



Book of Abstracts

18th Global Science Technology & Management Conference (GSTMC-26) Taunsa Sharif (Pakistan)

16-17 February 2026



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Evolution EduTech Pakistan & Govt Graduate College for Boys and Girls Taunsa Sharif

D-G-Khan Punjab

In Collaboration with

GC University Faisalabad Layyah Campus, Thal University Bhakkar

& Women University Multan

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BOOK OF ABSTRACTS

18th Global Science Technology and Management Conference (GSTMC-26) Taunsa Sharif

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Conference Fields

- Agriculture & Animal Sciences
- Biological & Chemical Sciences
- Computer, Physics & Numerical Sciences
- Commerce & Management Sciences
- Pharmacy & Allied Health Sciences
- Social Sciences & Languages

Introduction

About Conference

The goal of 18th **Global Science Technology and Management Conference (GSTMC-26)** is to provide a stage for researchers and practitioners from academia and business to deal with state-of-the-art advancement in their respective fields.

18th GSTMC-26 will offer participants to interact with industry experts on the recent challenges in scientific research and associated areas. Leading researchers will share their incredible research findings and tools that they use to achieve better results. This international conference on multidisciplinary research and education is bound to generate a number of new ideas and experiences that participants, irrespective of who they are (Experienced scientists, seasoned professionals or young scholars at the early stages of their careers), can derive and make use of in some form of another, towards the advancement of their careers. For those looking to spread awareness of their incredible research findings and other work, they will also have the chance to present their papers and articles.

Objective of the Conference

18th Global Science Technology and Management Conference (GSTMC-26) is revolves around bringing Science Technology and Management research areas synchronically on an individual platform. This conference will draw collectively research fellowships from diverse fields in untidiness, to share their research findings and latest ideas. The main intention of this conference is to integrate interdisciplinary inquiry to deliver the best applications.

18th Global Science Technology and Management Conference (GSTMC-26) , one of the most meticulous specialist conferences of its kind in the academic world, has been specially devised to present technological and additional assistance to intensify investigation and innovative enterprises, disseminating groundbreaking experimental outcomes, as well as innovative magazines/papers.

