time. It aims to provide a statistical description of price movements and uncover general patterns and time trends present in the data, thus contributing to a clearer picture of the nature of the stock market movements under study. The research also aims to highlight the role of statistical methods in financial data analysis by combining the analysis of relationships between variables and the analysis of the evolution of time data. This approach helps improve understanding of price behavior and provides results that can be used in academic studies, in addition to supporting those interested in financial analysis in understanding the nature of fluctuations in the Saudi stock market.

Study and analysis of economic factors affecting inflation in Saudi Arabia: Using the ARDL methodology

Faisal bin Mohammed Al-Shatri

Mahmoud Mohamed Alderiny

This research aims to study and analyze the economic factors affecting inflation rates in the Kingdom of Saudi Arabia using the ARDL methodology. This is achieved by designing a dynamic inflation rate model to study the cointegration relationships between its variables in the short and long run, determine the rate of adjustment to correct the error that occurred in the short run, and predict inflation rates during the period 2026-2030.

The Impact of Domestic and Inbound Tourism on Achieving Saudi Vision 2030 Targets

Feras Khalaf Salem Almalki

Abdulhakim A Albabtain

This research examines the impact of domestic and inbound tourism on achieving Saudi Vision 2030 targets, through quantitative statistical analysis of data spanning the period (2015–2024). The results of five hypotheses confirmed that domestic tourism spending has a significant positive effect on the tourism sector's contribution to GDP, while inbound spending generates a multiplied employment effect on Saudi labor with an elasticity of 1.25. In contrast, the Herfindahl-Hirschman Index revealed a structural challenge in the form of growing geographic concentration among inbound tourism sources, despite emerging diversification trends toward Europe and the Middle East. Regarding future trajectories, the Seasonal Mann-

Kendall test established a statistically significant upward trend in both overnight stays and tourism spending, while leisure tourism recorded exceptional growth of 565% between 2019 and 2024, reflecting the tangible impact of Vision 2030 reforms. The research concludes that the sector is on the right track toward achieving its targets; however, diversifying geographic attraction sources toward new European and Asian markets, and translating growth in spending and overnight stays into more stable visitor number growth, represent the two principal challenges to sustaining and accelerating this momentum.

A Benchmarking Analysis of Particle Swarm and Genetic Optimization Algorithms (PSO & GA) using Python: An Investigative Study on Exploration and Exploitation Balance Across 11 Complex Benchmark Functions

Naif Mohammed AlQahtani

Wael Ibrahim Al Hajailan

This study conducts a comparative benchmarking and investigative analysis of Particle Swarm Optimization (PSO) and Genetic Algorithms (GA) in solving non-linear, multi-dimensional optimization problems using Python. An experimental methodology was adopted to subject both algorithms to intensive performance tests across 11 benchmark functions, designed to simulate complex topographical challenges such as local optima traps and high ruggedness. The research focuses on evaluating the dynamic balance between exploration and exploitation mechanisms, while analyzing the impact of control parameters on convergence speed and solution accuracy. Results demonstrate PSO's superiority in computational efficiency and precision for unimodal functions, whereas GA exhibited an exceptional ability to escape stagnation in chaotic and multimodal environments. This study contributes to understanding the computational behavior of each algorithm, providing a technical framework for selecting the most efficient metaheuristic based on the problem's topographical nature. The study concludes with technical recommendations for optimal parameter tuning to ensure solution stability and minimize overall computational costs in engineering applications.

Application of the Assignment Problem in Operations Research to Human Resource Management

Fares Hassan Alamri

Adel Fahad Alrasheedi

This project, titled “Application of the Assignment Problem in Operations Research to Human Resource Management,” examines how mathematical optimization can improve employee–job assignment decisions in organizations. It highlights the role of Operations Research (OR) as a scientific approach to solving complex problems using quantitative models, and its application in Human Resource Management (HRM). Traditional HR decisions are often based on subjective judgment, which may lead to inefficiency, bias, and poor resource utilization. To address this issue, the project models the employee–job assignment problem using the Assignment Problem framework. A scenario involving multiple applicants and job positions is developed, where each applicant is evaluated based on criteria such as education, experience, technical skills, certifications, language proficiency, and soft skills. These criteria are converted into numerical scores and combined with job-specific weights to generate suitability scores. A mathematical optimization model is then formulated to maximize total job performance efficiency. The model includes constraints ensuring that each applicant is assigned to at most one job, each job receives at most one applicant, and minimum qualification requirements are satisfied. The model is implemented using Microsoft Excel Solver, where binary decision variables represent assignment choices. The results show that the model successfully identifies the optimal assignment, achieving a maximum efficiency score of 77.036. In conclusion, the project demonstrates that OR techniques provide a

structured, objective, and data-driven approach to HR decision-making, improving efficiency, fairness, and overall organizational performance.

Bayesian causal inference: a comparison between Bayesian Additive Regression Trees(BART) & propensity score

Abdullah Turki Bin Jumaiah

Dr. Thamer Munshi

This project aims to compare two models of causal inference on observational data, to evaluate the accuracy and characteristics of each.

A study on the impact of using digital platforms on the academic achievement of students in the College of Science at King Saud University

Hamad Sultan Alqahtani

Mazin Saleh Amin Zaindin

This study aimed to identify the impact of using digital educational platforms (both formal and informal) on the academic achievement of students in the College of Science at King Saud University. It also sought to explore the relationship between the average number of hours spent using these platforms and students' cumulative grade point averages (GPAs), as well as to identify the most significant technical and academic obstacles that limit their effectiveness in teaching scientific disciplines. To achieve the study's objectives, the researcher adopted a descriptive correlational approach, deemed most suitable for the nature of the topic. The study instrument (a questionnaire) was administered to a representative random sample of students from various departments within the College of Science (Mathematics, Statistics, Physics, Chemistry, Biology, and others). The significance of this study lies in highlighting the current state of digital education in applied scientific disciplines, thereby contributing to providing university decision-makers with practical recommendations for improving the quality of e-learning and activating the role of virtual laboratories and simulation programs to enhance learning outcomes and raise academic achievement levels.

Time Series Analysis and Forecasting of Strategic Food Commodity Prices in Saudi Arabia (2009–2025)

Abdualelh Mastour Alomari

Dr. Thamer Munshi

This study applies ARIMA and SARIMA models to forecast the monthly prices of rice, wheat flour, sugar, and vegetable oil in Saudi Arabia (2009–2025), generating 12-month ahead forecasts for 2026 to support food security decision-making.

Inbound and Domestic Tourism Impacts Across Saudi Arabian Regions

Azzam Fahad Alhusayni

Abdulhakim A Albabtain

This study aimed to analyze the inbound and domestic tourism impacts across the thirteen administrative regions of Saudi Arabia from 2015 to 2024, excluding the years affected by the COVID-19 pandemic. The research adopted a comparative analytical approach to test six hypotheses covering tourist numbers, total expenditure, spending structure, and purpose of visit. Statistical analyses were conducted using R, employing appropriate non-parametric tests including the Kruskal-Wallis test, Dunn's post-hoc test, Mann-Whitney U test, and the Chi-Square test. The findings led to the rejection of all six null hypotheses, revealing that geographic location is the strongest determinant of tourism demand and expenditure, with very large effect sizes exceeding 75% in the first four hypotheses. Makkah Al-Mukarramah dominated the tourism landscape in both inbound and domestic tourism. Furthermore, the results demonstrated a clear structural differentiation between inbound and domestic tourism in spending patterns and purpose of visit; religious motives dominated inbound tourism at 47.42%, while leisure

represented the primary motivation for domestic tourists at 39.37%. The study recommends adopting differentiated tourism development policies that account for the unique characteristics of each region and the prevailing tourism type, directing investments according to the structural priorities of each region.

Determinants of Job Offer Acceptance Decisions and Enterprise Performance by Size: A Dual-Pronged Statistical Analysis of the Saudi Labor Market (2010–2024)

Bushra Mohamed alshihah

Dr. Razan abdulaaziz alsehibani

This study examines the Saudi labor market through a dual-pronged quantitative design, integrating micro-level job seeker preferences with macro-level enterprise performance. The purpose is twofold: first, to identify the factors influencing individuals' decisions to accept or reject job offers in Saudi Arabia; and second, to analyze the growth trajectories of Saudi enterprises by size (small, medium, large) from 2010 to 2024. Primary data were collected via a structured survey of 101 individuals who had received at least one job offer in the preceding five years. The survey measured the importance of nine motivators—base salary, benefits, work pattern, growth opportunities, job title, company reputation, work culture, work location, and job security—on a 5-point Likert scale. Secondary data on enterprise counts, employment, revenues, and profits were obtained from official Saudi records and analyzed using compound annual growth rates (CAGR) and Spearman's rank correlation. Statistical analyses employed non-parametric tests, including Mann-Whitney U, Kruskal-Wallis, Chi-square, and Spearman's rank correlation. The results revealed that base salary (M = 4.1) and company reputation (M = 3.8) were the most influential motivators, with no significant demographic differences in preferences. Financial and non-financial motivators were positively correlated, and acceptors and rejectors valued the same attributes. At the macro level, large enterprises (20+ employees) exhibited the fastest growth, with employment and profits growing at compound annual rates of 12.2% and 12.9%, respectively. A very strong positive correlation was found between operating revenues and profits ($\rho = .94$, $p < .001$). Integrative linking hypotheses confirmed that large firms are structurally best positioned to meet job seekers' priorities, while small and medium enterprises can differentiate through culture and flexibility. These findings offer evidence-based guidance for employers seeking to attract Saudi talent and for policymakers advancing the workforce objectives of Saudi Vision 2030.

Predicting Drug-Drug Interaction Side Effects with Graph Neural Networks: A Decagon-Based Approach

Leen Khalid Alsaif

Boshra Khalid Alarfaj

Polypharmacy has become a significant public health challenge globally, carrying a high risk of adverse drug-drug interactions. And identifying which specific side effect will result from taking a certain drug combination is a big challenge, as traditional clinical trials can be hard due to the amount of drugs that need to be tested. This study suggests the application of the Decagon graph convolutional network as an approach to predict what specific side effects can be caused by taking a certain drug combination. The dataset used in this study was a TWOSIDES polypharmacy dataset, which contains 4,649,441 drug pair side effect interactions with 645 unique drugs and 1,317 unique side effect types. Before modeling, a Spearman correlation test was done to examine the relationship between drug degrees in the network and the number of side effect occurrences, results showed a strong positive correlation with ρ=0.9539, confirming that network structure carries meaningful information. The Decagon model encodes each drug as a 32-dimensional embedding through a two layer's graph convolutional encoder and decodes drug pair embeddings into probability

scores across all side effect types. The five highest ranked predictions generated by the model, and the top ranked prediction was a combination of the drug pairs Pyrimethamine and Aliskiren which resulted in a high predicted probability of getting sarcoma as a side effect. These findings show that graph convolutional networks can accurately predict specific drug-drug interaction side effects from a network structure, providing a statistical basis for improving patient safety when multiple drugs are prescribed together.

Analyzing Oil Consumption and Exports in Saudi Arabia Using Time Series Models in the Context of Vision 2030 Toward Reducing Oil Dependency.

Shahla abdulrahman albahdal

Dr. Maha ahmed omair

This study analyzes Saudi Arabia's domestic oil consumption and crude oil exports (2011-2024) using time series models to assess alignment with Vision 2030's oil dependency reduction goals. Utilizing SARIMA for consumption and ARMA for exports, forecasts for 2025 show a 10.53% decrease in domestic consumption, indicating successful energy efficiency. However, a 7.16% increase in exports suggests continued reliance on oil revenues. The Peña-Rodríguez (2006) test validated model accuracy.

Predicting the Monthly Inflation Rate in Saudi Arabia Using SARIMA Time Series Models

Hayat Yahya Alqarni

Arwa Al-Shanqiti

This study aims to analyze and forecast the monthly inflation rate in Saudi Arabia using "SARIMA" seasonal time series model, based on monthly data from 2016 to 2023. Time series methods were applied to select the optimal model and evaluate its predictive efficiency. The results showed that the SARIMA model has a good ability to represent inflation data and predict its future trends with reasonable accuracy, thus supporting economic planning and data-driven decision-making.

The Impact of Paper Checks and POS Activity on Digital Transformation in Saudi Cities

Lamees Fadhel Alharbi

Dr. Amal Abdallah Almohisen

This study analyzed the impact of paper checks and POS activity on the digital transformation index in 9 Saudi cities (2016-2023) using SAMA data and Pooled OLS with Newey-West errors. Results showed checks have a significant negative impact, service quality is insignificant, with a positive time effect and negative seasonal effect in Q4. The model explains 75.6% of the variance. The study recommends accelerating e- checks adoption and intensifying pre-Q4 awareness campaigns.

Tourism in Saudi Provinces: Clustering and Regression Analysis

Ghala Turki Al Daghrer

Weaam Alhadlaq

Tourism in Saudi Arabia has grown rapidly in recent years, particularly after the adoption of Vision 2030. This study analyzes tourism patterns across Saudi provinces using tourist spending and average number of tourists per night. Provinces were classified into three categories using K-Means and Gaussian Mixture Models (GMM) approaches, yielding consistent results, with statistical tests confirming the significance of the clusters. The study further employs a Fixed-Effects Model to account for province variations and a simple linear regression to examine the relationship between tourist numbers and spending. The results offer a clearer understanding of regional tourism patterns and their economic implications, which can support future research and strategic planning.

Examining the Iron-Thyroid Relationship: An Analysis of Pathways, Confounders, and Effect Modification

Lena Zuhair Ghuraibi

Yusra Abdullateef Tashkandy

This study investigates the relationship between iron levels and thyroid function while considering the influence of multiple physiological factors. Using a large dataset of 48,908 observations collected between 2015 and 2023, the research examines how indicators of iron status—including serum iron, ferritin, and total iron-binding capacity (TIBC)—are associated with thyroid hormones (TSH, T3, and T4) and various thyroid disorders. Additional health factors such as kidney function, liver enzymes, electrolytes, blood lipids, glucose levels, inflammation markers, complete blood count parameters, and vitamin levels were analyzed as potential confounders and effect modifiers. After removing observations with missing thyroid variables, the final sample included 33,562 cases. Descriptive statistics, Pearson and Spearman correlations, partial correlations, independent t-tests, and ordinal regression models were used to evaluate associations between variables. The findings indicate that iron-related variables are significantly associated with several thyroid indicators, although the strength of the relationships varies when controlling for other physiological factors. Regression models suggest that iron status may act as an indicator of thyroid dysfunction rather than a direct causal determinant. Overall, the results highlight the complexity of the iron–thyroid relationship and emphasize the importance of considering broader metabolic and physiological conditions when evaluating thyroid health.

Measuring the impact of a shutdown at a major Domestic Airport in Saudi Arabia using Network Analysis

Layan Alzaidi

Boshra Khalid Alarfaj

This study examines the impact of shutdown at a major airport on the structure and performance of the domestic air transportation network in the Kingdom of Saudi Arabia using network analysis methods. The network is modeled as a system of nodes representing airports and edges representing flight routes, with the number of flights used as a weight to capture connection strength. The results reveal a concentration of connectivity in a small number of major airports, such as Riyadh, Jeddah, and Dammam, highlighting their roles as key hubs. Network metrics indicate that the system exhibits small-world characteristics, reflecting efficient connectivity alongside strong local clustering. In the applied analysis, Riyadh Airport was identified as the most critical node based on centrality measures, particularly betweenness centrality. A disruption scenario was simulated by removing the airport and recalculating network metrics. The network remained fully connected, indicating structural resilience; however, its efficiency declined. The increase in average path length suggests that reaching destinations requires more connections (i.e., shifting from direct flights to multi-leg journeys), while the decrease in the clustering coefficient reflects reduced local connectivity among airports. Alternative scenarios, involving the redistribution of flights to nearby airports such as Qassim and Dawadmi, improved network performance compared to the disruption case, demonstrating the network's adaptability. Overall, the findings show that disruptions have a greater impact on network efficiency than on connectivity, emphasizing the value of network analysis in supporting decision-making for air transport planning and resilience.

Forecasting Al Rajhi Bank Stock: A Time Series Approach to Saudi Arabia's Most Valuable Listed Bank

Norah Sultan Alarfaj

Dr. Maha ahmed omair

This study models Al Rajhi Bank's stock price (2010–2025) using time series analysis on 192 monthly observations from Tadawul. A SARIMA$(1,1,0)(2,2,1)_{12}$ model was identified as the best fit, with forecasts for 2026 ranging from SAR 94.50 to SAR 104.97. The model's accuracy was validated against actual Q1 2026 prices, which fell within predicted intervals. A complementary seasonal strategy — buying in October and selling in January — achieved a 66.67% success rate and 5.58% average annual return historically, with the 2025–2026 cycle already confirming a 20.07% return.

Analysis of Cancer Incidence Rates in Saudi Adults During 2023

Rwan Hassan Alfaifi

Dr. Amal Abdallah Almohisen

This study analyzes cancer incidence patterns in Saudi Arabia using data from the Saudi Cancer incidence report 2023. It examines variations in incidence rates by cancer type, gender, and age group using descriptive statistics, ANOVA, Poisson, and negative binomial regression models. The results show that cancer incidence differs significantly across cancer types and age groups, with age identified as the most influential factor. However, gender was not found to be statistically significant. These findings highlight the importance of age in understanding cancer incidence patterns and support the use of statistical models in population-based analyses.

Analysis and forecast of Banking Deposits in the Kingdom of Saudi Arabia

Lena al jarrah

Reem Abdullah Alghamdi

Saudi Arabia and forecast their future values using time series models for the period from 2000 to 2024. It also examines the effect of key economic factors such as interest rates, inflation, and gross domestic product (GDP) on deposit behavior using descriptive statistics. The results show a clear increase in bank deposits, along with a good level of forecasting accuracy, which helps in understanding depositor behavior and supporting better economic decisions.

Mathematics Department

Mathematical Tools in Finance

Saud Saleh Alhwiesh

Dr. Fawzi Ahmed Al-Thukair

This research explores the role of mathematical tools in modern finance, highlighting the shift from intuition-based decisions to quantitative models. It introduces key concepts such as probability, calculus, and linear algebra, and explains their applications in pricing financial derivatives and managing risk. The study also presents important models like the binomial model and the Black-Scholes formula. Furthermore, it discusses portfolio construction and risk measurement techniques. Finally, the research evaluates the strengths and limitations of mathematical models in real-world applications.

An Introduction to Riemannian Geometry and Curvature

Abdullah Bassam AlMubereek

Prof. Nasser Bin Turki

The main goal of this project is to introduce the basic concepts of Riemannian geometry in a clear and accessible way, focusing

on intuition, examples, and geometric meaning rather than technical complexity.