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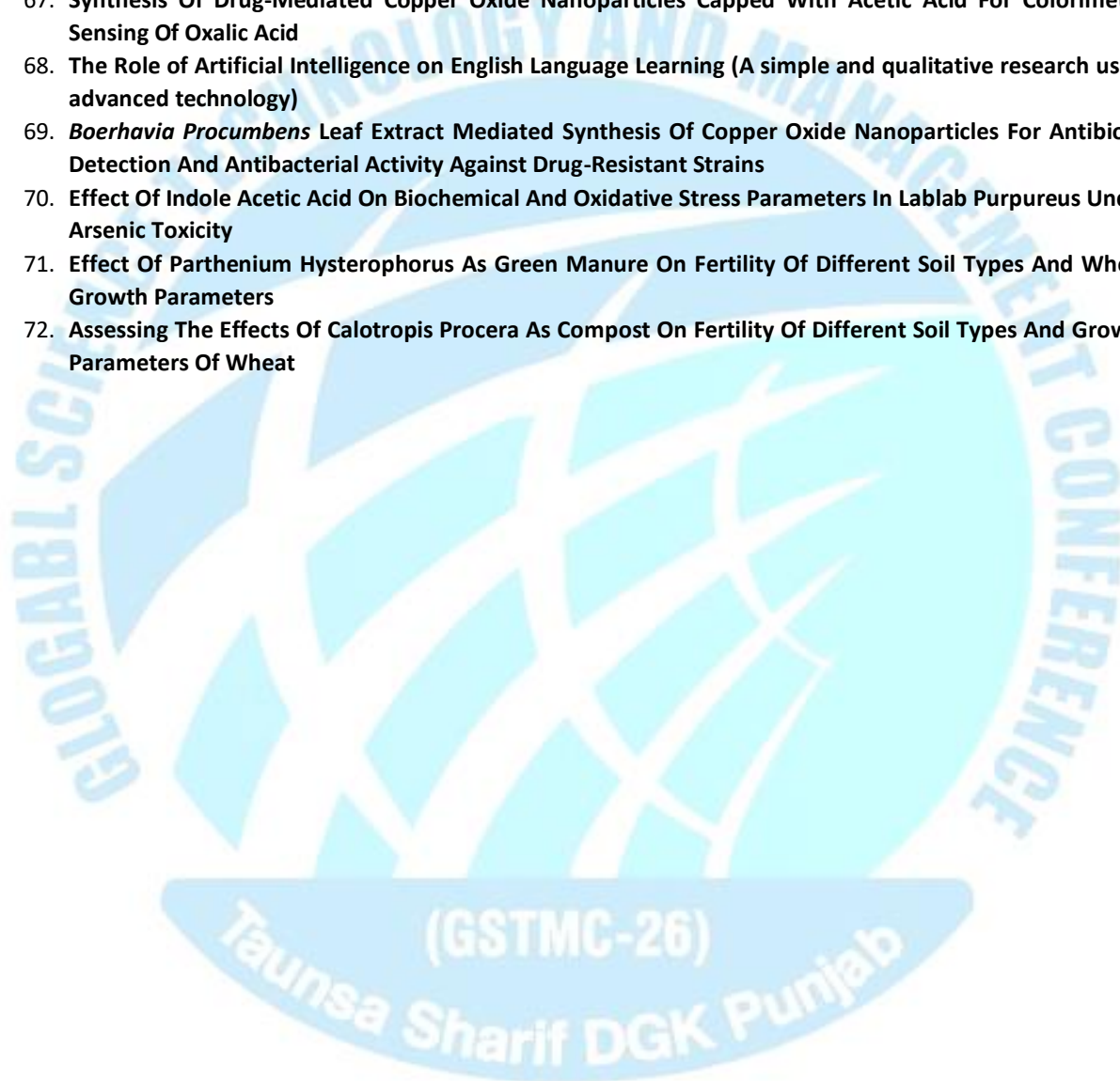
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First-principles investigation of optoelectronic, thermoelectric, and mechanical properties of double perovskites K_2AgGaX_6 ($X = I, Br$) for energy harvesting applications

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Potassium-based perovskites have significant potential to advance renewable technology through the development of eco-friendly devices. A comprehensive analysis of the structural, electronic, optical, transport, and mechanical properties of the double perovskites K_2AgGaX_6 ($X = I, Br$) was performed using the Wien2K code. Stability was confirmed by examining optimization curves, tolerance factors, and formation enthalpies, while AIMD simulations further validated the thermodynamic stability of both compounds. Electronic band structure analysis shows that K_2AgGaI_6 has a bandgap of 1.75 eV, which decreases to 1.24 eV for $K_2AgGaBr_6$. Optical properties, evaluated using the Kramers-Kronig relations, reveal strong absorption across the visible spectrum for both materials, making them suitable for photovoltaics and optoelectronics. Thermoelectric properties, calculated using the Boltzmann semi-classical approach, indicate high ZT values, supported by elevated Seebeck coefficients and electrical conductivities, demonstrating potential for renewable energy applications. The mechanical analysis confirms ductility, stiffness, anisotropy, and high melting points. Overall, this study provides theoretical evidence that these perovskite compounds are promising candidates for green energy harvesting.

Next-Generation Universal Influenza Vaccines: Broad-Spectrum Immune Targets

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The development of next-generation universal influenza vaccines is based on the assumption that wide-ranging immunity will be produced by targeting conserved viral antigens or those with little sequence variation in the entire range of circulating influenza strains. Two antigenic determinants have become of special interest in this regard: the extracellular domain of matrix protein 2 (M2e) and the stalk region of hemagglutinin. Both are highly conserved and play critical roles in the infectivity and replication of the virus, thus making them resistant to the antigenic drift and shift that can render the current seasonal vaccines less effective. Recent developments in nanoparticle-based delivery systems have significantly improved the immunogenicity of these epitopes by enhancing the stability of antigens, independent release, and optimal presentation of antigens to the immune system. The resulting immunological environment is one of strong humoral and cellular immune responses, in particular, the generation of broadly neutralizing antibodies and the recruitment of cytotoxic T lymphocytes that can attack various strains of influenza. In addition to systemic immunity, there has been immense focus on the induction of mucosal immunity with the help of intranasal vaccination. The initial line of defense is the mucosal defenses, specifically secretory IgA antibodies and resident memory tissues situated in the respiratory mucosa, which neutralize the virus particles at their point of entry, thus reducing

the infection as well as further infection. The combination of conserved antigen targets with nanoparticle-mediated delivery models and mucosal immunization approaches is likely to overcome the drawbacks of conventional vaccines. This is a versatile strategy that not only enhances the protective range but also increases the longevity and total effectiveness of the immune response. Overall, this review summarizes the current advances in the field of conserved antigen detection, nanoparticle vaccines, and mucosal immunization approaches and highlights the combination of these systems to achieve actual universal influenza vaccines. Such innovations constitute a significant milestone towards effective, broad-spectrum influenza prophylaxis, which can swiftly adapt to emerging viral strains, ultimately reducing the impact of influenza worldwide.

Keywords: Universal influenza vaccine, Broad-spectrum immunity, conserved viral antigens, Matrix protein 2 ectodomain (M2e), Hemagglutinin stalk domain, Nanoparticle-based vaccine Delivery

Vegetation Dynamics as a Determinant of Ecosystem Resilience under Global Climate Change

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Vegetation dynamics are central to ecosystem resilience, mediating the capacity of terrestrial systems to withstand and recover from climate-induced disturbances. Recent global analyses using remotely sensed vegetation indices and resilience metrics demonstrate that vegetation resilience is closely associated with water availability. Higher resilience is typically observed in regions with greater precipitation and lower inter-annual variability. However, increased precipitation variability, temperature extremes, and anthropogenic pressures have led to widespread declines in resilience, particularly in tropical, arid, and temperate regions. Over 60% of global ecosystems have shifted from increasing to declining resilience trends in recent decades. Future projections under high-emission scenarios (SSP5-8.5) suggest that resilience loss will intensify, particularly in cold and equatorial regions. Vegetation growth, as measured by NDVI and LAI, has generally increased in many regions, yet this does not uniformly translate to enhanced resilience. In equatorial and high-latitude ecosystems, resilience degradation occurs despite greening trends, highlighting the complex interplay between vegetation productivity and system stability. The time-lag and accumulation effects of climate drivers—such as temperature, precipitation, and solar radiation—play a critical role in shaping vegetation responses. These lag periods can range from less than a month to several months, depending on vegetation type and prevailing climatic conditions. Human activities, such as land use change and grazing, exert spatially heterogeneous impacts on ecosystems. In some cases, these pressures can offset or even reverse the positive effects of climate amelioration. Modeling studies and empirical evidence underscore the multidimensional nature of resilience, with metrics such as recovery rate, autocorrelation, and variance capturing different aspects of ecosystem response. Notably,

forests with historically high disturbance regimes may retain resilience longer but are also at greater risk of abrupt regime shifts under escalating climate stress. These findings emphasize the urgent need for adaptive management and climate mitigation strategies to sustain ecosystem resilience in the face of accelerating global change.

Keywords: vegetation dynamics, ecosystem resilience, climate change, remote sensing, disturbance regimes

Structural, elastic, electronic, and optical properties of double perovskites Ba_2NaXO_6 ($X = Br, I$) for Optical gadgets; A DFT Study

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The structural, elastic, electronic, and optical properties of double perovskites Ba_2NaXO_6 ($X=Br, I$) were investigated through first-principles calculations. The results show that all three compounds exhibit stable mechanical and dynamical properties, with anisotropic elastic behavior. These materials are direct bandgap semiconductors, with bandgap values of 0.61 eV (2.43 eV), and 2.38 eV (4.09 eV) for PBE (HSE06), respectively. The electron localization function (ELF) was used to analyze their internal chemical bonds and electronic characteristics. In terms of optical properties, all three materials show strong absorption and photoconductive behavior in the UV region. Among these compounds, Ba_2NaBrO_6 demonstrates the most favorable photovoltaic performance and conversion efficiency, making it a promising candidate for optoelectronic applications in the UV region.