On the Logical Equivalence of Induction Principles and the Structural Properties of the Natural Numbers

Linah Adel Alkhudair

Dr. Ibtesam Bajunaid

This research investigates the logical structure of the natural numbers $\mathbb{N}$ through three fundamental concepts: the Principle of Mathematical Induction (PMI), the Principle of Complete Induction (PCI), and the Well-Ordering Property (WOP). The study begins by demonstrating the efficacy of mathematical induction as a formal tool for proving mathematical laws, followed by an analysis of complete induction and its applications in complex problems such as the Fibonacci sequence and the Fundamental Theorem of Arithmetic. Furthermore, the research explores the significance of the Well-Ordering Property in proving the Division Algorithm and the irrationality of $\sqrt{2}$. The primary objective of this work is to establish the logical equivalence between these three principles, proving that they constitute a unified axiomatic framework where accepting any one principle necessitates the acceptance of the others. Finally, the study examines the order properties of $\mathbb{N}$ to demonstrate that every non-empty, upper-bounded subset of natural numbers possesses a maximum element. This profound interconnection highlights the robust structural integrity of the natural number system, which serves as the essential basis for all rigorous mathematical proofs.

Evaluating and Applying Generative Artificial Intelligence for Mathematical Understanding through Prompt Engineering

Lujain Mansour Ghatasha

Prof. Najla Altwaijry

This project explores the role of Generative AI in supporting undergraduate mathematics education, specifically focusing on the impact of "Prompt Engineering" on enhancing output quality. The methodology follows an empirical and analytical approach, starting with testing various prompting strategies, such as Chain-of-Thought and constrained prompting, on specialized mathematical topics. Furthermore, the work involves designing a preliminary educational prototype powered by structured prompt templates to improve mathematical comprehension. The research aims to evaluate the accuracy and reliability of these outputs while discussing limitations related to hallucinations and ethical considerations, contributing to a critical perspective on how to effectively integrate these technologies into educational environments.

The role of topology in modern machine learning

Leen Rabea Alwahaiby

Prof. Maysaa AlQurashi

Topology studies the structural properties of spaces that remain unchanged under continuous transformations. In modern machine learning, topological methods help analyze the geometric structure of complex and high dimensional datasets that traditional statistical techniques may fail to capture. One important approach is Topological Data Analysis (TDA), which uses tools such as persistent homology to identify features like connected components, loops, and holes within data. These features describe the global shape of the dataset and help distinguish meaningful patterns from noise. By revealing the underlying structure of data,

topology contributes to several machine learning tasks including feature extraction, dimensionality reduction, clustering, and improving the interpretability of models. As datasets continue to grow in complexity and size, topological methods provide powerful tools for understanding the hidden structure of data.

Shortest Path Problems in Graph Theory and Some of Their Applications

Noura Mustafa Alosman

Dr. Norah Hassan Alshehri

This research explores the shortest path problem in graph theory, recognizing it as a fundamental issue in applied mathematics and computer science. It presents the basic concepts related to graphs and paths, and examines several algorithms used to find the shortest route, namely Dijkstra, Bellman-Ford, A*, and Floyd-Warshall. The study also includes a comparison of these algorithms in terms of their working mechanisms, efficiency, advantages, and limitations, while outlining the appropriate use cases for each. Furthermore, the research reviews the applications of these algorithms across a variety of fields, such as navigation systems and digital mapping, logistics and supply chain management, artificial intelligence, and video games. It also highlights their use in social network analysis, financial markets, network and circuit design, disease spread tracking, and natural language processing. Ultimately, this research aims to highlight the connection between theoretical foundations and practical applications, demonstrating how these algorithms are employed to solve diverse, real-world problems.

Chemistry Department

Design, synthesis, and characterization of 'phenylspiro[indeno[1,2-b]quinoxaline-11,2'-pyrrolidin] derivatives tethered with 2-phenylpropene-1-one

Ibrahim Abdulrahman Ibrahim Alabdullatif

Dr. Abdulmajeed Alayaf

This study reports the synthesis of a series of chalcone derivatives (2a–f) and 11H-indeno[1,2-b]quinoxalin-11-one (3) following established literature procedures (Schemes 1 and 2). The synthetic route employs a convergent strategy: chalcone intermediates (2a–f) were prepared via Claisen–Schmidt condensation of substituted aromatic aldehydes (1a–f) with acetone, while the quinoxaline scaffold (3) was obtained through condensation of ninhydrin with o-phenylenediamine. Subsequently, these key intermediates were utilized in the synthesis of biologically relevant spiro[indeno[1,2-b]quinoxaline-11,2′-pyrrolidin] derivatives (5a–f) via a one-pot, multicomponent [3+2] cycloaddition. This transformation involves the reaction of chalcones (2a–f) with an azomethine ylide generated in situ from compound 3 and L-Methionine 4 in methanol at 65–70 °C for 24 h (Scheme 3). The resulting spiro compounds (5a–f) constitute privileged scaffolds with potential medicinal relevance, particularly as candidates for targeting kinase-associated pathways and cancer cell lines.

Fabrication of hybrid nano-composite as electrocatalyst for water splitting

Moath Ibrahim alharbi

Dr. Riyadh Alshammari

This study focuses on developing cost-effective catalysts for water electrolysis to produce clean hydrogen energy. By using affordable materials like egg whites (as a carbon source) combined with nickel and iron nanoparticles, the researchers created a highly efficient catalyst. The results demonstrated excellent performance in both acidic and alkaline conditions, offering a practical and sustainable

alternative to expensive traditional materials for green energy applications.

Preparation and Characterization of Mixed Metal Oxides (Mo–Fe) via the Co-precipitation Method for Environmental Applications

Majed Matar Alharbi

Khalid abdullah alrshidi

This research investigates the optimization of water treatment methodologies through advanced chemical techniques, specifically focusing on the design and application of nanocatalysts to address industrial pollutants resistant to conventional treatments. Central to this study is the synthesis of a molybdenum-iron (Mo–Fe) mixed oxide via the coprecipitation method, aimed at facilitating the degradation of persistent organic dyes and pollutants. The synthesized catalytic materials underwent rigorous characterization to evaluate their structural and thermal properties. Energy-Dispersive X-ray Spectroscopy (EDS) confirmed high-purity composition, yielding approximately 46.55 mass% Mo, 18.74 mass% Fe, and 34.71 mass% O. Morphological assessment using Scanning Electron Microscopy (SEM) revealed irregular, porous, and agglomerated granular structures, which are conducive to high catalytic activity. Furthermore, Transmission Electron Microscopy (TEM) verified the nanoscale nature of the particles, with primary diameters ranging between 15–30 nm. Thermal stability analysis (TGA) indicated robust performance, with 92.12% mass retention up to 800 °C, ensuring suitability for high-energy photocatalytic oxidation processes. The findings demonstrate that the Mo–Fe mixed oxide possesses the necessary purity, porosity, and thermal resilience to serve as an efficient catalyst for wastewater remediation. By providing an innovative, sustainable solution for improving water quality, this project contributes to environmental protection and aligns with the Kingdom's strategic transition toward a green economy, showcasing the integration of advanced chemical theory with practical environmental applications.

Synthesis and Characterization of Sodium Alginate/Tannic Acid Hydrogels for Dye Removal Applications

Faihan Mobark Alqhtani

Dr. Sultan Saad Almadhhi

Industrial wastewater having synthetic dyes is considered one of the common sources of water pollution. In this study, hydrogels based on sodium alginate and tannic acid were prepared using calcium chloride as a crosslinking agent. Three hydrogel samples (HG1, HG2, and HG3) were prepared using different ratios of sodium alginate and tannic acid. The prepared samples we are further tested using methylene blue (MB), crystal violet (CV), eosin orange (EO), and trypan red (TR) dye solutions. The adsorption experiments were carried out by mixing the hydrogel samples with contaminated aqueous solutions followed by shaking for 24 h before UV–Visible analysis. The results showed better dye removal for MB and CV compared with EO and TR. HG3 showed the highest removal for MB, while HG2 showed better removal for CV. FTIR analysis showed the characteristic functional groups of sodium alginate and tannic acid in the prepared hydrogels. Thermal properties of the samples were also studied using TGA and DSC analyses. The obtained results suggest that the prepared hydrogels have good adsorption behaviours and promising properties for dye-removal and water-treatment applications.

Selective Oxidation of Ethylbenzene to Oxygenated organic Products over Spinel ($CoO/CoFe_2O_4$) Catalysts Using (H_2O_2) as a green oxidizing agent.

Faisal turki Alhuqaili

Dr. Saad Al-Qahtani

This study synthesized a blended metal oxide catalyst [$CoO/CoFe_2O_4$] via co-precipitation and applied it to oxidize ethylbenzene to acetophenone. The prepared catalyst was characterized by FT-IR, XRD, SEM, TEM, and TGA to evaluate structural, morphological, and thermal properties. Results confirmed a spinel [$CoFe_2O_4$] structure with [CoO] as a secondary phase, nanoscale particle size, and validated thermal stability. Catalytic performance was assessed by varying catalyst loading, reaction temperature, reaction time, and reusability. Increasing catalyst amount improved conversion; optimal conditions were 75 °C and 6 hours, achieving high selectivity to acetophenone. The catalyst demonstrated notable stability and maintained activity over multiple cycles after washing with water and ethanol, indicating [$CoO/CoFe_2O_4$] is an effective catalyst for selective oxidation of ethylbenzene.

Synthesis and Spectroscopic Studies of Aminoquinoline complexes

Abdullah Abdulaziz Alkahtani

Rajih Dheeb Al-Otaibi

Transition-metal complexes with heterocyclic ligands, especially quinoline derivatives, have gained significant attention due to their wide applications in catalysis, photophysics, and photochemistry. Quinoline compounds are commonly found in natural and synthetic products and are widely used in medicine, pharmaceuticals, sensor technology, and dye production. Quinoline alkaloids exhibit diverse biological activities, including antimicrobial, anticancer, anti-inflammatory, anti-HIV, antiallergic, analgesic, and antimalarial effects, making them highly valuable in medicinal chemistry. In coordination chemistry, quinoline derivatives are important because of their strong chelating ability, which contributes to structural stability and enhances photophysical and catalytic properties. The nitrogen atom in the quinoline ring plays a key role in influencing electronic energy states and interactions with metal ions. Aminoquinoline, in particular, is a fluorescent molecule used in sensing, supramolecular chemistry, and electron transfer studies. Recent research highlights that substituted quinolines exhibit unique photophysical behavior influenced by factors such as intramolecular charge transfer and solvent effects. Based on these properties, complexes of Co(II), Ni(II), and Cu(II) with 3-aminoquinoline were synthesized and characterized using elemental and spectroscopic techniques, along with thermal analysis to study their stability.

Green Synthesis of a Pd–Carbon Composite from PET Waste and Its Application in the Catalytic Hydrogenation of Furfural to Furfuryl Alcohol

Mohammad Omar Alattas

Dr. Osamah Alduhaish

The growing accumulation of PET waste and its limited recycling efficiency highlight the urgent need for sustainable valorization strategies that convert plastic waste into high-value functional materials. This project aims to develop a green and integrated approach to transform PET waste into a palladium–carbon (Pd/C–PET) composite catalyst and evaluate its performance in biomass upgrading reactions, specifically the transfer hydrogenation of furfural to furfuryl alcohol. The novelty of this work lies in combining PET depolymerization, hydrothermal carbonization, and in-situ reduction of Pd^{2+} into a single-step process, thereby eliminating the need for separate carbon support preparation. This study presents a green approach to convert PET waste into a Pd/C–PET nanocomposite via alkaline hydrothermal treatment, where PET depolymerizes, glucose forms a carbon matrix, and Pd^{2+} is reduced to Pd nanoparticles, yielding

a catalyst derived from plastic waste. XRD and TGA confirm fcc Pd nanoparticles on a PET-derived carbon support, with thermal stability up to ~300 °C and major carbon loss at 350–520 °C; a mild calcination at 280 °C removes residual species and PET crystallinity while preserving the Pd phase on an amorphous carbon matrix. The Pd/C–PET catalyst shows low activity for furfural transfer hydrogenation, likely due to blocked or oxidized Pd sites, indicating the need for improved activation and optimization, while still demonstrating the feasibility of converting PET waste into Pd–carbon catalysts for biomass upgrading. This work is significant as it integrates plastic waste recycling with catalyst design and biomass valorization, contributing to circular economy concepts, green chemistry principles, and sustainable chemical production.

Synthesis and Characterization of Carbon Dots and Their Fluorescence Properties

Yousef Awad Alanzi

Dr. Mohammed Rafe Hatshan

Preparing Carbon Dots from Saudi coffee

Synthesis, Characterization and Investigation of Potential Application of Ag - doped $ZnMoO_4$

Layan Fayez Alshashaa

Dr. Nouf Alotaibi

In this study, pure and silver (Ag)-doped zinc molybdate ($ZnMoO_4$) nano- particles were successfully synthesized using a cost-effective chemical co- precipitation method, followed by calcination at 550°C. The silver concentration was varied from (0.5 to 5%). X-ray diffraction (XRD) analysis confirmed the formation of a highly crystalline monoclinic phase, in good agreement with JCPDS card No. 35-0765, with no detectable secondary phases. The observed peak shifts and broadening in the doped samples suggested lattice distortion and a reduction in crystallite size, confirming the successful incorporation of Ag+ ions into the ZnMoO4 host lattice. FTIR spectroscopy further verified the phase purity and the complete decomposition of precursors. The structural integrity of the ZnMoO4 lattice was maintained even at the highest doping concentration. These findings demonstrate that Ag- doping introduces favorable synergistic effects, making these tailored nanostructures promising candidates for advanced applications in photocatalysis, optical devices, and energy storage systems.

Effect of Temperature and Sodium Dodecyl Sulphate (SDS) on the Morphology of ZnO Nanoparticles

Wejdan Sultan Alshowaired

Dr. Raisah Alshehri and Dr. Huda Alqahtani

ZnO nanoparticles were synthesized by direct precipitation at 10, 20, and 60oC with and without SDS to investigate the effect of temperature and surfactant addition. SEM results showed improved particle uniformity with increasing temperature, while severe agglomeration was observed without SDS. The addition of SDS significantly reduced aggregation, and the optimal morphology and optical properties were obtained at 60oC with SDS.

Degradation of Crystal Violet Using a Heterogeneous Fenton-like $BaFe_2O_4/H_2O_2$ System

Ghaida Rashed Alzanan

Dr. Munirah Albaqami and Dr. Hamda Al Anzi

This study investigates the performance of barium ferrite ($BaFe_2O_4$) as a heterogeneous Fenton-like catalyst for the removal of Crystal Violet (CV) dye from aqueous solutions. $BaFe_2O_4$ was synthesized and employed in the presence of hydrogen peroxide (H_2O_2) to activate oxidative degradation pathways through the generation of reactive oxygen species. In addition to catalytic oxidation, adsorption on the catalyst surface also

contributed to the overall dye removal process. The effects of important operational parameters, including contact time, initial dye concentration, catalyst dosage, and solution pH, were systematically evaluated to optimize the removal efficiency. The results showed that acidic conditions significantly enhanced dye removal, with the highest efficiency obtained at pH 3, confirming the favorable conditions for Fenton-like reactions. Increasing contact time improved the removal performance until equilibrium was approached. Kinetic analysis indicated that the experimental data was best fitted by the pseudo-second-order model, suggesting that surface-controlled interactions play an important role during the removal process. The combined adsorption–oxidation mechanism demonstrates that $BaFe_2O_4$ possesses promising catalytic activity and stability for dye-contaminated wastewater treatment. Overall, the findings highlight $BaFe_2O_4$ as an efficient and promising material for heterogeneous Fenton-like degradation of organic dyes in aqueous systems.

Sustainable Synthesis of ZnO@Silica Nanostructures from Pistachio Shell Waste for Sunscreen

Shaima Albediwi

Dr. Seham Alterary

$ZnO@SiO_2$ nanoparticles were sustainably synthesized from pistachio shell waste and successfully applied in a sunscreen formulation. The nanoparticles showed enhanced UV absorption, and the final product achieved SPF 30 with good stability and skin compatibility, highlighting the potential of agricultural waste for sustainable sunscreen development.

Chemical Recycling of Expanded Polystyrene (EPS) Waste Synthesis and Characterisation

Sadeem Saeed Alzhrani

Dr. Iman Aldowsar and Dr. Hissah Altilasi

We aim to chemically recycle Expanded Polystyrene (EPS) by converting it into a high-value functional material, Sulfonated Polystyrene (SPS). The process involves using concentrated sulfuric acid as a sulfonating agent in a dichloromethane medium at 40 °C. The reaction was monitored and evaluated at different time intervals (2, 4, and 6 hours) to observe the transformation.

Sol-gel synthesis and characterization of Lanthanum phosphate ($LaPO_4$) nanoparticles

Ruba Ali Yaqoub Al-Shdaifat

Prof. Noura Al-Haqbani and Dr. Amal Al-Fawaz

In this research Lanthanum Phosphate ($LaPO_4$) nanoparticles were successfully synthesized via the sol-gel technique. This method proved effective in producing homogeneous nanoparticles with distinct chemical properties. The samples were prepared using Lanthanum Nitrate Hexahydrate ($La(NO_3)_3 \cdot 6H_2O$) and Diammonium Hydrogen Phosphate ($(NH_4)_2HPO_4$) as precursors, with the pH adjusted to 3.5. The synthesis process involved chemical precipitation, hydrothermal aging, and calcination at 400°C for two hours. Subsequently, several characterization techniques were employed: UV-Visible (UV-Vis) spectroscopy was used to determine absorption properties and the optical bandgap , Photoluminescence (PL) spectroscopy was utilized to study light emission and assess optical efficiency ,Fourier-Transform Infrared (FTIR) spectroscopy confirmed the chemical bonding of the phosphate groups; and Thermogravimetric Analysis (TGA) was conducted to monitor the thermal behavior of the material.

Strontium-Based Metal–Organic Framework (Sr-MOF) as an Efficient Catalyst for Organic Dye Degradation in Aqueous Systems

Najla Abdulrahman Abdulaziz Aloraini

Prof. Asma Abdullah M Alothman

A strontium-based metal–organic framework (Sr-MOF) was successfully synthesized by a hydrothermal method and evaluated for the removal of organic dyes from aqueous solutions. The synthesized material was characterized using XRD, FTIR, TGA, SEM, and EDS, confirming the formation of a predominantly crystalline framework with suitable structural and thermal stability. The dye removal performance of Sr-MOF was studied using crystal violet (CV), methylene blue (MB), and Congo red (CR). The effects of pH, contact time, initial dye concentration, catalyst dosage, and hydrogen peroxide (H_2O_2) were investigated by UV–Vis spectroscopy. Sr-MOF showed the highest removal efficiency toward CV, moderate performance toward CR, and weak removal toward MB. Neutral pH and longer contact time generally enhanced removal efficiency.

Kinetic studies indicated that the pseudo-second-order model best described the adsorption process, while isotherm analysis suggested Langmuir behavior for CV and more heterogeneous adsorption for CR. Overall, the results demonstrate that Sr-MOF is a promising material for dye-contaminated water treatment, particularly for cationic dye removal.

Spectrophotometric Determination and Validation of Metformin Hydrochloride in its Pure Form and Pharmaceutical Formulation

Raghad Salem Alqarni

Dr. Samar Aldossari

A simple, accurate, and cost-effective spectrophotometric method was applied for quantifying metformin hydrochloride in pure and tablet forms. The method measures absorbance at a selected wavelength using a suitable solvent system. Validation followed ICH guidelines, showing excellent linearity (5–40ppm, r^2=0.9994) with high accuracy (99.75±0.49%) and precision. It was successfully applied to commercial tablets.