Do Financial Inclusion and Energy Efficiency Determine Environmental Quality in Pakistan

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This study will investigate the impact of financial inclusion, and energy efficiency on environmental quality along with other factors in Pakistan from 1990 to 2024, using the Auto-Regressive Distributed Lag (ARDL) method. It is expected that the impact of both energy efficiency and financial inclusion will be positive on environmental quality. Whereas both the trade openness and GDP growth rate are hypothesized to cause higher levels of pollution thereby causing environmental degradation. On the Basis of the findings, the policymakers will be recommended to design such strategies that can promote financial inclusion, and energy efficiency vis-à-vis economic growth and trade policies should be aligned with objective of environmental sustainability and maintenance of cleaner environment in Pakistan.

Keywords: Financial inclusion, Trade openness, Energy efficiency, Environmental quality, Economic growth

Network-Based Bioinformatics Approaches for Unraveling Nutrient Transport Pathways in Plants

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Nutrient transport is a fundamental process that influences plant growth, stress adaptation, and crop yield. Understanding the complex interactions governing nutrient uptake, translocation, and signaling is crucial for developing strategies to improve plant nutrition efficiency. In this study, we employ network-based bioinformatics approaches to reconstruct and analyze plant nutrient transport pathways, integrating multi-omics datasets, including transcriptomics, proteomics, and metabolomics. Using publicly available databases and experimentally validated transporters, we constructed a gene- protein-metabolite interaction network focusing on key macronutrients (N, P, K) and micronutrients (Fe, Zn). Graph theory-based network analysis identified highly connected hub genes and regulatory modules, highlighting critical transporters and signaling components. Co-expression and functional enrichment analyses revealed candidate genes involved in crosstalk between nutrient stress responses and hormonal regulation. Additionally, machine learning algorithms were applied to predict novel transporters based on structural and evolutionary similarities. Comparative analysis across plant species provided insights into conserved and species-specific transport mechanisms. This system's biology approach offers a holistic perspective on nutrient transport, enabling targeted genetic modifications and precision breeding for improved nutrient use efficiency. Our findings provide a foundation for engineering crops with enhanced nutrient acquisition and resilience to soil nutrient limitations, contributing to sustainable agricultural practices.

Keywords: Bioinformatics, Nutrient Transport, Network Analysis, Systems Biology, Omics Integration

Impacts of heavy metals stress on plants and their mitigation approaches; a global perspective

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Heavy metal contamination has emerged as a critical environmental issue, posing significant risks to plant growth, productivity, and ecosystem stability. Elevated concentrations of metals such as cadmium, lead, arsenic, and mercury disrupt physiological, biochemical, and molecular processes in plants, leading to reduced germination, impaired photosynthesis, oxidative stress, and altered nutrient uptake. The severity of these impacts varies across species, environments, and degrees of exposure, highlighting the complexity of plant responses under metal stress. To cope with toxicity, plants employ a range of avoidance and tolerance strategies, including metal exclusion, chelation, sequestration in vacuoles, and activation of antioxidant defense mechanisms. Recent advances in plant biotechnology, phytoremediation, and soil management have provided promising avenues to enhance resilience and reduce contamination. Techniques such as the use

of phytoremediation, GMO crops, nano particles approaches are increasingly recognized as sustainable approaches for mitigating heavy metal stress. This global perspective underscores the urgent need for integrated strategies that combine ecological, technological, and policy-based approaches to address heavy metal pollution. Strengthening research on plant tolerance mechanisms, remediation technologies, and risk assessment frameworks will be crucial for ensuring ecosystem health, food security, and environmental sustainability in contaminated landscapes.

Keywords: Heavy metal, tolerance strategies, phytoremediation, nanoparticle approaches.