Adsorption of Congo Red Dye from Aqueous Solutions onto Activated Carbon

Norah Abdullah Alqahtani

Dr. Razan Alshgari

This project investigated the removal of Congo Red dye from aqueous solutions using commercial activated carbon through batch adsorption experiments. The effects of initial dye concentration, contact time, and adsorbent dosage on adsorption performance were examined. The results showed high removal efficiency, with adsorption equilibrium reached within 90 minutes. Equilibrium data were analyzed using Langmuir and Freundlich isotherm models. The Langmuir model provided a better fit to the experimental data ($R^2 = 0.9996$), indicating that the adsorption process followed a monolayer adsorption mechanism on a relatively homogeneous surface.

Synthesis of CuFe5O8 via Co-precipitation Method for the Catalytic Reduction of 4-Nitrophenol

Athoog Waleed Alhowail

Dr.Salwa Alrashidan & Dr.Tahani Algarni

This study investigates the synthesis of $CuFe5O8$ via co-precipitation for the catalytic reduction of toxic 4-Nitrophenol into 4-Aminophenol. The catalyst showed high efficiency with pseudo-first-order kinetics and an activation energy of 70.81 kJ/mol. Characterization via FT-IR and XRD confirmed the formation of a stable nanocrystalline structure, proving that $CuFe5O8$ is a sustainable, low-cost, and magnetically recoverable alternative for industrial wastewater treatment applications

Biochemistry Department

Comparative Analysis of Human Glutathione S-Transferase P1 (GSTP1): An In-Silico Study

Saud Abdulaziz Aljoraid

Dr. Mohammed Hassanein

Glutathione S-transferase P1 (GSTP1) is a critical Phase II detoxification enzyme responsible for neutralizing various xenobiotics and maintaining cellular redox homeostasis. While the GST superfamily is widely distributed, understanding the specific structural and evolutionary properties of the human isoform is essential. This study conducted a comprehensive in silico analysis of human GSTP1. Physicochemical profiling revealed a stable cytosolic protein with a molecular weight of 23.35 kDa and an acidic isoelectric point of 5.40. Multiple sequence alignment highlighted strictly conserved residues within the core structural and binding domains. Furthermore, phylogenetic analysis demonstrated the distinct evolutionary trajectory of Homo sapiens compared to distant taxa, emphasizing species-specific structural adaptations. Finally, a highly accurate 3D homology model was constructed using the 1PGT template and computationally validated via QMEAN and Z-score analyses. These findings provide a robust and validated structural framework, offering deep insights into the enzyme's evolutionary divergence and its fundamental role in human xenobiotic metabolism.

Inhibition of Methylglyoxal-Induced Glycation of Human Serum Albumin by Vitamin C: A Spectroscopic and Structural Study

Muhannad Yousef Sliman Alhamed

Mohamed Farouk Elsadek Badr

This study investigated the antiglycation potential of Vitamin C against methylglyoxal (MG)-induced glycation of human serum albumin (HSA). HSA was incubated with 5 mM MG at 37°C for 72 hours in the presence and absence of Vitamin C (1–100 μM), and structural changes were analyzed using fluorescence spectroscopy and circular dichroism (CD). Results revealed that MG induced significant formation of advanced glycation end-products (AGEs) and structural unfolding, both of which were effectively inhibited by Vitamin C in a dose-dependent manner. These findings emphasize the protective role of Vitamin C in preserving protein integrity, highlighting its potential as a natural therapeutic agent for mitigating glycation-related diabetic complications.

Iron Oxide Nanoparticles Augments Inflammatory Cytokine Production and Lowers Antioxidant Levels in Breast Cancer Cells

Walid Abdullah Nasser Al-Hamdan

Prof. Salman Alrokayan

Nanotechnology is a fast-evolving scientific field with wide range of applications including medicine, energy, electronics, and consumer products. Nanotechnology deals with the molecules ranging from 1nm to 100 nm dimensions where unique physical, chemical and biological properties emerge.

Application of nanomaterials in the field of medicine has tremendously improved the diagnosis and treatment of diseases. However, reports have indicated the toxic effects of nanomaterials on human health. Animal and cell-based studies have found nanomaterials to increase oxidative stress, inflammation and DNA damage. In this study, the effect of iron oxide (FeO) nanoparticles on inflammatory cytokine interleukin-6 (IL-6) and antioxidant hemoxigenase-1 (HO-1) was investigated in MCF-7 breast cancer cells. It was observed that FeO NPs significantly upregulated the IL-6 levels and lowered the HO-1 levels, implying that

exposure of FeO nanoparticles may have adverse effect on human health.

Analysis of Expression of ATM and MSH2 genes in Treated versus Untreated samples from Leukemia patients

Abdullah abdulmohsen al jeraisy

Prof. Mohammed saud alanazi

Leukemia is a hematological malignancy characterized by genomic instability and impaired DNA repair mechanisms [1]. Among the key genes involved in maintaining genome integrity are ATM (Ataxia-Telangiectasia Mutated), which regulates the cellular response to DNA damage, and MSH2 (MutS Homolog 2), an essential component of the DNA mismatch repair pathway [2]. This study aims to evaluate the gene expression levels of ATM and MSH2 in treated and untreated leukemia samples to understand how therapy affects DNA repair processes [3]. Gene expression analysis was performed using quantitative polymerase chain reaction (qPCR) to measure relative expression levels. The results showed differences in ATM and MSH2 expression between treated and untreated samples, suggesting that treatment may alter DNA repair activity in leukemia cells. These findings provide insight into the molecular response of leukemia to therapy and may contribute to a better understanding of treatment outcomes and resistance mechanisms.

Effects of Rutin on the levels of Oxygen Free Radicals generated by Riboflavin: Implication in Protein Degradation

Faisal Fahd Saeed Al-Harbi

Dr. Mansour Khalil M. Gatasheh

This study investigates the effects of the flavonoid Rutin on oxygen free radicals generated by photoilluminated riboflavin (RF), specifically in relation to protein degradation. Rutin, known for its antioxidant properties, was evaluated for its dose-dependent impact on superoxide anion (O_2^-) production. The results demonstrate that Rutin inhibits the generation of O_2^- by photoilluminated RF in a time-dependent manner, with over 50% inhibition observed at concentrations of 100 µM or higher.

The addition of Rutin to a protein-riboflavin reaction mixture containing bovine serum albumin (BSA) as a target molecule led to enhanced degradation of the protein. SDS-PAGE separation followed by densitometry analysis was used to quantify morphological changes in BSA. The protein band density indicated significant structural deterioration of BSA following light irradiation in the presence of riboflavin. Notably, the inclusion of Rutin further increased protein defragmentation, as measured by densitometer, suggesting an enhancement of oxidative damage rather than protection. In conclusion, reactive oxygen species generated by photoilluminated riboflavin cause protein damage. The presence of Rutin appears to exacerbate this effect, likely via direct energy transfer mechanisms. These findings provide new insights into the pro-oxidant interactions between Rutin and riboflavin under light exposure, with implications for understanding oxidative stress pathways in protein degradation.

In silico study on uric acid dissolving enzyme (Urate oxidase), a comparative study

Nawaf mohammed almadhi

Dr.Farid Ataya

Urate oxidase (UOX) is an enzyme that converts uric acid into allantoin, a more soluble compound. It is absent in humans, leading to conditions such as gout and hyperuricemia, while recombinant UOX is used clinically, especially for tumor lysis syndrome. This study presents an in silico analysis of UOX from Penicillium digitatum. The gene (906 bp) encodes a 302-amino-acid protein, and sequence comparisons were used for phylogenetic analysis.

Viral Entry Proteins: A Case Study in Spike Proteins

Albraa Saad Alqhtani

Dr.Ibrahim AlDubayan

Viral entry into host cells represents a critical and highly regulated step in the viral life cycle, largely mediated by specialized surface proteins such as spike glycoproteins. These proteins play a central role in host recognition, membrane fusion, and ultimately the successful delivery of viral genetic material into host cells. This study provides a comprehensive overview of viral biology, including classification, life cycle progression, mechanisms of immune evasion, and the diverse strategies viruses employ to penetrate host cellular barriers. Particular emphasis is placed on the structural and functional characteristics of viral entry proteins, with spike proteins serving as a primary model system due to their biological importance and therapeutic relevance. This project incorporates computational approaches to further investigate viral entry mechanisms. Specifically, structural analyses of various viral entry proteins are conducted using available protein data, allowing for the exploration of conformational dynamics, receptor-binding domains, and functional regions involved in membrane fusion. Furthermore, comparative sequence analysis is performed across different viral species to identify conserved motifs, evolutionary relationships, and key residues associated with infectivity and host specificity. By integrating molecular biology with computational structural and sequence-based approaches, this study aims to provide deeper insights into the mechanisms governing viral entry and highlight potential targets for antiviral therapeutics and vaccine design.

Biophysical Characterization of Albumin Unfolding Induced by Urea and Guanidine Hydrochloride

Fahd bin Ali bin Hassan Al-Fifi

Prof. Omar Salem Abdullah Al-Attas

Albumin is a vital plasma protein whose structural integrity is essential for its biological function. This study examines the unfolding behavior of albumin induced by urea and guanidine hydrochloride (GdnHCl) using multiple spectroscopic approaches. Intrinsic fluorescence spectroscopy was employed to monitor changes in the tertiary structure, while ANS binding assays assessed the exposure of hydrophobic regions during unfolding. Circular dichroism (CD) spectroscopy provided insights into alterations in secondary structure, and TEM analysis revealed the aggregated or fibrillated nature of proteins. Both denaturants induced concentration-dependent conformational changes, with GdnHCl exhibiting a stronger unfolding effect than urea. At very low concentration of GdnHCl (0-2 M), fluorescence intensity increased approximately double accompanied with 2 nm red shift, suggesting unfolding of albumin. With further increase in concentration (3-6 M) blue shift was observed. Urea showed different pattern of unfolding with slight increase in wavelength maximum 1nm at lower concentration (0-1 nm) followed by long stretch of blue shift over the concentration range of 2-8 M. ANS dye binding measurement reaffirm the pattern of intrinsic flourescnece and increases for unfolded albumin. Circular dichroism (CD) results showed loss of alpha helical structures under denaturing conditions where GdnHCl produces more significant alterations in their secondary structure. Transmission electron microscopy (TEM) analysis illustrated more hydrophobicity and amorphous aggregates are generated in albumin treated with urea while albumin undergoes short and sparse aggregates. The results reveal distinct structural transitions and unfolding pathways, enhancing our understanding of albumin stability under denaturing conditions

Structural Dynamics analysis of Chalcone-Acetylcholinesterase

Mohammed Fadil Alturki

Prof. Majed AlOkail

Understanding the molecular basis of drug–protein interactions is essential for predicting pharmacokinetics and off-target effects. Here, we employ an advanced computational approach to characterize the binding of four natural chalcone scaffolds to Acetylcholinesterase (AChE), a primary therapeutic target in Alzheimer's disease pathology. Using molecular docking simulations against high-resolution AChE crystal structures (PDB ID: 4EY7), we observed pronounced variations in binding affinities and spatial topologies. Donepezil, serving as the gold-standard positive control, yielded binding energies of -10.0 to -11.0 kcal/mol, establishing a baseline for dual-site inhibition. Among the natural candidates, Hesperidin methylchalcone (HMC) emerged as the superior inhibitor, yielding an estimated binding energy of -8.5 to -9.5 kcal/mol. Thermodynamic principles predict that this highly negative ΔG° corresponds to a strong, spontaneous complex formation. Structural analysis revealed that HMC's highly oxygenated, water-soluble framework perfectly spans the narrow 20 Å active site gorge, forming a dense network of hydrogen bonds and π-π interactions without steric clashes. HMC forms a stable, structurally robust complex with AChE, effectively blocking substrate entry and potentially mitigating Amyloid-β aggregation. In-Vitro validation of HMC binding with the AChE enzyme using fluorescence spectroscopy resulted in the quenching of tryptophan fluorescence intensity, suggesting strong binding with enzyme. Furthermore, CD spectroscopy illustrates changes in the ellipticity of the enzyme after interaction with HMC. This integrative study provides a detailed roadmap for interrogating chalcone binding to neuro-enzymes and offers insights valuable for neurotherapeutic drug design.

The effect of cetyltrimethylammonium bromide (CTAB) on the solubility and conformation of ovalbumin

Khalid bin Abdulrahman bin Atiq Al-Mutairi and Faisal bin Abdulrahman bin Faraj Al Mutlaq

Prof. Omar Salem Abdullah Al-Attas

Background: Protein folding and stability are critical for maintaining biological functionality, as misfolding and aggregation are hallmarks of numerous conformational diseases. Ovalbumin (OVA) serves as an essential model globular protein for studying these biophysical phenomena due to its well-defined structure and sensitivity to environmental stressors. This study aims to investigate the concentration-dependent effects of the cationic surfactant, cetyltrimethylammonium bromide (CTAB), on the structural integrity and aggregation profile of OVA, which is vital for pharmaceutical and industrial protein stabilization.

Methods: The interaction was analyzed by preparing samples with a constant OVA concentration (0.2 mg/mL) and varying CTAB concentrations ranging from 0 to 2000 μM. Aggregation behavior was quantitatively monitored via turbidity measurements at 350 nm after overnight incubation. Furthermore, conformational changes and secondary structural dynamics were investigated using Far-UV Circular Dichroism (CD) spectroscopy to monitor the transition of alpha-helical content under surfactant stress.

Results: Turbidity data revealed a characteristic bell-shaped aggregation profile, reaching a maximum peak at 150 μM CTAB (A_350 = 0.81), which indicates the point of maximum aggregation due to charge neutralization. Subsequent re-solubilization and a decrease in absorbance were observed at concentrations exceeding 300 μM. Far-UV CD spectroscopy confirmed a progressive loss of the signature double minima at 208 nm and 222 nm, physically demonstrating the surfactant-induced unfolding of the protein's secondary structure. These conformational changes correlate directly with

the macroscopic aggregation observed in the turbidity profile

Conclusion: The findings demonstrate that CTAB effectively perturbs the secondary structure of OVA in a concentration-dependent manner, triggering maximum aggregation at the point of charge neutralization. This study provides fundamental insights into the mechanisms of surfactant-induced protein destabilization, highlighting the importance of managing surfactant concentrations to prevent undesirable protein aggregation in biotechnological applications.

Alpha-Amylase Inhibition by Ajwa Date Seed Extract and Atorvastatin: An Integrated Enzymatic and Molecular Docking Study

Asma Abdulrahman Alharthi

Tahani Alshehri

The inhibition of pancreatic α-amylase represents a validated therapeutic approach for attenuating postprandial hyperglycemia in the management of type 2 diabetes mellitus. This study comparatively evaluated the α-amylase inhibitory efficacy of Ajwa date seed extract (Phoenix dactylifera L.) and the pharmaceutical agent Atorvastatin through integrated in vitro enzymatic assays and in silico molecular docking simulations. In vitro inhibitory activity was quantified spectrophotometrically using CNPG3 as a chromogenic substrate, with a concentration-specific blank correction protocol applied at each tested concentration to eliminate optical interference from the colored crude extract. Molecular docking was performed using CB-Dock2 against the crystal structure of human pancreatic α-amylase (PDB ID: 1HNY) to characterize the binding dynamics of Atorvastatin and the principal Ajwa phytochemicals, Quercetin and Gallic Acid. Both compounds demonstrated potent, concentration-dependent inhibition; Atorvastatin achieved a maximum valid inhibition of 92.5% at 10 mg/mL, with data at 25 and 50 mg/mL excluded from analysis due to confirmed spectrophotometric interference at those concentrations, while Ajwa seed extract exhibited a consistent sigmoidal dose-response across its full tested range, reaching a maximum inhibition of 78.9% at 50 mg/mL with an estimated IC_{50} between 10–25 mg/mL. These in vitro findings were strongly corroborated by the molecular docking results, wherein Atorvastatin and Quercetin recorded the highest binding affinities of −9.2 and −8.8 kcal/mol, respectively, with both ligands forming key hydrogen bonds at the catalytic residues Asp197 and Glu233 within the enzyme's active site. The strong concordance between the observed inhibition profiles and computational binding energies confirms that Ajwa seed extract possesses significant α-amylase inhibitory potential mediated by its polyphenolic constituents, positioning it as a promising natural complementary agent in the dietary management of type 2 diabetes mellitus.

Evaluation of the Antioxidant, Antibacterial, and Anti-Cancer Activities of Ashwagandha and Shilajit: A Comparative Study

mentalla nazih elsayed elbahnsawy

Dr. Hamida al anzi

This study aims to conduct a comparative evaluation of the biological activities of Ashwagandha and Shilajit, with a focus on their antioxidant, antibacterial, and anticancer properties. Extracts of both natural substances were analyzed using a series of laboratory assays to determine their ability to scavenge free radicals, inhibit the growth of various bacterial strains, and assess their cytotoxic effects on cancer cells under controlled experimental conditions. The study seeks to compare the effectiveness of each extract across different biological activities and evaluate their potential as promising natural sources for pharmaceutical and therapeutic applications. The expected findings may contribute to a better scientific understanding of the bioactive properties of these natural compounds and highlight their possible role in the development of natural-based therapeutic alternatives.

Green synthesis of Silver nanoparticles using leaf extract of Cupressus Sempervirens with antioxidant and antibacterial activity

Shoug abdulaziz alrommaney

Abeer aldbass

The aim of this study was to prepare green silver nanoparticles using Cupressus sempervirens leaf extract. Their antibacterial activity and antioxidant capacity were evaluated. The leaf extract and prepared particles were characterized using Fourier transform infrared spectroscopy (FTIR). The results confirmed interactions between the biocomponents and silver ions, as evidenced by shifts in functional group peak positions (e.g., -OH and C=O). New absorption peaks appeared in the range (500-700 cm^{-1}), attributed to vibrations of the silver-oxygen (Ag-O) bond, which confirms the success of the synthesis process and the role of the extract as a stabilizing and reducing agent. Furthermore, the antibacterial activity results, as measured by the inhibition zone test, showed clear efficacy of the nanoparticles against both Bacillus subtilis and Escherichia coli, with inhibition zone diameters of approximately 11mm and 12mm, respectively, surpassing those of the crude extract and silver nitrate. In addition, bacterial growth curves revealed a tangible effect of the nanoparticles on inhibiting bacterial growth. Regarding antioxidant activity, the nanoparticles achieved a free radical inhibition rate of 61.07%, while the crude extract achieved 98.54%. In general, this study highlighted Cupressus sempervirens as an effective biological and environmental option for synthesizing silver nanoparticles with promising biological properties.

Green synthesis of silver nanoparticles using rosemary (Rosemarinus officialis) and antibacterial activity

Dalia Saeed Al Saeed

Amani Alghamedi

This study explores the green synthesis of silver nanoparticles (AgNPs) using rosemary extract and evaluates their antibacterial activity. UV-Vis results indicated incomplete nanoparticle stability. The synthesized AgNPs were associated with reduced growth of Escherichia coli and Bacillus subtilis, increased doubling time, and limited inhibition zones These findings suggest a potential antibacterial effect of the synthesized AgNPs.

In-silico Investigation of Withania Somnifera Compounds and Their Indirect Effects on Human Thyroid Regulation

Munerah Abdullah Albusaimi

Dr. Nouf Omar Abdulaziz AlAfaleq

This study investigates the potential indirect effects of Withania somnifera (Ashwagandha) compounds, specifically Withaferin A (WA) and Withanone, on human thyroid hormone regulation through in-silico analysis. Utilizing the RNA-seq dataset GSE158085, differentially expressed genes (DEGs) from WA-treated cells will be identified and cross-referenced with thyroid-disease-associated genes from the DisGeNET database. A Protein-Protein Interaction (PPI) network will be constructed using STRING and Cytoscape to identify key hub genes such as PPARG, PTGS2, and DIO2. Furthermore, transcription factor enrichment and kinase-gene network analysis will be performed to map regulatory pathways. Molecular docking via AutoDock Vina will evaluate the binding affinities of Ashwagandha compounds against selected regulatory kinases. The expected results aim to elucidate the molecular mechanisms by which these phytochemicals influence thyroid function, providing a computational foundation for future therapeutic research into herbal endocrine regulation.

Basil oil: natural antibaterial and antifungal agents

Walaa Ismail

Dr. Jihan alghamdi

The increasing resistance of microorganisms to conventional antibiotics has led to the need to search for safe and effective natural alternatives. Medicinal plants are a rich source of bioactive compounds with antimicrobial and antioxidant properties. basil (Ocimum basilicum) is known for containing potent plant compounds and for their wide-ranging uses in traditional medicine. This study aims to evaluate the antibacterial, antifungal, and antioxidant activity of basil oil. The plant oils will be used, and the antimicrobial activity will be assessed using the disc diffusion method and the determination of the minimum inhibitory concentration(MIC). The antioxidant activity will be investigated using free radical capture assays. This study highlights the potential of plant oils as promising natural alternatives in medical and research fields.

Antimicrobial and antioxidant potential of lavender essential oil

Deema Abdullah Alsuwaykit

Dr. Jihan mesfer alghamdi

The study will examine the effect of lavender essential oil on microbial resistance by performing a disc diffusion test and also study its effect as an antioxidant by performing a hydrogen peroxide scavenging test and a DPPH test in this experimenting the ascorbic acid that also known as vitamin C will be used as a standard to study the effect of lavender oil in neutralizing free radicals and reducing oxidative stress.

Molecular Genotyping and Risk Association of the TP53 (rs78378222) Variant in Breast Cancer

Shaden Abdulaziz Almalki

Dr. Arwa Khayyat

This study investigated the association between the TP53 polymorphism (rs78378222) and breast cancer risk in Saudi women. Results showed a statistically significant difference in genotype and allele distribution between patients and controls: 30% of patients carried the heterozygous A/C genotype, while all controls had the wild-type A/A genotype. The C allele was present in 17% of patients but absent in controls ($p = 0.006$), indicating a strong association with increased cancer susceptibility. Functionally, rs78378222 lies in the polyadenylation signal of TP53, and its alteration may impair mRNA processing, reducing p53 protein expression and weakening genomic stability. This supports its role in tumor development. Despite these findings, the small sample size and absence of homozygous mutant genotypes limit broader conclusions. Overall, the study suggests that rs78378222 may be a genetic risk factor for breast cancer in Saudi women, and confirms T-ARMS PCR as an effective genotyping method.

In Silico Analysis of microRNAs Targeting BCL11A as Potential Regulators of Fetal Hemoglobin in Sickle Cell Disease

Joud Mohammed Dokhi Alharthi

Dr. Hannah Faisal Almubarak

Sickle cell disease (SCD) is a genetic blood disorder caused by a mutation in the β-globin gene, leading to the production of abnormal hemoglobin S (HbS). This results in red blood cell sickling, impaired function, and multiple clinical complications. Increasing fetal hemoglobin (HbF) levels has been shown to alleviate disease severity by inhibiting HbS polymerization and improving red blood cell function. The transcription factor BCL11A is a key repressor of γ-globin expression and plays a central role in regulating HbF levels. Current

therapies, such as hydroxyurea, can induce HbF production but show variable efficacy and may cause adverse side effects. Gene-editing approaches targeting BCL11A are promising but remain costly and technically challenging. Therefore, alternative strategies for safely modulating BCL11A expression are needed. This study aims to identify microRNAs (miRNAs) that target BCL11A as potential post-transcriptional regulators of HbF. Using in silico bioinformatics tools and databases including TargetScan, miRDB, and miRWalk, candidate miRNAs will be screened based on binding affinity, conservation, and target specificity. Structural stability and interaction dynamics will also be evaluated computationally. We anticipate identifying high-confidence miRNAs capable of downregulating BCL11A, thereby reactivating γ-globin expression and increasing HbF levels. These findings may support the development of novel miRNA-based therapeutic approaches for SCD.

Immunometabolic Crosstalk in Hashimoto's Thyroiditis: An Integrated In-silico and In-vitro Study

Norah Rayes Mubarak Sirhak

Dr. Mona Shuja Al harbi

Hashimoto's thyroiditis (HT) is a chronic autoimmune disorder characterized by progressive thyroid tissue destruction and hypothyroidism. While it is classically defined by lymphocytic infiltration and autoantibody production, these features do not fully explain disease progression, suggesting additional mechanisms such as metabolic reprogramming may be involved. The interaction between immune activation, macrophage infiltration, and lipid metabolism in HT remains unclear. This study investigated immunometabolic alterations in HT thyroid tissue and examined their relationship with inflammatory signaling and lipid-associated pathways. Publicly available transcriptomic datasets (GSE29315 and GSE138198) were analyzed to compare gene expression profiles between HT and healthy thyroid tissues. Differential gene expression analysis was performed using defined statistical thresholds, followed by pathway enrichment analysis using KEGG and Reactome databases. Protein–protein interaction networks were constructed to identify key hub genes, and immune cell infiltration was assessed with a focus on macrophage-associated markers. A large number of differentially expressed genes were identified in both datasets, with strong upregulation of immune-related genes. Enrichment analysis revealed significant activation of pathways related to T cell signaling, interferon response, cytokine interactions, and autoimmune disease processes. Key chemokines, including CXCL9, CXCL10, and CCL2, were markedly increased, indicating active recruitment of immune cells. In parallel, macrophage markers such as CD163, CD68, and STAT1 were significantly elevated, confirming macrophage infiltration and activation within HT thyroid tissue. In contrast to immune activation, lipid-associated genes including APOE, APOC1, PLTP, and ALOX5 showed moderate upregulation. These genes are primarily involved in lipid transport and inflammatory mediator production rather than lipid synthesis. Overall, the findings demonstrate that immune activation and macrophage recruitment are the primary reasons of HT, while lipid alterations represent a secondary adaptive response that may further contribute to inflammation and disease progression.

Age-Related Changes in Antioxidant Defense and Cell Integrity in Rat Brain and Liver

Renad Fahad Almalki

Dr. Amal Abdulah Albati

This study investigates the effects of aging on antioxidant defense and cellular integrity in brain and liver tissues of rats. Young and aged rats were compared to evaluate age-related physiological changes. Lactate dehydrogenase (LDH) activity was measured as an indicator of cell membrane integrity, while the DPPH assay was used to assess total antioxidant

capacity. Tissue samples were collected. Results are expected to show increased LDH activity in aged tissues, indicating higher cellular damage, along with decreased DPPH radical scavenging activity, reflecting reduced antioxidant defense. These findings highlight the impact of aging on oxidative stress and tissue function in different organs.

The α-amylase inhibition by Berberis crude & Pharmaceutical Berberine extract

Ghala Ahmed Al-ghannass

Reem Nasser Al-Otaibi

Berberine is an alkaloid bioactive compound with a positive effect on diabetes by inhibiting or activating relevant signaling pathways. Our laboratory experiments aims to demonstrate the inhibitory effect of alpha-amylase enzyme by berberine and to compare the inhibitory% between Berberis crude at different temperatures & pharmaceutical berberine extract.

Antioxidant and antidiabetic potential of moringa oleifera using Dpph and Alph amylase asaay

Ghaida ahmad al anzi

Reem alotaibi

This study aimed to evaluate the antioxidant and antidiabetic activities of Moringa oleifera extract. The DPPH assay was used to measure antioxidant activity, while the alpha-amylase assay was used to assess enzyme inhibition. The results showed that the extract has good free radical scavenging activity and reduces alpha-amylase activity compared to the control

Antioxidant enzyme inhibition and cytotoxicity properteis of green coffee extract

Joud Ibrahim Abdullah AlTaweel

Prof. Abir Ghannouchi Ben Bacha

This research investigated the biochemical profile and therapeutic potential of the green coffee extract, especially its antioxidant capacity, enzyme inhibitory effects, and cytotoxicity against colon cancer cell lines. The maximum recovery of the protease inhibitor against trypsin was recorded in the crude extract made in distilled water. The green coffee aqueous extract showed a high total phenolic content of 734µg/ml and significant antioxidant activity, with an IC50 value of 46.48µg/ml using the DPPH assay. Enzyme inhibition studies established that the green coffee extract displayed multi-target metabolic properties, achieving 63% inhibition against alpha-amylase and a high inhibitory activity toward some known proteases (chymotrypsin, pepsin, proteinase K, subtilism, and trypsin). Notably, the extract demonstrated its strongest effect against trypsin, with a potent inhibition of 95%. Furthermore, cytotoxicity assays showed the green coffee extract's ability to suppress the proliferation of human colon cancer cells, yielding IC50 values of 44.09% and 29.93% for LoVo and HCT-116, respectively. These results suggested that green coffee extract is a rich source of bioactive molecules, including chlorogenic acids and stabilized proteinaceous inhibitors, which offer significant potential for managing oxidative stress, glucose and protein metabolism, and oncological applications.

Effect of Silver Nanoparticles and Chitosan on the Structural Behavior of Bovine Serum Albumin

Razan Nafez Albasheeti

Dr. Areej Alzahrani

The present study investigated the interaction of bovine serum albumin (BSA) with silver nanoparticles (AgNPs) and chitosan using UV–Visible and fluorescence spectroscopy. The aim was to evaluate the effect of these interactions on the structural behavior of BSA at different wavelengths (280, 340, and 405 nm) and under different concentrations of proteins and AgNPs, also to assess possible alterations in the protein environment and conformation. In addition, the role of chitosan in modulating the interaction between BSA and AgNPs was evaluated. The results provide insight into concentration-dependent behavior and the overall interaction between protein, nanoparticles, and polymer systems.

Evaluation of two plant extracts (Juniperus procera and Artemisia Judaica) as therapeutic agents against MCF-7 Breast Cancer cells.

Reema Ali Al-Zahrani

Dr. Amal Majed Alenad

Methanolic extracts of Juniperus procera and Artemisia judaica showed dose-dependent cytotoxicity against MCF-7 cells (IC_{50}: 3.707 mg/mL and 0.8025 mg/mL at 48 h, respectively. High phenolic/flavonoid contents correlated with apoptosis-like morphology (shrinkage, rounding, detachment). Wound healing inhibition was 11.764% (J. procera) and 13.793% (A. judaica) at 24 h. These polyphenol-rich extracts warrant further breast cancer phytotherapy investigation.

Cytotoxic and anti-migration effects of green-synthesized Nickel Oxide Nanoparticles and Doxorubicin in MCF-7 breast cancer cells

Rama Alshehi

Dr. Nojood Altwaijry

Breast cancer, among other malignancies, has continued to be a major global health issue. Current standard treatments possess a myriad of limitations and shortcomings. Consequently, alternative treatments that bypass these challenges and exhibit exceptional potential have emerged, notably nanoparticles like nickel oxide (NiO N.P). The focus of this study was to evaluate the dose-dependent cytotoxicity and anti-migration efficacy of NiO N.P and doxorubicin (DOX) in MCF-7 cells (breast carcinoma cell line). Cytotoxicity of the NiO N.P and DOX was demonstrated through the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. Moreover, the anti-migration activity of both compounds was established through the wound healing assay at 24 h and 48 h. It was observed that NiO N.P showed both cell migration inhibition and cytotoxicity at higher concentrations. Similarly, DOX exhibited significant levels of cytotoxicity, that correlate with the strong anti-migration activity evident in the wound healing assay.

Bioactivity of Oregano Essential Oil: Antimicrobial and Antioxidant Effects

Zain Mohammed Alenazi

Dr. Jihan Mesfer AlGhamdi

The study aimed to determine the antioxidant and antimicrobial activity of origanum vulgare essential oil. Different concentrations of the oil against microorganisms, including Gram-positive and Gram-negative bacteria and fungi, were evaluated using the disk diffusion method to assess the antimicrobial effect. Candida albicans was the most sensitive, while Staphylococcus aureus, E. coli, and Enterococcus faecalis were also shown to have varying sensitivities that differed slightly by microbe type and oil concentration. In the

meantime, the antioxidant effect was determined using the DPPH and hydrogen peroxide scavenging assays. The results showed a moderate effect at low concentrations and a strong effect at high concentrations, indicating that its biological activity is concentration-dependent. All test results indicate that oregano oil possesses promising biological activity for use as an antimicrobial and antioxidant.

Antimicrobial and Antioxidant Activity of Tea Tree Oil and Fenugreek Oil

Dalia Ali Alhafe

Dr. Jihan Mesfer AlGhamdi

This study investigated the antibacterial activity of tea tree oil and Fenugreek oil against Staph aureus, Escherichia coli, Salmonella Typhimurium, and Candida albicans using conventional laboratory techniques. The antibacterial efficacy of the oils was evaluated using the disk diffusion assay, which involved applying each oil to paper disks and wells put on microbe-seeded agar plates and observing the zone of inhibition, which represents how efficiently the oil blocks microbial growth. The DPPH (2,2-diphenyl-1-picrylhydrazyl) free-radical scavenging test was used to assess antioxidant capability, with the reduction in purple DPPH color indicating the oil's ability to neutralize free radicals. The hydrogen peroxide scavenging test was used to determine the oils' capacity to degrade or neutralize hydrogen peroxide, a reactive oxygen species that can harm cells. These tests, taken together, give information on the studied oils' antibacterial power and antioxidant potential. This study discovered that tea tree oil has significant antibacterial properties, particularly on Candida albicans, with a dose-dependent response. In contrast, fenugreek oil did not give notable antibacterial effects. Both oils exhibited antioxidant activity; tea tree oil was more effective at lower doses, while fenugreek oil, although less effective initially in DPPH assay, achieved similar inhibition levels at higher concentrations, particularly in hydrogen peroxide scavenging assays. In conclusion, tea tree oil exhibited substantial antibacterial and antioxidant activities, while fenugreek oil showed a minimal antibacterial but significant antioxidant activity.These results show that tea tree oil could be used as an antimicrobial and fenugreek oil could be used as a natural sources of antioxidants.

Binding Interaction of Rutin and Colchicine with BSA

Rofaida Aounallah

Areej ali alzahrani

This study examines the interaction between Bovine Serum Albumin (BSA) and two ligands, rutin and colchicine, using UV–Visible spectroscopy at 280, 340, and 405 nm. Changes in absorbance indicated successful binding, with interaction strength depending on ligand type and concentration. These findings support the importance of protein–ligand interactions in drug design and delivery.

Biosynthesis of Silver Nanoparticles Using Moringa oleifera and Assessment of Their Antibacterial Properties

Taghreed Mansour Albaqami

Dr. Atekah Hazzaa Alshammari

This study focused on the green synthesis of silver nanoparticles (AgNPs) using leaf extract of Moringa oleifera. The nanoparticles were prepared by reacting the plant extract with a silver nitrate solution under mild and straightforward laboratory conditions. The formation of AgNPs was confirmed using UV–Visible spectroscopy. The synthesized nanoparticles exhibited notable antibacterial activity against Escherichia coli and Bacillus subtilis. Overall, the findings demonstrate that this green synthesis approach is a simple, efficient, and environmentally friendly method for producing AgNPs with promising antimicrobial potential.

Single-Cell Resolution Mapping of Cellular States Driving Antigen Presentation Suppression in Breast Cancer

Tala Mohammed Saad Alhokbany

Hannah Faisal Almubarak

Breast cancer remains a leading cause of cancer-related mortality in women worldwide, with tumor heterogeneity and immune evasion limiting treatment success. Antigen presentation via MHC class-I molecules is critical for cytotoxic T-cell recognition of tumor cells; however, many tumors suppress this pathway to escape immune surveillance. Identifying the specific cell populations responsible for this suppression could reveal new therapeutic targets. Despite its importance, antigen presentation dysfunction has not been fully characterized at the single-cell level across different stages of breast cancer. Bulk analyses often mask cellular diversity, and large single-cell datasets spanning normal, preneoplastic, and tumor tissues remain underutilized for studying immune evasion mechanisms. This study aims to identify tumor and immune cell populations that suppress antigen presentation across breast cancer states. Using single-cell RNA-seq data (GSE161529), cells will be classified into distinct tumor and immune states based on gene signatures. Antigen presentation activity will be assessed through expression of MHC class-I genes and antigen processing machinery components. We expect to identify specific tumor cell states, such as mesenchymal-like or stressed populations, with reduced antigen presentation, along with immune subsets contributing to this suppression. These findings may guide strategies to restore immune recognition and improve immunotherapy outcomes.

Comparative Assessment of Lead (Pb) in Organic and Inorganic Lipsticks Using Atomic Absorption Spectroscopy (AAS), Oral Bioaccessibility, and Thermogravimetric Analysis (TGA)

Jumanah Ahmed Albusaily

Dr. Tahani Alshehri

The widespread use of cosmetic products, especially lipstick, has growing concerns about the presence of heavy metals and the potential for health risks with prolonged exposure. This study investigates the presence, thermal behavior, and bioaccessibility of lead (Pb) in organic and inorganic lipsticks. A total of 4 lipstick sample was analyse using Atomic Absorption Spectroscopy (AAS), Thermogravimetric Analysis (TGA), and evaluate its oral bioaccessibility using artificial saliva. The findings revealed that Pb concentrations ranged from 0.13 to 0.32 mg/L, with slightly differences between organic and inorganic samples. Oral bioaccessibility revealed that lead concentrations are measured in artificial saliva were negative under simulated oral conditions. TGA results indicated multi-stage thermal degradation, with residual mass suggesting the persistence of inorganic components (including b). Lead was. found in higher concentrations in samples S1 (0.32 mg/L) compared to other, however it still does not exceed the acceptable 10 mg/L limit set by FDA of Health Canada. If it exceeds the limit, it suggests potential systemic toxicity. Health risk assessment parameters, including Chronic Daily Intake (CDI), Hazard Quotient (HQ), and Lifetime Carcinogenic Risk (LCR), were calculated. All HQ values were below unity (HQ < 1) and LCR values were within acceptable safety limits (1.10^6 to 1.10^4). These findings highlight the safety of organic and inorganic lipsticks on human health; however stricter regulation is important due to the limitations of sample number. In addition, consumer awareness of the potential risks posed by heavy metals in cosmetics is essential. Strengthened safety standards and monitoring regulated by the Food and Drug Administration's (FDA) around the

world are necessary to protect public health from the harmful effects of toxic minerals in cosmetics field.