Assessing the Differences between Agriculture Techniques and Indigenous Farming Practices: A Study on Crop Productivity and Sustainability

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This study examines the differences between modern agricultural techniques and farming practices, with a focus on their impacts on crop productivity and long-term sustainability. Using wheat, chana, makai, ganna, and mongi (local names) as representative crops, the research compares input requirements, soil health outcomes, water use efficiency, and yield patterns across both systems. Findings indicate that modern techniques generally enhance short-term productivity through high-yield varieties, chemical inputs, and mechanization, while indigenous methods prioritize ecological balance, resilience, and resource conservation. The study highlights how traditional practices such as mixed cropping, organic soil amendments, and water-conserving cultivation contribute to sustained productivity under variable climatic conditions. Overall, the research underscores the potential for integrated approaches that combine the efficiency of modern methods with the sustainability of indigenous knowledge to support both food security and environmental health. The agricultural sector in Pakistan is a significant contributor to the country's economy, with crops such as wheat, chana (chickpea), Makai (maize), Ganna (sugarcane), and mongi (mung bean) being major players. However, the sustainability of these crops is threatened by the widening gap between technical agricultural techniques and indigenous farming practices. This study aims to assess the differences between these two approaches and their impact on crop sustainability. Technical agricultural techniques involve the use of modern machinery, high-yielding varieties, and chemical fertilizers, which can lead to increased yields but also contribute to environmental degradation and soil fertility decline. In contrast, indigenous farming practices, passed down through generations, emphasize the use of local varieties, organic fertilizers, and traditional irrigation systems, promoting soil conservation and biodiversity. The study focuses on the Bhakkar region, where these crops are commonly grown, and evaluates the effects of technical and indigenous practices on crop yields, soil health, and water usage. Results show that while technical practices increase short-term yields, indigenous methods promote long-term sustainability and environmental stewardship.

Development of Nanomaterial-Based Portable Sensors for Detecting Trace Environmental Pollutants

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The escalation of industrial and urban activities has led to increased release of trace environmental pollutants, such as heavy metals, (VOCs), and fine particulate matter, which pose serious threats to both human health and ecosystems. Conventional laboratory-based detection methods, although precise, are often time-consuming, expensive, and unsuitable for on-site monitoring. This study explores the design and development of portable sensors utilizing nanomaterials for rapid, sensitive, and selective detection of trace pollutants in air, water, and soil. Nanomaterials including graphene, carbon nanotubes (CNTs), metal oxide nanoparticles (ZnO, TiO₂), and noble metal nanoparticles (Au, Ag) are employed due to their high surface-to-volume ratio, excellent electrical conductivity, and customizable surface properties, which significantly enhance detection capabilities. For instance, graphene-based electrochemical sensors have successfully measured lead (Pb²⁺) and cadmium (Cd²⁺) ions in water at sub-parts-per-billion (ppb) levels, while CNT-based chemiresistive devices enable real-time detection of NO₂ and NH₃ in ambient air. The portable prototypes incorporate microcontrollers and wireless data transmission for on-site analysis and remote monitoring. Experimental results confirm rapid response, reproducibility, and selectivity against interfering species, demonstrating the potential of nanomaterial-enhanced sensors as efficient tools for environmental monitoring and pollution management.

Keywords: Portable sensors (CNTs), Graphene-based sensors, Real-time detection

Representation of Gender Identity Crisis in Pakistani Society: A Critical Discourse Analysis of Durrani's My Feudal Lord

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Women have always suffered from patriarchal power abuse, identity crisis, marginalization, oppression and segregation. The researchers probe the suppression and subjugation of women in Pakistani society with reference to Tehmina Durrani's autobiography *My Feudal Lord* (1995). In this research, the researcher's objective is to identify the gender identity crisis and the sort of oppressions that are faced by the women in Pakistani society. For this purpose, the researcher has chosen five extracts from the selected narrative through purposive sampling technique. The nature of this research is qualitative in which the selected extracts have been analyzed through Fairclough's three-dimensional model of critical discourse analysis (1995). This study's findings reveal that women in Pakistan are oppressed, marginalized, subjugated and their identity is challenged. By taking gender discrimination and women oppression into consideration, this

research brings to the fore the fact that Pakistani women are marginalized and considered as sex objects and marriage is emphasized as the only social identity in the life of a woman.