Evaluation of the Anticancer and Apoptotic Potential of Adenium obesum Root and Stem Extracts Against Colorectal Cancer Cells (SW480)

Somaiya Aziz

Mona Al-harbi

Colorectal cancer remains one of the leading causes of cancer-related mortality worldwide, highlighting the urgent need for novel and effective therapeutic strategies. Natural products have gained increasing attention as potential sources of anticancer agents due to their diverse bioactive compounds. This study aimed to evaluate the anticancer and apoptotic potential of root and stem extracts of Adenium obesum against the SW480 colorectal cancer cell line. Adenium obesum commonly known as "desert rose" belongs to the family Apopcynaceae and has previously been reported for its anti-influenza, antimicrobial, and cytotoxic efficacies and well-known for their ethno-medicinal applications. In the present study, plant extracts were prepared using PBS and 80% methanol, followed by filtration, centrifugation, and concentration to obtain crude extracts. The anticancer activity was assessed using a 3D spheroid invasion assay, Real-Time Cell Analysis (RTCA), and Annexin V/Propidium Iodide (PI) flow cytometry (FACS). Spheroid morphology and invasion were monitored over time, while cytotoxicity and apoptosis were quantified at different extract concentrations. The results demonstrated a significant reduction in spheroid size and invasive potential following treatment with both root and stem extracts, with the root extract showing a stronger inhibitory effect compared to the stem. RTCA analysis further confirmed a dose-dependent decrease in cell viability, indicating increased cytotoxicity at higher concentrations. Flow cytometry analysis revealed a marked increase in apoptotic cell populations, particularly in cells treated with root extract, which induced higher levels of early and late apoptosis compared to stem extract. In conclusion, Adenium obesum root extract exhibited more potent anticancer activity than stem extract, primarily through the induction of apoptosis and suppression of colorectal cancer cell proliferation and invasion. These findings suggest that Adenium obesum contains bioactive compounds with promising therapeutic potential, warranting further investigation to identify the active constituents and elucidate their molecular mechanisms in cancer treatment.

Age-Related Changes in Antioxidant Defense and Cell Integrity in Rat Brain and Liver (LDH & DPPH Analysis)

AarobNahes Alotaibi

Dr. Amal Abdulah Albati

This study investigates the effects of aging on antioxidant defense and cellular integrity in brain and liver tissues of rats. Young and aged rats were compared to evaluate age-related physiological changes. Lactate dehydrogenase (LDH) activity was measured as an indicator of cell membrane integrity, while the DPPH assay was used to assess total antioxidant capacity. Tissue samples were collected. Results are expected to show increased LDH activity in aged tissues, indicating higher cellular damage, along with decreased DPPH radical scavenging activity, reflecting reduced antioxidant defense. These findings highlight the impact of aging on oxidative stress and tissue function in different organs.

Evaluation of DNA Degradation and Oxidative Stress Induced by Green-Synthesized Silver Nanoparticles and Pomegranate Peel Extract in HCT116 Cells Using Comet Assay and ROS Assay

Riam Khalid Mohammad Sheikh

Iman Al-Shehri

This study aimed to evaluate the effects of silver nanoparticles (AgNPs) on HCT116 cells and to assess the impact of pomegranate peel extract. ROS generation and DNA damage were evaluated using fluorescence imaging and comet assay. AgNP-treated cells exhibited increased ROS levels and DNA damage compared to control cells. In contrast, the treated group showed reduced ROS levels and DNA damage. These findings suggest that AgNPs compromise cellular integrity, while treatment modulates these effects.

Department of Physics and Astronomy

Studying of stability of double cation Perovskite solar cell

Suliman Ahmed Alalwan

Dr. Mohammed Said Alqahtan

Improving the long-term stability of perovskite solar cells (PSCs) remains a critical challenge for their commercialization as next-generation photovoltaic devices. In this study, (PEAI) was employed as a surface passivation layer to enhance the performance and long-term stability of $(FAPbI_3)_x(MAPbBr_3)$ PSCs with n–i–p architecture. Three devices were fabricated on Glass/FTO/c-TiO_2/mp-TiO_2 substrates with different PEAI concentrations of 0, 5, and 8 mg using a single-step spin-coating method, with (MACl) as a crystallization additive and Spiro-OMeTAD as the hole transport layer. The photovoltaic parameters including (Voc), (I sc), (FF), and (PCE%) were characterized over 600 hours under AM 1.5G illumination at 1000 W/m² with an active device area of 0.158 cm². At the initial measurement, the Control sample exhibited the highest PCE of 18.94%, while PEAI 5 mg and PEAI 8 mg devices showed PCE values of 15.88% and 14.33%, respectively. Long-term stability measurements revealed that the PEAI 5 mg device demonstrated the most stable performance, retaining 99.6% of its initial PCE after 600 hours, while the Control sample showed significant fluctuations and the PEAI 8 mg device exhibited a gradual performance decline. These results confirm that an optimal PEAI concentration of 5 mg effectively passivates surface defects, suppresses non-radiative recombination, and significantly improves the long-term stability of PSCs, making them more suitable for practical photovoltaic applications.

Learning Quantum Potential from Scattering Data: A Bayesian approach

Ibrahim Khalid Bin Arfaj

Ibrahim Khalid Alnamlah

This project addresses an inverse quantum problem by inferring the parameters of a potential barrier (height V_0 and width a) from transmission coefficient data T(E). Synthetic noisy data are generated to mimic realistic measurements, and Bayesian inference combined with MCMC (via emcee) is used to estimate the parameters and their uncertainties. The results demonstrate accurate recovery of the true parameters, with improved performance as data quantity increases and noise decreases.

Creating Polymer Capacitor for Chemical Sensing Applications

Muhannad K. Almushawah

Hadi Alqahtani

Gas and chemical vapor detectors play a crucial role in safety applications and in sensing hazards before they occur. Most electrical gas sensors are fabricated as chemiresistors due to their ease of manufacturing, whereas chemicapacitors have not received the same level of research or technological attention because they are more difficult to fabricate and characterize compared to chemiresistors. In this work, we fabricated a polymerbased chemicapacitor and characterized it using a simple electrical circuit. The capacitance was measured experimentally and found to be approximately 100 pF, which lies within the same range as some commercially manufactured capacitors, such as the P14 capacitor produced by IST, which has a capacitance of about 150 pF. The chemical detector was exposed to several chemical vapors, and variations in response were observed due to differences in their solubility parameters. The approximate thickness of the polymer film was estimated using the capacitance equation and was found to be around 5 μm. Our simple characterization method for the polymer capacitor enables the study of the dielectric constant of polymers, since the film thickness can be directly measured using thicknessprofiling instruments such as the Dektak.

Broadband solid-state Amplified Spontaneous Emission (ASE) based on a processable Flaxseed oil-based epoxy matrix using a conjugated polymer and an oligomer.

Abdulrhman Alajmi

Dr. Khalid Eidah AlZahrani

This work aims to investigate and achieve broadband Amplified Spontaneous Emission (ASE) in the solid state using an organic system composed of a conjugated polymer and an oligomer embedded within a linseed oil–based epoxy matrix. The study is motivated by the inherent limitations of conventional laser systems, which rely on complex optical cavities and require precise alignment, thereby restricting their implementation in compact and low-cost applications. In contrast, ASE represents a promising alternative, as optical amplification can be realized without the need for an optical cavity. The conjugated polymer PFO-co-PE was employed as the primary gain medium due to its strong absorption and efficient emission in the green spectral region, while the oligomer BECVA was utilized as an energy acceptor to extend the emission toward longer wavelengths. The system operates based on Förster Resonance Energy Transfer (FRET), whereby energy is non-radiatively transferred from the polymer (donor) to the oligomer (acceptor), resulting in improved energy distribution and enhanced emission efficiency. The optical properties of the materials were initially examined in the liquid state. The results indicated that the polymer exhibits strong and stable emission at low concentrations, whereas the oligomer shows concentration-dependent behavior with an optimal concentration that maximizes fluorescence efficiency. In addition, a significant spectral overlap between the emission spectrum of the polymer and the absorption spectrum of the

oligomer was observed, confirming the feasibility of efficient FRET. Experimentally, the polymer demonstrated pronounced ASE behavior in solution, evidenced by spectral narrowing and the emergence of a clear pumping threshold, indicating its effectiveness as a gain medium. Upon transitioning to the solid state using the epoxy matrix, a mechanically and optically stable environment was established, which contributed to molecular immobilization and the suppression of non-radiative losses, thereby enhancing the potential for ASE generation in the solid state. These results demonstrate that integrating conjugated polymers with oligomers within a processable solid matrix constitutes an effective strategy for the development of broadband optical systems, and may pave the way for future applications in compact light sources and flexible photonic devices.

Photon Downconversion in Rare-Earth Doped Nanomaterials

Saja alshehri

Dr. Reem alsaigh

Photon downconversion is a process where high-energy light is converted into lower-energy light. This helps improve how energy is used in many technologies like solar cells, bioimaging, and LEDs. In this project, i studied how downconversion works. The process starts when a photon is absorbed, then some energy is lost as heat, and finally light is emitted again with lower energy. also I looked at the main mechanisms such as Stokes emission, energy transfer between ions, and quantum cutting, where one photon can produce two photons. And I focused on the materials used, especially rare-earth-doped nanomaterials, because they are very effective in this process. and also discussed important factors that affect efficiency, like the type of material, phonon energy, and dopant concentration. Overall, downconversion is an important process that can improve the performance of modern technologies and has strong potential for future applications.

Reduction of Graphene Oxide Using a High-Power Laser with Characterization of Structural and Optical Properties

Aljory Abdulmohsen Almohsen

Wafaa Mujammami

This study investigates the laser-induced reduction of graphene oxide (GO) into reduced graphene oxide (rGO) and examines the influence of laser parameters on its structural, optical, and morphological properties. GO samples were irradiated at different laser powers (180–220 W) and exposure times (1–3 s), and the resulting materials were characterized using UV–Vis spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), and X-ray diffraction (XRD). UV–Vis analysis revealed a red shift in the absorption edge and a decrease in the optical band gap from 3.93 eV for GO to 3.16–3.71 eV for rGO, indicating increased electronic delocalization due to partial restoration of sp^2 carbon domains. FTIR results confirmed the progressive removal of oxygen-containing functional groups with increasing laser power and exposure time. SEM observations showed a transition from a compact layered structure to a porous, defect-rich morphology, while XRD analysis indicated reduced interlayer spacing and the formation of small graphitic domains. The results demonstrate that laser parameters play a critical role in controlling the reduction process. Increasing power and exposure time enhances deoxygenation; however, excessive energy input introduces structural disorder and limits further

improvement. An optimal reduction condition was observed at intermediate laser parameters, particularly around 200 W, where improved structural ordering and optical properties were achieved. These findings establish laser-induced reduction as a controllable method for tuning the properties of graphene-based materials for applications in optoelectronics, sensing, and energy systems.

The gain of Stimulated Raman Scattering : 1 D investigation

Shahd Abdulaziz Al Thahir

Dr. Reem A. B. Alraddadi

This work presents a one-dimensional (1D) investigation of the gain of Stimulated Raman Scattering (SRS) in laser–plasma interactions. We examine how key plasma parameters—laser intensity and density scale length—affect the SRS convective gain. The findings of this work provide insight into controlling SRS in applications such as inertial confinement fusion (ICF) and high-energy-density plasma experiments.

Development of Eco-Friendly Dye Sensitized Solar Cells Using ZnO-GO nanocomposite, and Natural Dyes

AlJouhrh Mohammed AlSwailem

Dr. Nargis Bano

This study presents the development of an eco-friendly dye-sensitized solar cell (DSSC) using a ZnO-GO (zinc oxide-graphene oxide) nanocomposite photoanode and a natural dye sensitizer. Zinc oxide (ZnO) nanoparticles were successfully synthesized and integrated with graphene oxide (GO) to form a ZnO-GO nanocomposite. The material was characterized using Transmission Electron Microscopy (TEM), Fourier Transform Infrared (FTIR) spectroscopy, and Ultraviolet-Visible (UV-Vis) spectroscopy, confirming nanoparticle formation, attachment of ZnO nanoparticles onto GO sheets, and combined optical properties. The fabricated DSSC exhibited an initial photocurrent of 1.14 mA under sunlight, indicating photovoltaic activity and demonstrating that the ZnO-GO nanocomposite and natural dye contributed to light-induced charge generation and transport. However, the current rapidly decayed to zero, indicating limitations in charge collection stability and electrical contacts within the device. These results confirm the successful synthesis of ZnO nanoparticles and the formation of a functional ZnO-GO nanocomposite, supporting its potential application in DSSCs.

A Review Of Transport Properties And Performance Optimization Of Bi2Te3 Thermoelectrics

Sarah Mosaad Alfaiz

Jawaher Alotaibi

This study examines the transport physics and performance limitations of Bi2Te3-based thermoelectric materials using a literature-based analysis of transport behavior, optimization strategies, and device-level constraints. Results show that while performance has improved mainly through reducing lattice thermal conductivity, gains remain limited by strong coupling between transport parameters. Device-level factors such as contact resistance, thermal losses, and mechanical instability further reduce efficiency, highlighting the need for a system-level approach to improve thermoelectric performance.

Tolerance analysis of manufactured freeform optical surfaces using MATLAB

Nourah Alqahtani

Dr. Reem Alsalamah

Freeform optical surfaces provide enhanced flexibility in controlling aberrations and improving optical system performance in modern applications such as imaging, illumination, and sensing. However, their performance is highly sensitive to manufacturing imperfections and alignment errors, which can significantly degrade optical quality. Small deviations in surface form, such as sag errors, ripple, and roughness, can introduce wavefront distortions and reduce system efficiency. Commercial optical design tools offer tolerance analysis capabilities but are often expensive, closed-source, and limited in flexibility for custom research applications. Therefore, there is a need for an accessible, reproducible computational framework for tolerance analysis of freeform optical systems.

Searches for Dark Matter Particles Using Low Energy Experiments

Amirah Abdulmohsen AlShurayhi

Dr. Sheakha AlDaihan

The strong CP problem in the Standard Model motivates the existence of the axion, a light pseudoscalar boson proposed as a dynamical solution to the CP-violating theta-bar term. Axions are also among the most compelling dark matter candidates. While searches for new particles usually require access to large accelerators, this class of particles can mediate long-range interactions that can be probed through small, low-energy precision experiments. In this work, we demonstrate this by using an experiment employing a micro torsional oscillator (MTO), previously used to detect other types of dark matter candidates, to search for axion-mediated interactions. Instead of the conventional Yukawa parametrization previously used in this experiment, we derive the expected force signal and integrate it over the experimental geometry. Performing this analysis over the interaction range lambda between 2×10^{-7} and 1×10^{-6} meters, no signal for axion-mediated forces was found, with all measured forces consistent with zero within an upper bound of $|\Delta F| \leq 10^{-17}$ newtons. We translate this force limit into new upper bounds on the scalar–pseudoscalar axion–neutron coupling product, $g_s^N\, g_p^N \leq 10^{-15}$, at the micrometer interaction range scale, which overlaps with limits obtained from other more complex and large-scale experiments. Although this approach did not result in new limits, it opens a new avenue for using simple tabletop experiments, such as the torsional oscillator used here, to detect axion dark matter once precision is improved.

Investigating Galaxy Evolution Using SDSS photometric CMD and SFR

Moulok Abdulmalik Ahmad

Noura Mohammad Alonzi

This study investigates galaxy evolution using color indices derived from the Sloan Digital Sky Survey (SDSS). A sample of 100, 000 galaxies was selected using an r-band Petrosian apparent magnitude limit of $rp \leq 17.77$ and a redshift range $0.02 \leq z \leq 0.25$,together with photometric constraints related to the signal-to-noise ratio ($S/N \approx 5\sigma$) and the saturation limits. The relationship between absolute magnitude and the $u - r$ color index was then analyzed,with $u - r$ adopted as the primary classifyication parameter of its strong ability to distinguish galaxies population. A color threshold of $u - r = 2.22$ was

used to separate blue and red galaxies. The color-magnitude diagram (CMD) reveals that blue galaxies are concentrated at lower u − r values, whereas red galaxies occupy higher u − r values. We also examined the relation between color and star formation rate(SFR). The results show that the u − r color index effecive criterion dividing galaxies into two main population: the Blue Cloud and the Red Sequence. Galaxy with the higher star formation rates are primarily located in Blue Cloud,whereas less active galaxies are concentrated in the Red Sequence.In addition, blue galaxies constitute a larger fraction of the sample than red galaxies, indicating that a substantial proportion of the studied galaxies are still in active evolutionary stages.

Botany & Microbiology Department

Evaluation of the Effect of Rosemary (Rosmarinus officinalis) Leaf Extract on the Susceptibility of Efflux-Mediated Antibiotic-Resistant Bacteria to Drugs

Saleh Alhamlan

Dr. naiyf Alharbi

Evaluation the effect of rosemary against the microbes with efflux pump.

Antimicrobial Activity of Selected Medicinal Plant Extracts

Bander khalaf alghamdi

Khalid bin Salmin Almaary

This study investigates the antimicrobial activity of selected medicinal plant extracts as potential alternatives to antibiotics due to increasing bacterial resistance. Aqueous and ethanolic extracts of several plants were tested using the agar well diffusion method. The results showed that ethanolic extracts, particularly guava, were the most effective, and Gram-positive bacteria were more sensitive. The study concludes that medicinal plants represent a promising source of natural antimicrobial agents.

The effect of Gibberellic acid on reducing salinity stress on Zea mays (sweet corn)

Faris Alabdulsalam

Ibrahim Abdullah Al-Araidh

Soil salinity is a severe abiotic stress that drastically limits global agricultural productivity, particularly affecting the critical germination stage of staple crops like sweet corn (Zea mays L. saccharata). This study investigated the physiological efficacy of exogenous Gibberellic Acid (GA3) in mitigating the inhibitory effects of sodium chloride (NaCl) stress during Zea mays seed germination. A laboratory experiment was conducted using a Completely Randomized Design (CRD) with 12 treatments, combining varying concentrations of NaCl (20,000, 30,000, and 40,000 ppm) and GA3 (100 and 200 ppm). Germination indices, including Final Germination Percentage (GP), Mean Germination Time (MGT), and Coefficient of Velocity of Germination (CVG), were evaluated over 10 days. The results demonstrated a dose-dependent suppression of germination by salinity, with 40,000 ppm NaCl inducing complete inhibition of germination (0% GP). Conversely, the isolated application of 200 ppm GA3 maximized germination (90% GP). Crucially, the co-application of GA3 under saline conditions significantly rescued seed vitality. Under severe 20,000 ppm NaCl stress, adding 200 ppm GA3 more than doubled the GP from 17.5% to 42.5%, significantly shortened the MGT, and accelerated germination velocity. These findings suggest that exogenous GA3 effectively counteracts salt-induced osmotic and ionic toxicity by mobilizing seed reserves, offering a sustainable and cost-effective agronomic strategy to enhance crop resilience in arid and saline environments.

Effect of β-Cyclodextrin–Mediated Cholesterol Depletion on Salmonella Typhimurium Entry into THP-1-Derived Macrophages

Osama Sami wali

Dr. Ayman Salem Mubarak

This study examined whether reducing membrane cholesterol using β-cyclodextrin (βCD) affects the entry of Salmonella Typhimurium into THP-1-derived macrophages and alters cytokine response. THP-1 cells were differentiated into macrophage-like cells using PMA, then treated with βCD before exposure to Salmonella Typhimurium or LPS. Intracellular bacterial recovery was assessed by CFU plating, while IL-18 and IL-6 levels were measured from culture supernatants using sandwich ELISA. No measurable bacterial colonies were recovered from the CFU assay. However, after applying the corrected ELISA standard-curve calculation, IL-18 and IL-6 showed detectable levels with variation between conditions. The βCD-treated groups did not show one consistent pattern across all conditions, so the findings should be interpreted as preliminary. Overall, the results suggest that cholesterol depletion may influence cellular response, but further optimization and repeated experiments are required before confirming a clear βCD-dependent effect.

Evaluation of date seed extract as an alternative growth medium for bacterial cultivation

Ahmad Abdallah Al-Otaibi

Prof. Abdullah Abdulaziz Alarfaj

The search for sustainable and low-cost alternatives in microbiology has highlighted the potential of agricultural by-products such as date seeds (Phoenix dactylifera), which are rich in essential nutrients. This study aims to develop and evaluate a growth medium derived from date seed extract as an alternative to conventional nutrient media. Date seeds were processed, extracted (10% w/v), filtered, pH-adjusted, and sterilized to obtain a usable medium. Standardized inocula of Escherichia coli and Staphylococcus aureus were cultured under controlled conditions. Bacterial growth was assessed using optical density (OD600) and colony-forming unit (CFU) measurements, with comparisons made to standard nutrient media. This study provides a systematic approach to evaluating plant-based media and underscores the potential of date seed extract as a sustainable and economical option for bacterial cultivation, supporting resource-efficient microbiological practices.

A Comparative Study of the Antimicrobial Activity of 2 Organic honey and Commercial Natural Honey Against 3 Bacterial and Candida Strains

Salma sibari

Dr.Dalia Al Sarar

Background: The emergence of antimicrobial resistance has intensified the search for natural alternatives to conventional antibiotic agents. Aim: This study evaluated and compared the antimicrobial activity of four honey types: two organic honeys (Talh and Sidr) and two commercial natural honeys (Shifa and Sary) against bacterial strains (Staphylococcus aureus, Escherichia coli) and yeast strains (Candida krusei, Candida parapsilosis). Method: Antimicrobial activity was assessed using agar well diffusion and streak plate methods at varying concentrations (30%, 60%, and 100%). Results: The results demonstrated concentration-dependent inhibitory effects. Talh and Sidr honeys showed the strongest antibacterial activity, particularly against E. coli, achieving complete inhibition at 60% and higher concentrations. S. aureus was less susceptible, with significant inhibition observed primarily with Talh and Sidr honeys at higher concentrations. For Candida species, Sidr honey displayed the most potent antifungal activity, achieving complete inhibition of C. krusei at 60% and markedly reducing the growth of C. parapsilosis. Shifa and Sary honeys generally exhibited weaker antimicrobial effects, with

partial inhibition observed only at higher concentrations. Conclusion: The present in vitro findings indicate that organic Talh and Sidr honeys possess significant antimicrobial properties, suggesting their potential as natural antimicrobial agents. However, due to the limited range of honey types and microbial strains examined, as well as the in vitro design of the study, these results should be considered preliminary rather than conclusive evidence of therapeutic efficacy. Therefore, further in vivo and clinical studies are necessary to validate these results.

Investigating Immune Cell Metabolism During Salmonella Minnesota Infection In Vivo

Ahad Saud Alshehri

Saeedah Almutairi

Bacterial infection triggers immune function complemented with enhanced cellular metabolism; however, the mechanisms linkingnutrient uptake with lymphocyte proliferation during infectionremain incompletely understood. In this study, we examined proliferation via Ki67 and expression of the nutrient transportersCD71 (transferrin receptor) and CD98 (amino acid transporter) in a murine model of Salmonella enterica serovar Minnesota infection, with and without azithromycin treatment.

Lymphocytes from infected mice, particularly NK cells, displayed increased expression of CD71 and CD98. While T cells showed increased CD71, no significant change was observed in CD98 expression, indicating a subset-specific metabolic regulation. Despite the enhanced expression of nutrient transporters, infection with Salmonella enterica serovar Minnesota significantly reduced lymphocyte proliferation compared to control naïve or azithromycin-treated groups. Across all groups, proliferating ($Ki67^+$) cells expressed higher levels of CD71 and CD98 than non-proliferating ($Ki67^-$) cells, confirming that increased nutrient uptake is associated with higher proliferative demand. Notably, $Ki67^+$ cells from infected mice exhibited the highest expression of these nutrient transporters despite reduced overall proliferation. Antibiotic treatment restored both proliferation and nutrient transporter expression to baseline levels. These findings suggest that infection induces metabolic activation without effective cell cycle progression. Inflammatory conditions are known to drive upregulation of nutrient transporters, enhancing iron uptake via CD71 and amino acid uptake via CD98 to meet the biosynthetic demands of immune activation. However, during infection, inhibitory signals such as inflammatory stress and metabolic dysregulation may limit proliferation despite increased nutrient availability, resulting in a functional uncoupling between metabolic activation and lymphocyte expansion. In conclusion, Salmonella infection induces a dysregulated immunometabolic state characterized by increased nutrient transporter expression but impaired proliferation, which is reversible upon antibiotic treatment.

Effect of Bio-Active Silver Hydrosol on Bacterial Growth Compared with Ampicillin

Shaima Saleh Alfarraj

Dr. Mashail Fahad Alsayed

Antimicrobial resistance (AMR) has emerged as one of the leading public health threats of the 21st century, necessitating the exploration of alternative antimicrobial strategies like silver. This study aimed to evaluate the antibacterial efficacy of Sovereign Silver® Bio-Active Silver Hydrosol against two clinically significant pathogens: the Gram-positive Staphylococcus aureus and the Gram-negative Escherichia coli. The research compared the inhibitory and bactericidal effects of various silver hydrosol concentrations (100%, 70%, 50%, and 30%) with the conventional antibiotic Ampicillin, using agar well diffusion and disc diffusion methods. Morphological changes in the bacterial cells following treatment were further investigated through Scanning Electron Microscopy (SEM). The results demonstrated a

concentration-dependent inhibitory effect of the Bio-Active Silver Hydrosol. E. coli exhibited sensitivity across a wider range of concentrations (100%, 70%, and 50%), whereas S. aureus showed inhibition only at higher concentrations of 100% and 70%. Notably, while Ampicillin exhibited a bactericidal (fatal) effect on both pathogens, the silver hydrosol was determined to be bacteriostatic, primarily inhibiting bacterial proliferation rather than causing immediate death. SEM analysis provided visual confirmation of severe structural damage, including cell wall creases, partial lysis, and loss of characteristic morphology in both Gram-positive and Gram-negative bacteria. In conclusion, Bio-Active Silver Hydrosol is a potent antimicrobial formulation that exerts its effect by disrupting the bacterial cell envelope and interfering with intracellular processes. The study confirms that the highest concentrations are the most effective for inhibition, with Gram-negative bacteria showing higher susceptibility than Gram-positive strains. These findings highlight the potential of silver hydrosol as a promising alternative strategy to combat antibiotic-resistant microorganisms in clinical settings.

Antibacterial and Anti-Inflammatory Activities of Plant Extracts in an IL-4–Stimulated Human Alveolar Epithelial Cell Model (A549)

Sahar Khalid Alhomoudi

Dr. Roua Mohammad Saleh ALKufeidy

The increasing prevalence of antibiotic-resistant Pseudomonas aeruginosa in ICU-associated lung infections highlights the urgent need for alternative therapeutic strategies. Medicinal plant extracts have attracted considerable interest due to their potential antibacterial and anti-inflammatory properties. This study evaluated the phytochemical composition, antibacterial activity, antibiofilm potential, cytotoxicity, and anti-inflammatory effects of methanolic extracts from Eucalyptus globulus (E1), Thymus vulgaris (E2), and Zingiber officinale (E3). Phytochemical profiling using Gas Chromatography–Mass Spectrometry (GC–MS) identified 47 compounds in E1, dominated by cineole (20.57%); 24 compounds in E2, dominated by thymol (46.35%); and 34 compounds in E3, dominated by zingiberene (44.73%). Antibacterial activity against Pseudomonas aeruginosa was assessed using the agar well diffusion method, where only E2 demonstrated limited inhibitory activity (1.0 cm at 50 mg/mL decreasing to 0.6 cm at 6.25 mg/mL), while E1 and E3 showed no detectable effect. Gentamicin (10 µg/disc) exhibited the highest antibacterial activity (2.4–2.9 cm), whereas penicillin G (10 IU/disc) showed no inhibitory effect. Biofilm formation was evaluated using a coverslip-based biofilm assay with confocal microscopy. Cytotoxicity assessment using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay confirmed that all extracts maintained A549 lung epithelial cell viability at the tested concentrations. In an IL-4–stimulated inflammatory model, Enzyme-Linked Immunosorbent Assay (ELISA) demonstrated that IL-4 markedly increased IL-6 protein secretion, whereas treatment with the plant extracts significantly reduced IL-6 levels. Zingiber officinale extract (E3) showed the greatest inhibition (67.70%), followed by Thymus vulgaris (E2; 57.28%) and Eucalyptus globulus (E1; 55.16%). Gene expression analysis using real-time reverse transcription polymerase chain reaction (RT-qPCR) revealed that E1 (0.29-fold) and E2 (0.58-fold) produced stronger reductions in IL-6 mRNA expression compared with E3 (0.72-fold). Collectively, these findings indicate that Thymus vulgaris extract (E2) exhibits the most notable antibacterial activity against P. aeruginosa, whereas Zingiber officinale extract (E3) demonstrates the strongest anti-inflammatory effect with minimal cytotoxicity. These results support further investigation of these plant extracts as potential adjunct approaches for managing respiratory inflammation associated with bacterial infection and IL-4–mediated immune responses.

Study the Effect of Phoenix dactylifera Seed Extract and its Green Synthesized Silver Nanoparticles on Germination of Solanum lycopersicum Seeds Under Abiotic Stress.

Jamilah Abdullah bin Hashbal

Dr. Amal M. Al-Garawi

This study aimed to evaluate the effect of seed priming with date seed extract (Phoenix dactylifera) and green-synthesized silver nanoparticles derived from it on the germination of tomato seeds (Solanum lycopersicum) under three abiotic stresses: salinity, drought, and cold stress. Four priming treatments were used: distilled water (control), date seed extract (DSE), silver nitrate ($AgNO_3$), and silver nanoparticles (AgNPs). Germination percentage, shoot length, and root length were measured after seven days. In addition, samples were analyzed using scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDS) to investigate surface morphology and determine the distribution and concentration of mineral elements, particularly ions associated with salt stress such as sodium and potassium. The results showed that salinity stress had the most severe negative effect, reducing the germination percentage in the distilled water treatment to 11.11%. Date seed extract (DSE) outperformed most treatments, recording the highest germination percentage (97.78%) and the highest values for shoot and root length. Silver nanoparticles (AgNPs) also demonstrated effectiveness under salinity stress, increasing the germination percentage to 42.22% compared to 11.11% in the control. SEM-EDS elemental analysis showed that silver nitrate was the most effective treatment in reducing sodium accumulation. Silver nanoparticles enhanced potassium uptake, which improves osmotic balance and increases the plant's ability to adapt to stress. Date seed extract showed a moderate effect, possibly associated with its antioxidant properties. The results indicate that date seed extract can be used as a sustainable strategy to improve seed germination under salinity stress, while silver nanoparticles may serve as effective germination enhancers.

pH-Triggered Silver Nanoparticle Release from Ca-Alginate Hydrogel for On-Demand Antibacterial Activity with Reduced Unnecessary Silver Exposure.

Yara Tariq Dubayan

Dr. Rawan Mohammed Alshalan

Silver nanoparticles (AgNPs) are promising antibacterial agents; however, their biomedical application is limited by cytotoxicity and uncontrolled silver release, which may expose healthy tissue to unnecessary damage. This study aimed to develop and evaluate a pH-responsive calcium alginate hydrogel system for the controlled release of silver-based nanoparticles, enhancing antibacterial activity against methicillin-resistant Staphylococcus aureus (MRSA) under infection-relevant wound conditions while reducing unnecessary silver exposure under healthier acidic conditions. AgNPs and Ag-Fe nanoparticles were encapsulated within Ca-alginate beads and incubated at pH 5, 7, and 8 for 24, 48, and 72 h. Antibacterial activity was assessed by colony-forming unit (CFU) enumeration, while cytotoxicity was evaluated using the MTT assay. In parallel, a scratch assay was performed to evaluate the influence of nanoparticle release on cell migration, as an indicator of wound-healing compatibilityThe results showed that the antibacterial response was strongly influenced by pH, incubation time, and nanoparticle formulation. AgNP-loaded alginate beads produced the greatest reduction in MRSA viability at pH 7, particularly after 24 and 72 h, indicating enhanced antibacterial activation under near-neutral conditions. In contrast, reduced antibacterial activity was observed at pH 5, suggesting limited nanoparticle release under acidic conditions, which may help minimize unnecessary silver exposure in healthier wound-like environments. Ag-Fe nanoparticle-loaded beads also inhibited MRSA growth, although their activity was less consistent than AgNP-loaded beads. The MTT assay showed formulation-dependent cytotoxicity, whereas alginate-only controls maintained absorbance values comparable to those of untreated cells,

supporting the biocompatibility of the hydrogel matrix. Scratch assay observations showed greater wound closure at pH 5 than at pH 7, suggesting reduced cytotoxic interference with cell migration under acidic conditions, whereas reduced closure at pH 7 was consistent with enhanced silver release and stronger antibacterial activity.Overall, these findings suggest that Ca-alginate encapsulation can regulate silver nanoparticle release in response to environmental pH. The system remains less active under acidic conditions but shows enhanced antibacterial performance under near-neutral, infection-relevant conditions. This pH-triggered hydrogel platform may represent a promising strategy for smart antimicrobial wound dressings that balance antibacterial efficacy with reduced cytotoxicity.

Antibacterial Activity of different Myrrh Extracts Against Clinical Isolates of Staphylococcus aureus, MRSA, and Escherichia coli

Manair Ibrahem AL-Qahtani

amal sabour

Antibiotic drug resistance has become a worldwide concern amongst health care professionals, particularly with pathogens such as methicillin-resistant Staphylococcus aureus and Escherichia coli. This research paper aims to identify a natural substitute for antibiotic drugs using various extracts of the medicinal plant myrrh and to measure their antibacterial activity against standard ATCC strains, including Staphylococcus aureus (29213) and Escherichia coli (25922). Clinical isolates were also collected from patient samples at KSMC: S. aureus from wound swab samples, including MRSA, and E. coli from urine samples. 10 g of fine powder of myrrh were dissolved separately in three solvents using a ratio of 1:10 (w/v) of distilled water, ethanol, and acetone. The extracts were then filtered, the solvents were evaporated to concentrate, and the extracts were reconstituted prior to use. The method used in this paper was agar well diffusion, with the respective antibiotic discs as positive controls. Zones of inhibition were observed for all strains; maximum activity was detected with the ethanolic extract against Staphylococcus aureus (ATCC 29213) (1.33 ± 0.06 cm), while minimum activity was observed against clinical isolates of Escherichia coli (0.37 ± 0.06 cm). MRSA clinical isolates showed moderate susceptibility, with inhibition zones reaching 0.83 ± 0.06 cm. In conclusion, this research paper confirms that myrrh extracts exhibit in vitro antibacterial activity against both standard and clinical bacterial strains, including MRSA. The results suggest that myrrh could be a potential alternative to conventional antibiotic treatment or a complementary treatment for bacterial infections, including those caused by resistant strains. However, the antibacterial effects of myrrh extracts still need further clinical investigation.

Resistance Patterns Assessment of Acinetobacter bumannii Detected in Drinking Water in Riyadh Region

Lana AlGumaizi

Dr. Mashael Aljumaah

The nosocomial pathogen Acinetobacter baumannii was detected in drinking water using the membrane filtration method, with 28 isolates subjected to AST by the BMD. MICs were measured for 26 antimicrobials, showing no resistance and intermediate susceptibility to Colistin and Polymyxin B according to the CLSI guidelines. Its presence suggests current water treatments may be insufficient, as UV light and Ozone treatment are dominant among manufacturers, while our findings exhibit a sensitive reaction to direct contact with UV, and a significant reduction after exposure within the sample, underscoring the need for ongoing monitoring in Saudi Arabia.

Isolation and Functional Screening of Biosurfactant-Producing Bacteria Associated with Oil Contamination

Areen Showiman Alshowiman
Hissah Abdulrahman Alodaini

Biosurfactants produced by microorganisms have attracted increasing attention due to their role in environmental bioremediation and hydrocarbon degradation. This study aimed to isolate and functionally screen biosurfactant-producing bacteria from oil-contaminated environments and compare them with isolates from uncontaminated sites. Environmental samples were collected using sterile swabs suspended in normal saline. The tested isolates were coded according to their oil-contaminated sample source, where O1 and O2 represent two different oil-contaminated samples. Serial dilution and spread plating on Nutrient Agar were performed to obtain pure isolates. Selected isolates were cultured in Nutrient Broth supplemented with 1% vegetable oil to stimulate biosurfactant production, while castor oil was used in the oil spreading assay. Functional activity was evaluated using the oil spreading test and emulsification index (E24%). The results showed variation in biosurfactant activity among isolates. In the oil spreading assay, isolate O1-2 showed clear displacement activity with a diameter of 20 mm, while isolate O2-2 exhibited the largest displacement diameter (23.5 mm), and isolate O2-1 showed limited spreading activity (4.5 mm). The emulsification index results indicated that isolate O1-2 exhibited the highest emulsification activity (12.5%), followed by isolate O2-1 (10%). Based on the E24% value as the primary selection criterion and the oil spreading test as a secondary parameter, isolates O1-2 and O2-1 were selected as the most promising biosurfactant-producing isolates. Gram staining revealed Gram-variable rod-shaped cells. PCR amplification produced clear DNA bands at approximately 1500 bp. DNA sequencing identified both isolates as Priestia megaterium with sequence similarities of 98.17% and 97.88%. Phylogenetic tree analysis using MEGA version 12 further confirmed their close relationship with reference strains of Priestia megaterium. Overall, the findings indicate that oil-contaminated environments are valuable sources of biosurfactant-producing bacteria with potential applications in hydrocarbon degradation and environmental bioremediation.

Assessment of Surface Sterilization Efficiency and Germination Percentage in Wheat (Triticum asetivum L.) Grains under Different Sterilization Treatments.

Norah Hamad Alghaihab
Dr. Hanan Alharbi

Nanotechnology is widely used in agriculture for seed surface sterilization due to its antimicrobial properties. In this research, silver nanoparticles were green synthesized using Commiphora myrrha extract for wheat (Triticum aestivum L.) seed surface sterilization and compared it with conventional methods and assess the efficiency of the sterilisation methods and calculate the germination percentage. The formation of AgNPs was confirmed by the color change of the solution to dark brown. The AgNPs were characterized using UV-Vis, FTIR, Zeta potential, DLS, TEM and EDX which confirmed the successful synthesis of nanoparticles. For the seed's treatments, seeds were treated with 13 different treatments including the AgNPs treatments. The synthesized AgNPs were used to prepare three concentrations (250, 500, 1000 mg/L) for three different immersion durations (15 min, 1 h, 3 h). The results showed that the bacterial contamination percentage reduced to 26.67% for the 1000 mg/L for 3 hours of immersion treatment and 0% bacterial contamination for the 5% Clorox treatment compared to 60% contamination in the negative control. Also, all treatments showed a complete fungal contamination except the 5% Clorox treatment that exhibited an 80% fungal contamination percentage. Moreover, seed germination percentage reached to 100% in 1000 mg/L for 3 hours of immersion treatment. Indicating that C. myrrha silver nanoparticles acted as a biostimulant and did not cause any damage to the seed embryo, but the concentrations weren't enough for the seed surface sterilization.

Geology and Geophysics Department

Remote sensing and spatial information systems for groundwater quality assessment in Harrat Khaybar

Mohamed Alrajhi
Fahad Bin Khudier Alshehri

This study aims to investigate shallow groundwater resources in Harrat Khaybar by analyzing their spatial distribution and hydrogeological characteristics. The objectives include identifying the occurrence of shallow groundwater, determining the extent and depth of aquifers beneath the basaltic bedrock, and evaluating groundwater quality and its suitability for various uses. The study integrates field data with remote sensing data and Geographic Information System (GIS) techniques to enhance the analysis of both surface and subsurface features. This integrated approach improves the understanding of groundwater systems in volcanic environments and provides valuable insights to support sustainable water resource management and informed decision-making.

Computation of Water Quality Index (WQI) for Groundwater in Hail Province

Abdullah Salah Al-Huwaisal
Faisal Kamal Zaidi

Groundwater is the main freshwater source in Hail Province, Saudi Arabia, where surface water is scarce. This study evaluates its suitability for drinking using the Drinking Water Quality Index (DWQI) and examines spatial water-quality variation. Thirty-seven groundwater samples from bore wells in alluvial aquifers were analyzed for major physicochemical parameters, including TDS, major ions, and nitrate. The DWQI was calculated using the weighted arithmetic method based on WHO drinking-water standards. Results show TDS values ranging from 259.8 to 2578 mg/L. Dominant ions were Na^+ and Cl^-, while nitrate reached up to 170 mg/L in some wells, suggesting localized human-related contamination. DWQI values ranged from 18 to 192, with about 75% of samples classified as excellent or good for drinking. However, wells H1, H5, and H36 showed poor quality due to high TDS, chloride, sulfate, and nitrate. Spatially, poorer water quality occurs in the northeastern lowlands, while better quality is found in the southwestern recharge zones. Overall, groundwater is generally suitable for drinking, but localized contamination requires monitoring and management.

Structural Study On The Upper Jurassic Arab Formation, Eastern Al-Arid District, Riyadh, Saudi Arabia

Omar Moteb Hamad Alsaadoon
Essam Abd El-Motaal Mohamed

The outcrops of the Upper Jurassic Arab Formation at Eastern Al-Arid district display solution breccia and structural deformation such as folding, faulting and joints. The Arab Formation consists of four geographically widespread carbonate evaporite cycles or members (A, B, C and D). Karstification (dissolution) of the carbonate and evaporite has caused the subsidence and collapse of the overlying carbonates forming solution breccia. The geological structures, in the study area, are represented by NW-SE trending folds (anticline and syncline) and NW-oriented normal faults.The main cause of deformation was removal of evaporite by solution and subsequent slumping of Arab carbonate beds. In the subsidence areas the structure and the topography are primarily governed by dissolution-induced gravitational deformation. Sinkholes related to carbonate and evaporite karst constitute an important geohazard in Saudi Arabia, despite its desert environmental conditions. Moreover, the associated damage is expected to increase in the future due to the intensification of the anthropogenic alterations and the expansion of development. Therefore, it is highly recommended that any building in the study area should be preceded by geological investigation.

Assessment of Groundwater Quality in Wadi Ad Dawasir, Saudi Arabia

Fawaz Kader Alzahrani

Faisal Kamal Zaidi

This study assesses the hydrochemical characteristics, spatial distribution, and irrigation suitability of groundwater from the Upper Wajid Sandstone Aquifer in Wadi Ad Dawasir, Saudi Arabia. Forty-nine groundwater samples were analyzed for major physicochemical parameters, and groundwater quality was evaluated using statistical analysis, SAR, Piper plots, and spatial mapping. Results show spatial variation in groundwater quality, with TDS ranging from 573 to 3430 mg/L, indicating moderate to high mineralization in some wells. High variability in chloride, sodium, calcium, sulfate, and nitrate suggests the influence of evaporation, mineral dissolution, water–rock interaction, and agricultural return flow. Nitrate reached 196.70 mg/L, indicating localized contamination likely caused by fertilizer leaching and irrigation activities. SAR values ranged from 1.52 to 9.43, placing all samples in the low sodium hazard class and indicating general suitability for irrigation. However, high TDS, chloride, and sulfate in some areas may pose salinity risks. Higher salinity and nitrate levels are mainly concentrated in the western and northwestern parts of the area. Overall, groundwater quality is affected by both natural and human activities, requiring regular monitoring and improved irrigation management.

Stratigraphy of the Upper Jurassic open shelf platform in central Saudi Arabia

Abdullah Turki Al Nassar

Prof. Ali Y. Kahal

This study investigates the stratigraphy of the Upper Jurassic successions exposed along the Tuwaiq Escarpment around Riyadh, central Saudi Arabia. The Upper Jurassic interval includes the Hanifa, Jubaila, Arab (A–D), and Hith formations, which collectively represent a carbonate–evaporite platform developed along the passive margin of the Neo-Tethys Ocean. These strata are the most productive oil reservoirs in the world. They have a significant petroleum potential, and contain an important source, reservoir and seal rocks. Many locations along the Upper Jurassic outcrops have been studded around Riyadh region to revise stratigraphy of the upper Jurassic succession of central Saudi Arabia.

Study Of Geological Deformation In The Upper Jurassic Arab Formation, Western Al-Arid District, Riyadh, Saudi Arabia

Faris Hammad Sallh Albuhaiji

Essam Abd El-Motaal Mohamed Mohamed

The outcrops of the Upper Jurassic Arab Formation at Western Al-Arid district display solution breccia and structural deformation such as folding, faulting and joints. The Arab Formation consists of four geographically widespread carbonate evaporite cycles or members (A, B, C and D). Karstification (dissolution) of the carbonate and evaporite has caused the subsidence and collapse of the overlying carbonates forming solution breccia. The geological structures, in the study area, are represented by NW-SE trending folds (anticline and syncline) and NW-oriented normal faults.

The main cause of deformation was removal of evaporite by solution and subsequent slumping of Arab carbonate beds. In the subsidence areas the structure and the topography are primarily governed by dissolution-induced gravitational deformation. Sinkholes related to carbonate and evaporite karst constitute an important geohazard in Saudi Arabia, despite its desert environmental conditions. Moreover, the associated damage is expected to increase in the future due to the intensification of the anthropogenic alterations and the expansion of development. Therefore, it is highly recommended that any building in the study area should be preceded by geological investigation.

Ore deposit geology of Al Khnaiguiyah, eastern part of the Arabian Shield: A review of its stratigraphy, structure and base metal potential

Ryan belal nasser Knaier

Prof. Dr Bassam A. Abuamarah

The Al Khnaiguiyah district, located in the eastern part of the Neoproterozoic Arabian Shield of Saudi Arabia, hosts volcanogenic massive sulfide (VMS)-type base metal mineralization. Despite historical exploration, a modern, integrated review of its stratigraphy, structural geology, and copper-zinc-lead potential has been lacking. This project presents the available geological data, including published reports, openfile exploration datasets. The stratigraphy of Al Khnaiguiyah comprises mafic to felsic volcanic sequences intercalated with exhalative cherts, clastic sediments, and synvolcanic intrusions. Intense hydrothermal alteration (chloritization, sericitization, silicification) is spatially associated with sulfide lenses. Structurally, the district records early ductile folding followed by brittle faulting; post mineralization faults offset ore bodies.

Geology of North Riyadh Geopark, Thadiq, Saudi Arabia

Fahd Badr Hamad Gewaid

Abdelbaset Sabry Mohamed

This project aims to investigate the geological and geomorphological characteristics of the North Riyadh Geopark, located in Thadiq Governorate, northwest of Riyadh, Saudi Arabia. The geopark represents an important natural, scientific, educational, and geotourism site. It includes several distinctive geological sites that record the geological evolution, biodiversity, and cultural heritage of the Arabian Peninsula. Official sources describe the area as being located about 140–150 km northwest of Riyadh, with diverse landforms including mountains, valleys, caves, sand dunes, sabkhas, and fossil-bearing sedimentary rocks. The study focuses on describing the exposed rock units, especially the Jurassic–Cretaceous sedimentary successions, which were deposited in ancient shallow marine environments along a passive continental margin related to the southern Tethys Ocean. The presence of fossil coral reefs and marine fossils indicates that parts of the region were once covered by shallow seas. In addition, the geopark's tabletop mountains and escarpments, associated with the Tuwaiq Mountain system, provide excellent examples of differential weathering and erosion processes that shaped the present-day landscape. The project also discusses the role of the geopark in geological education, geoheritage conservation, geotourism, and sustainable development for local communities in Thadiq. The designation of North Riyadh Geopark as a UNESCO Global Geopark in 2025 further emphasizes its scientific, environmental, and cultural importance at both national and international levels. Overall, this project is expected to demonstrate the geological value of North Riyadh Geopark as an open-air natural laboratory for studying ancient depositional environments, geomorphological features, fossil records, and the interaction between humans and the natural landscape in central Saudi Arabia.

Geochemistry of the Qutn Granite

Abdulmajeed Bin Dawood

Ahmad Al-Saleh

The Qutn granite is a sub-circular (11 × 14 km) alkaline ring complex consisting of an incomplete biotite granite outer rim and a porphyritic core. It belongs to the Abanat suite of the northern Afif terrane and has a Rb/Sr isochron age of 579±4 Ma making it one of the youngest post-tectonic intrusions in the northern shield. This granitic body intrudes the slightly metamorphosed molassic sediments of the Murdama Group, but is not affected by the strike-slip Najd faults. The Abanat suite encompasses a group of late Proterozoic plutons (580-565 Ma) that are generally alkali-rich, leucocratic, siliceous, and highly evolved. They include the Aban Ahmar complex, Aban Asmar complex, the shurmah and Silsilah ring dykes; that latter is only

12 km NE of Qutn and contains the largest tin greisen deposit of the Arabian Shield. 27 representative samples from the two parts of the Qutn complex were chosen for major and trace element analyses using the ICP-AES/MS facilities at ALS labs, Australia. The Qutn rocks are classified as monzogarnites and syenogranites on the QAP diagram; their agapitic index indicates that they are alkaline, and their Shand index shows them to be peralkaline to slightly metaluminous. Little differentiation is shown on the Harker diagrams due to the limited silica range; on the spider diagrams they have high concentrations of Rb, Th, U, Zr, Y and LREE, with negative Nb, Ba, Sr, P and Ti anomalies in most samples, pointing to the role of feldspar and Fe-Ti oxides as major fractionating phases. The Qutn granite samples have relatively high total REE (155-362 ppm) producing consistent and smooth profiles. There is noticeable LREE enrichment relative to HREE (La/Lu = 0.8-4.1), and strong negative Eu anomalies (Eu/Eu* = 0.014-0.2), especially in the case of the biotite granite. The LREE patterns are moderately fractionated (La/Sm = 1.26–3.81), while the HREE have a weakly fractionated to flat profile (Gd/Yb = 0.56-0.95); this distribution gives the Qutn granites REE profiles a typical seagull pattern which is characteristic of A-type granite. By comparison with other post-orogenic granites from the Northeastern Arabian Shield the Qutn rocks are distinct in that they are the only granites with relatively flat REE patterns; all other granites including those of the Abanat suite have markedly steeper patterns. This is significant in that it point to either LREE depletion or HREE enrichment; the second cause is more likely, since LREE content in Qutn is similar to that of other peralkaline granites from this part of the shield. On the granitoid tectonic discrimination diagrams, the Qutn samples plot in the field of within-plate granite, while on the Ga/Al vs. Zr diagram they lie within the field of A-type granites.

Hydro-Geological Assessment of Catchment Data of Wadi Al Ula, Saudi Arabia, Applying Remote Sensing (RS), and Geographic Information System (GIS).

Abdullah Abdulrahman Alkhalaf

Prof. Bassam A. Abuamarah

This research presents a comprehensive hydro-geological assessment of the Wadi Al Ula catchment, geographically situated between latitudes 26° 30' N – 27° 15' N and longitudes 37° 45' E – 38° 20' E. Utilizing a multi-criteria decision analysis (MCDA) framework within QGIS, the study integrates high-resolution datasets from Sentinel-2, Landsat 8/9, and ALOS PALSAR to model complex surface dynamics. The methodology addresses the logistical challenges of the region's rugged terrain by employing remote sensing (RS) to delineate groundwater and recharge flash-flood susceptibility. The final hydro-geological hazard map serves as a strategic tool for sustainable water resource management, directly supporting Saudi Arabia's Vision 2030 objectives, specifically the 'Qatrah' program and the initiatives of the Royal Commission for AlUla (RCU).

Carbon Dioxide Mineralization Potential in Saudi Basalts: A Case Study on Harrat Al-Sarah and Harrat Lunayyir

Ahmed Khalid ALAmri

Dr. Suhail Alhejji

This study evaluates the in situ mineral carbonation (ISMC) potential of two basaltic fields in southern and NorthWest Saudi Arabia: Harrat Al-Sarah (Tertiary) and Harrat Lunayyir (Quaternary). An integrated approach combining Carbonation Potential Index (CPI), Loss on Ignition (LOI), and petrographic analysis was applied to assess both geochemical reactivity and physical reservoir quality. CPI values (0.364–0.640 mol/100 g) indicate that both harrats are geochemically comparable to global ISMC analogues such as CarbFix. Harrat Al-Sarah pre-hiatus flows show the highest CPI, but elevated

alteration (LOI up to 3.47 wt.%) and extensive secondary mineralization reduce effective porosity and limit practical suitability. In contrast, Harrat Lunayyir Quaternary flows exhibit slightly lower CPI (0.481–0.515 mol/100 g) but extremely low alteration (LOI < 0.5 wt.%), high vesicularity, and well-preserved volcanic glass, providing superior conditions for fluid injection and carbonation. The study demonstrates that CPI and LOI are decoupled, highlighting the importance of integrating geochemical and petrographic analysis. Overall, Harrat Lunayyir Quaternary units are identified as the most promising targets for future ISMC development in Saudi Arabia.

Groundwater Potential Assessment Using Second-Order Geoelectric Parameters and AHP-Based Multi-Criteria Analysis in Asir Region, Saudi Arabia

Abdulaziz Sulaiman Al-Omair

Dr. Saleh Ismail AlQaysi

Groundwater potential assessment in the Asir Region, southwestern Saudi Arabia, was carried out by integrating second-order geoelectric (Dar Zarrouk) parameters with the Analytic Hierarchy Process (AHP) and weighted linear combination algorithm. Five Vertical Electrical Sounding (VES) stations were established using the Schlumberger array with a maximum electrode spacing of 50 m. First-order geoelectric parameters layer resistivity and thickness were obtained through partial curve matching and computer iteration using the IXD1v3 software and were subsequently used to derive four second-order Dar Zarrouk parameters: Transverse Resistance (T), Coefficient of Anisotropy (λ), Reflection Coefficient (RC), and Longitudinal Conductance (S). VES interpretation delineated three subsurface layers across the study area: a topsoil layer (resistivity 57 – 1,542 Ω·m; thickness 0.4 – 1.3 m), a weathered basement or alluvial deposit layer (resistivity 4 – 429 Ω·m; thickness 1.0 – 14.9 m) and a fractured basement or bedrock layer (resistivity 86 – 289 Ω·m; depth 2.1 – 16.3 m). H-type and Q-type sounding curves were identified, with H-type dominating at 60%, indicating shallow basement occurrence. Transverse resistance ranged from 63.52 to 8,221.96 Ω·m², longitudinal conductance from 0.016 to 0.268 mho, coefficient of anisotropy from 10.68 to 168.69, and reflection coefficient from −0.045 to 0.972. AHP pairwise comparison assigned weights of 0.50, 0.26, 0.15, and 0.09 to T, λ, RC, and S, respectively, with a Consistency Ratio of 0.048, confirming acceptable consistency. The resulting Groundwater Potential Index (GWPI) computed as GWPI = 0.50RT + 0.26Rλ + 0.15RRC + 0.09RS ranged from 2.22 to 4.70, classifying the study area into low (VES 5), moderate (VES 1, VES 3), and high (VES 2, VES 4) groundwater potential zones. High-potential zones are characterized by thick, transmissive aquifer units, weathered or fractured basement conditions and permeable overburden materials. The study demonstrates that coupling Dar Zarrouk parameters with AHP provides a physically grounded and reproducible framework for groundwater exploration in basement complex terrains, particularly in data-scarce arid environments and offers practical guidance for borehole siting and sustainable groundwater management in the Asir Region of Saudi Arabia.

An Overview of Earthquake Frequency in the Red Sea Region

Abdulrahman Ali Alahmari

Prof. Dr. Sattam Almadani

The Red Sea is one of the most important active tectonic regions in the Middle East because it represents the present-day divergent boundary between the Arabian and Nubian plates. Earthquake activity in this region is controlled by continental rifting, incipient to mature oceanic spreading, transform interaction, and localized magmatic processes. This revised report examines earthquake frequency in the Red Sea region with emphasis on spatial distribution, magnitude-frequency behaviour, focal depth, and the dominant fault mechanisms within different tectonic sectors. The study is designed as a

literature-supported undergraduate research project. It uses open-access earthquake resources and published tectonic studies as the basis for interpretation, especially the USGS ANSS Comprehensive Catalog, the International Seismological Centre bulletin, the Global Centroid Moment Tensor catalog, and recent peer-reviewed studies of Red Sea seismotectonics. The reviewed evidence indicates that seismicity is not uniformly distributed along the basin. Instead, earthquakes cluster around the axial trough, fracture-zone accommodation areas, the Gulf of Aqaba transform system, and the southern Red Sea-Afar sector, where swarm activity and volcanism may accompany rifting episodes. The main conclusion is that earthquake occurrence in the Red Sea is best understood as the product of segmented rifting rather than a single uniform process. Most events are shallow, normal faulting dominates the rift-axis sectors, and strike-slip or oblique-slip motion becomes more important where spreading connects with transforms or microplate boundaries. These findings are relevant for coastal development, ports, desalination plants, pipelines, offshore engineering, tourism projects, and urban expansion along both margins of the Red Sea.

Basement depth estimation using gravity data. Application in Arabian platform

Mohammed Khalid Almuqbil

Chokri Jallouli

This study estimates the depth to the basement in a selected area of the Arabian Platform using gravity data. A first approximation of basement depth was obtained using a linear relationship between Bouguer anomaly values and basement depths derived from four well-control points. The model was subsequently refined using the iterative rescaling method (ITRESC loop) proposed by Florio (2018), which also allowed estimation of the density contrast between sedimentary cover and basement rocks. The final model reveals a significant central basement depression interpreted as a graben structure surrounded by relatively shallow basement blocks. The results demonstrate that gravity data, when integrated with wells constraints and iterative modeling, provide an effective and cost-efficient approach for basement depth estimation in the Arabian Platform.

Identifying groundwater barrier layers using Vertical Electrical Sounding (VES) in Al-Kharj, Saudi Arabia

Azzam Aljolaifi

Dr. Hassan Abdullah Alzahrani

This study aims to identify groundwater barrier layers and characterize subsurface stratigraphy in the Al-Kharj area, Saudi Arabia, using the Vertical Electrical Sounding (VES) method. Six VES stations were conducted, and the acquired data were processed and interpreted using IPI2WIN software, with RMS error values ranging between 2.88% and 7%, indicating a good agreement between the observed and calculated data. The results revealed the presence of four main subsurface layers with varying resistivity values. The first layer represents dry surface soil, followed by a clayey sand layer. The third layer is characterized by low resistivity values and is interpreted as a clay-rich barrier layer that restricts groundwater movement. The fourth and deepest layer is identified as a water-saturated formation, representing the main aquifer in the study area. The analysis successfully determined the number of subsurface layers, as well as their depths and thicknesses across the study area. A simplified cross-section was constructed to illustrate the lateral variation of subsurface layers and the continuity of the clay barrier layer. The findings demonstrate the effectiveness of the VES technique in identifying subsurface geological structures and provide valuable information for groundwater exploration and management in Al-Kharj.

Geology of the Al Amar gold-bearing sulfide ore mine,Ar Rayn terrane, Eastern Arabian Shield, Saudi Arabia

Waleed Menwer Almutairi

Hisham Gahlan

A gold-rich volcanogenic massive sulfide (VMS) deposits have been recorded in the Al Amar district, Eastern Arabian Shield, Saud Arabia. The Al Amar mineralization is generally pyrite chalcopyrite- sphalerite-galena that is confined mainly to and hosted by the volcanic unit III. The volcanic unit III is a metapyroclastic (ash, pumice and lapilli tuff) sequence. Mineralogically, it consists of talc, barite, carbonates and sulfides. The Al Amar deposit is classified into: (1) volcanic massive to sub-massive stratiform sulfides (VMS) that are confined to the volcanic unit III, and (2) vein-type deposits (stockwork) crossing the volcanic units I, II and III. Two mineralized zones have been identified in the Al mar mine; (1) the North Vein Zone (12.3 g/t gold) and (2) the South Vein Breccia Zone (5.1 g/t gold). Wall-rock alteration is represented by the sericite-talc-chlorite mineral paragenesis. Petrography, mineralogy and textural data indicate that the Al Amar VMS deposits and host rocks are affected by low to moderate deformation that often characterize the VMS of the Arabian Shield during the Neoproterozoic submarine-subaerial volcanism and formation of arcs. Tectonic setting, occurrence of epithermal veins and stringers, petrography and highly dispersed gold nature in the Al Amar VMS suggest that the Al Amar gold-bearing sulfide ore belongs to the kuroko-type syngenetic VMS deposits of shallow-water to subaerial volcanic setting equivalent to epithermal conditions. Partly, the Al Amar sulfide mineralization was affected by structural controls, which appear to be confined to post-mineralization and slight to moderate deformation.

Study of diagenetic process in the Coral reef along Rabigh coast

Abdulmalek mihimmed Alharbi

Dr.Mansour Hashim M Al hashim

This study investigates fossil coral occurrences in the Rabigh area along the Red Sea to reconstruct depositional environments and diagenetic processes. The rocks are mainly bioclastic limestones formed in a shallow, warm reef environment. Diagenetic processes, including dissolution, micritization, cementation, and transformation from aragonite to calcite, altered the original structures. The study highlights the role of diagenesis and the value of fossil reefs in recording past environmental conditions.

Ecological risk assessment of heavy metals in agricultural soils in central Saudi Arabia

Mohammed Faisal Aldosari

Khaled Mubarak Algahtani

The agricultural soils of Al-Badayea' Governorate in the Al-Qassim Region, Saudi Arabia, constitute an essential resource for date palm cultivation and national food security. This study assesses the concentrations and spatial distribution of selected heavy metals (Fe, Mn, Cu, Ni, Zn, Co, and Pb) and evaluates the extent of potential anthropogenic contamination in the topsoil of 33 date palm farms. Soil samples were collected from the 10–20 cm depth interval, digested using a mixed-acid protocol, and analyzed by inductively coupled plasma mass spectrometry (ICP-MS). The results indicate pronounced spatial variability in metal concentrations. Iron was the dominant element (9200–16,600 mg/kg), consistent with lithogenic control, whereas trace elements such as Mn (169–229 mg/kg), Zn (12–81 mg/kg), Ni (4–19 mg/kg), Cu (4–14 mg/kg), Pb (2–10 mg/kg), and Co (1.61–3.94 mg/kg) exhibited localized variations. Enrichment factor (EF) analysis, normalized to Fe and average shale values, indicates that Mn, Ni, Co, and Cu are predominantly of lithogenic origin (EF < 1), with very low enrichment levels.

Zinc shows low to moderate localized enrichment at three sites (B10, B28, and B31), while Pb exhibits minor increases in a limited number of samples. Overall, the distribution of these elements is largely governed by the natural geochemical background, with only slight inter-farm variability that may reflect differences in agricultural practices. Continued environmental monitoring is recommended to track temporal changes, maintain soil quality, and support sustainable agricultural development.

Structural Study of the Wadi Fatimah Fault Zone Using Aeromagnetic Data and Digital Elevation Models

Saud Abdullah Alothman

Dr. Faris A. Abanumay

The Wadi Fatimah Fault Zone (FFZ), located along the western margin of the Arabian Shield near Jeddah, represents a major structural feature associated with the tectonic evolution of the Red Sea. This study investigates the structural characteristics and geomorphological expression of the FFZ using an integrated approach combining aeromagnetic data and remote sensing techniques. The global EMAG2 dataset was processed to generate a Total Magnetic Intensity (TMI) map, revealing significant spatial variations in magnetic responses across the study area. Lower magnetic values dominate the coastal plain, while inland regions exhibit higher and more heterogeneous magnetic signatures, reflecting variations in subsurface lithology and structural complexity. Elongated and irregular magnetic patterns were identified, suggesting the presence of structural lineaments and possible fault-related features. Digital Elevation Model (DEM) analysis shows a gradual increase in elevation from the Red Sea coastal plain toward the eastern highlands, exceeding 500 m. The topography is characterized by well-developed drainage systems and linear geomorphological features trending predominantly NE–SW. These features correspond closely with the distribution of magnetic anomalies. The integration of aeromagnetic and topographic data indicates that the Wadi Fatimah Fault Zone exerts significant control on both subsurface structures and surface geomorphology. The alignment between drainage patterns, elevation gradients, and magnetic variations suggests strong structural influence associated with the fault zone. These results support the interpretation that the FFZ is a major tectonic feature influencing landscape development and may have undergone reactivation related to Red Sea rifting processes.

Mantle Source Evolution Beneath Western Arabia Over Time: Implications from Harrat Lunayyir (young) and As-sarat (old) lavas

Abdulaziz Abdullah Al-Mutairi

Dr. Suhail Alhejji

Western Arabia hosts one of the largest continental volcanic provinces on Earth, consisting of basaltic lava fields known as harrats that have been active from approximately 30 million years ago to the present day. Their origin is linked to Red Sea rifting and the Afar mantle plume, yet the mantle sources responsible for the different phases of volcanic activity remain debated. This study investigates mantle source evolution beneath western Arabia using trace element and rare earth element (REE) compositions from Harrat Lunayyir, As Sarat, and a broader regional dataset. The results should indicate that older lava flows are associated with greater melting depths and lower degrees of partial melting, reflecting a thicker lithosphere and stronger involvement of enriched subcontinental lithospheric mantle, whereas younger lava flows record shallower melting at higher degrees, consistent with progressive lithospheric thinning and increasing asthenospheric influence over time. These findings improve our understanding of how melting conditions and mantle source contributions beneath the Arabian-Nubian Shield have evolved from the early rift stage to more recent volcanism.

The Al-Amar ophiolite complex, Ar Rayn terrane, Eastern Arabian Shield, Saudi Arabia: Mantle Section Geology and Microscopy

Abdulmohsen Khaled Nasser Alodan

Prof.Dr/Hisham Gahlan

The studied Al-Amar ophiolite complex is one of the easternmost ophiolite segments along the well-known Al-Amar-Idsas fault, Ar Rayn terrane, Eastern Arabian Shield. It is a dismembered ophiolite complex. Serpentinites constitute the most prominent and easily recognizable member or unit in the Al-Amar ophiolite. They represent the mantle section of that ophiolite. The serpentinites form isolated masses, imbricated slices and thrust sheets of variable thicknesses, as small as lenses incorporated in the volcanic and metasedimentary matrix of the mélange. They thrust over the associated island arc calc-alkaline metavolcanics of the Al-Amar group, and replaced by talc-carbonates along faults and shear zones. Lack of thermal effects around serpentinites on the enveloping country rocks, as well as their association with thrust faults indicate their tectonic emplacement as solid bodies. Petrographically, they are composed essentially of antigorite, chrysotile and lizardite with subordinate amounts of carbonates, chromite, magnetite, talc, tremolite and chlorite. This mineral assemblage indicates low-grade greenschist facies metamorphic conditions. The regional metamorphism is occurred during the collisional stage or ocean basin closure, followed by thrusting over the continental margin. The parent rocks of the studied serpentinites are mainly harzburgite and dunite due to the prevalence of bastite and mesh textures. Carbonate masses represent the most prominent economic mineral deposit associated with the serpentinites in the studied area due to CO2 metasomatism. Other possible deposits need further geochemical exploration.

Evidence of Reactivation of the Ad Damm Fault Zone, Western Arabian Shield, Saudi Arabia

Nassar Hussain AL Qahtani

Fares Abanumay

The Ad Damm Fault Zone (AFZ) is a major NE-SW trending structural zone in the western Arabian Shield of Saudi Arabia. It forms a tectonic boundary between the Tonian Jeddah terrane to the northwest and the Asir terrane to the southeast. Although the AFZ is an ancient Precambrian structure, recent remote-sensing and geophysical observations suggest that it may have been reactivated during younger tectonic events related to the opening and evolution of the Red Sea (Abanumay et al., 2024). This project evaluates evidence for possible reactivation of the AFZ by integrating Landsat Thematic Mapper (TM) imagery, Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM), and aeromagnetic data. The Landsat image is used to map surface lineaments, lithological contrasts, and drainage patterns. The DEM is used to examine topographic breaks, escarpment disruption, elevation contrasts, and wadi morphology. Aeromagnetic data are used to interpret subsurface magnetic fabrics, structural discontinuities, and Red Sea-related dike swarms. The integrated interpretation indicates that the AFZ dissects the Red Sea topographic escarpment, controls parts of the paleo-drainage system, and cuts NW-trending magnetic anomalies interpreted as latest Paleogene to earliest Neogene mafic dike swarms associated with Red Sea rifting. These observations support the interpretation that the AFZ behaved as a pre-existing zone of weakness that was reactivated during younger Red Sea-related

deformation (Abanumay et al., 2024).

Flooding in Hail region

Mohammed Abdulaziz Almarri

Prof.Dr: Talal Alharbi

Flooding in the Hail Region is mainly caused by intense, short-duration rainfall typical of desert climates. Although the area is generally arid, heavy storms can quickly overwhelm dry valleys (wadis), leading to sudden flash floods.

Geochemical Exploration for PGE at Wadi Kamal complex, NW Arabian Shield.

Omar Al-Khathami

Ahmad Al-Saleh

Wadi Kamal intrusion is the largest layered Complex in the entire Arabian Shield; its size, petrologic character and style of mineralization makes it a perfect target for platinum group element (PGE) exploration. Previous exploration defined Ni-Cu-PGE targets within a gabbro and peridotite unit at the southern edge of the Wadi Kamal complex. Samples were collected from stream sediment in wadis draining the principal KMS-1 and neighboring gossans. Factor analysis was used on the data set, and 4 factors were recognized. Factor 1 is a lithology factor and includes Mg, Cr, Ni and Co; factor 2 has high loadings for Pt, Pd, Cu and Co and is inferred to be an "ore factor". Factor 3 comprises Al, K, Na, P and REE and is associated with granitic rocks. Factor 4 contains only Au. On the factor scores map, factor-1 is common in the serpentinite area and weakens south towards the gabbro. Factor-3 is highest within a pegmatite vein swarm, a pattern also imitated by the gold factor-4. The ore factor (Factor-2) is best characterized in the two wadis that drain the main KMS-1 gossan, but with a much more extended dispersion train when compared with the absolute values for Pt+Pd and Cu. Factor analysis is shown to be an efficient means of improving the geochemical signature of slight mineralization especially as applied to Pt, Pd and Cu with Co being less suitable as a pathfinder element.

Epithermal Mineralization at the Asfar Caldera, NE Arabian Shield

Mubarak Abdullah Alsanea

Ahmad Al-Saleh

The study area includes various types of rock units and mineral ores. As mentioned above, the rock-containing mineral units follow the Shammar Group. It is a dome of rhyolite located on the edge of a Caldera. It contains mostly volcanic rocks, which have been re-moved to varying degrees, especially on the edge of the caldera, near the dome where rocks take the appearance of sandstone and sedimentary rocks. Mineral occurrences in the area include: Disseminated mineralization in the volcanic caldera rocks includes sulphides, gold, and silver; iron and manganese oxides within sandstone and sandstone near the Rhyolite dome; Thin veins containing Uraninite and Pitchblende and their oxidation products. There is some similarity between Asfar mineralization and copper porphyry ore in terms of the nature of the rough ore and the potassium alteration (the appearance of the sericite and alkaline feldspar) of the wall rocks. The basic metal in such materials is chalcopyrite, which is completely absent from the assembly of ore minerals in the caldera region; added to the fact that the rocks containing copper porphyry mineralization are granitic rocks rather than volcanics, the Asfar area cannot be considered as belonging to this type of mineralization. Some researchers point to the possibility of copper porphyry in depth under the domes of Rhyolite and its mineralized chambers. The deposits of the Dome and Caldera are of the type associated with acidic rocks, one of the most common types of ores in the Arabian Shield, especially for precious metals, which is particularly concentrated in the younger layers and groups in the shield.

Groundwater Potential Investigation in the Dirab Area, by Using Vertical Electrical Sounding (VES)

Abdulaziz Mohammed Almrshid

Kamal Abdelrahman Elsayed Hassanein

This study investigates groundwater potential in the Dirab area, southwest of Riyadh, Saudi Arabia, using the Vertical Electrical Sounding (VES) method. The study area is mainly composed of Jurassic sedimentary formations, particularly the Dhruma Formation, which plays an important role in groundwater occurrence. Six VES profiles were conducted using the Schlumberger array to determine the subsurface resistivity distribution, layer thicknesses, and potential water-bearing zones; the data were interpreted using IPI2Win software. The results revealed four subsurface geoelectrical layers with resistivity values ranging from 28.1 to 91 Ω·m in the first layer, 3.12 to 103 Ω·m in the second layer, 9.83 to 45.2 Ω·m in the third layer, and 25.5 to 136 Ω·m in the fourth layer, reflecting variations in lithology and moisture content. Clear lateral and vertical variations were observed across the study area, with low resistivity values in the second and third layers, particularly at VES1–VES5, indicating potential groundwater-bearing zones, whereas higher resistivity values at VES6 suggest compact or relatively dry formations. The fourth layer generally exhibits high resistivity, indicating a consolidated, relatively dry unit, and the total interpreted depths range from 14 m to 231 m, reflecting subsurface variability. Overall, the study confirms that the VES method is an effective and cost-efficient tool for groundwater exploration in the Dirab area, with promising aquifer zones identified, although further verification through exploratory drilling is recommended.

A Hydro-Geophysical Investigation of Groundwater Potential in Al-Darah Village, Al-Qassim Region

Abdullah Khaled Alsager

nassir saad alarifi

In arid environments, the urgency of water scarcity demands precise and efficient strategies for identifying and assessing groundwater reserves. Al-Darah village, situated within Saudi

Arabia's Al-Qassim Province, encounters significant hurdles in securing reliable water sources due to its specific climatic and geological constraints. This research utilizes geophysical methods—specifically Vertical Electrical Sounding (VES)—to delineate subsurface structures and locate viable aquifers. Located on the Arabian Shield, the study area features a complex arrangement of Precambrian metamorphic and igneous rocks. By applying advanced resistivity modeling, this study offers critical data on the depth and thickness of water-bearing strata, facilitating informed decisions for sustainable water management and well placement.

Subsurface Evaluation and Structural Interpretation of the Ghawar Field Using Gravity Technique

Abdulaziz almusallam

Dr saad al mogren

The Ghawar Field in eastern Saudi Arabia is the world's largest conventional oil field and a key example of a structurally controlled carbonate reservoir system. This study evaluates its subsurface structure using gravity data integrated with geological interpretation. Gravity data were processed using standard corrections, including drift, latitude, free-air, and Bouguer corrections, to produce reliable Bouguer anomaly data representing true subsurface density variations. Regional and residual gravity separation was applied to distinguish deep structures from shallow features. The regional anomaly reveals a broad north–south gravity high

linked to a basement-controlled anticline, while the residual anomaly highlights local uplifted blocks and density contrasts. Tilt derivative analysis further improved the mapping of structural boundaries and fault systems, enhancing the detection of subsurface discontinuities. Subsurface modeling using GM-SYS (Geosoft) reveals a clear anticline extending to about 4.7 km depth. The section is dominated by carbonate reservoirs, including Arab-D, Shuaiba, and Yamama, sealed by the Hith anhydrite. Deeper Paleozoic units (Qusaiba and Sarah) are interpreted as potential source rocks, while the crystalline basement strongly controls the overlying sedimentary structures. The results show that basement-controlled tectonics, along with folding and faulting, strongly influence hydrocarbon generation, migration, and trapping.

Identifying shallow water-bearing zones in Wadi Nisah, Riyadh area using Vertical Electrical sounding method

Ziyad Abdullah Alqahtani

Elkhedr Hassan Hassan

This study aims to identify and characterize the shallow water-bearing zones in Wadi Nisah, located southwest of Riyadh near Al-Kharj, using the one-dimensional Vertical Electrical Sounding (VES) technique with the Schlumberger electrode array. Eight VES stations were measured along the wadi using the SYSCAL R2 resistivity meter. The recorded apparent resistivity values were processed and inverted using RINVERT software, which applies a least-squares inversion algorithm to convert the field data into reliable layered resistivity models of the subsurface.

Investigation of the Coastal Aquifer of Southern Jazan Area Using Electrical Resistivity Tomography Method

Alwaleed Talal Alkhalagi

Mahmoud Mohammed Elwaheidi

An electrical resistivity tomography survey (ERT) has been conducted to investigate the shallow aquifer of south Jizan, Saudi Arabia, to know the salinity of the shallow aquifer and to make sure there is no hazard. the area extends between latitudes 17° 00' 00" and 17° 14' 00" North, and longitudes 42° 18' 00" and 42° 42' 00" East, bordered in the west by the Red Sea, we used 72 electrode conducted by Dipole-Dipole configuration ,the Inversion of the data have provided us with a 2-D image of the subsurface and showed us a variations in the resistivity of the shallow aquifer, to know where is the dry sediment ,bedrock and sediment with salinity water ,since the low resistivity indicated the salinity water and the high show it dry sediment or bedrock.

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