Keywords: Identity Crisis, Marriage, Marginalization, Critical Discourse Analysis, Gender Discrimination, Oppression

A DFT study of vacancy-ordered lead-free double inorganic perovskites Na₂PtA₆ (A = Cl, I) for sustainable technologies

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The structural, optoelectronic, mechanical, and thermoelectric properties of Na₂PtA₆ (A = Cl, I) for renewable energy applications were examined using Density Functional Theory (DFT) calculations. Structural and thermodynamic stabilities were confirmed through the Birch-Murnaghan equation of state, cohesive energy, and formation energy. The compounds exhibit ductility, as indicated by structural parameters and elastic constant analysis. The calculated direct band gaps of 2.50 eV for Na₂PtCl₆ and 2.18 eV for Na₂PtI₆ suggest effective light absorption in the visible and ultraviolet ranges, making these materials suitable for solar cell and optoelectronic applications. Thermoelectric properties were analyzed using the Boltztrap code, based on the semi-classical Boltzmann transport equations (BTE). Electrical and thermal conductivities, Seebeck coefficient, power factor, and figure of merit (ZT) were calculated across temperature, carrier concentration, and chemical potential variations. This study indicates that Na₂PtA₆ (A = Cl and I) holds significant promise as a thermoelectric material for power generation devices over a wide temperature range in the future.

Mitigating SARS-CoV-2–Exacerbated Neuroinflammation and Alzheimer’s Pathology: Synthesis of Quinoline-Based Dual Inhibitors Targeting Cysteine and Aspartyl Proteases

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Viral and neurodegenerative proteases, such as the cysteine protease and aspartyl protease, offer strategic targets in a multi target therapeutic approach for Alzheimer’s disease, especially when viral infection may exacerbate neurological degeneration. To establish a multi target therapeutics for treating Alzheimer disease, we chose β -secretase (BACE-1), an aspartyl protease, and the SARS-CoV-2 main protease (Mpro), a cysteine protease, as dual targets. In search of BACE-1 and M pro inhibitors, a set of novel quinoline-4-carboxamide derivatives (2a-k, 3a-c, 4a-d, 5a-c, 6a-c) was synthesized using the Suzuki coupling reaction in good to excellent yields. All the synthesized compounds were screened in vitro for their potential inhibitory activities against two proteases. Compounds 2e, 6b, and 6c emerged as dual inhibitors of both proteases. Furthermore, a kinetic study revealed the mechanism of BACE-1 inhibition by compound 6c. Safety profiling of the most potent dual inhibitor 6c was performed via an in vivo acute cytotoxicity assay on Swiss albino mice. Molecular docking studies were conducted against aspartyl protease (2HM1) and cysteine protease (6XHM) to elucidate the binding interaction of

synthesized quinolone derivatives. The compound 6c exhibited strong binding affinities through multiple hydrogen bonds, π -Sulphur and π - π stacking interactions, within key subpockets of both targets, supporting inhibitory potential. These studies revealed that the lead compound 6c could be a good drug candidate with further structural modifications.

Keywords: Aspartyl protease, cysteine protease, Quinoline, Suzuki coupling, Alzheimer's Disease

The Effects Of Bacteria-Based *Serratia Marcescens* Biofertilizer On Maize Seedlings Growth In Bpa Contaminated Soil

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Bisphenol A (BPA) is an emerging environmental pollutant that adversely affects plant growth and physiology. In the present study, maize plants were subjected to BPA stress (100mg) and treated with different remediation strategies, including *Serratia marcescens*, biochar and their combination as a biofertilizer. Plant growth parameters such as roots and shoots length, fresh biomass and antioxidants enzymes activities (SOD, POD, CAT, and H₂O₂) were evaluated. Results revealed that BPA stress significantly reduced roots and shoots growth, as well as fresh biomass compared to the control. *Serratia marcescens* and biochar individually improved plant performance under BPA toxicity, while their combined application as a biofertilizer showed the most pronounced effect. Biofertilizer treatment not only enhanced root length and root fresh weight but also increased shoot growth surpassing the control. Under BPA stress, biofertilizer application mitigated toxicity, restoring root and shoot biomass close to control levels. Enhanced antioxidants enzyme activities in biofertilizer treated plants further demonstrated their protective role against oxidative stress induced by BPA.

KeyWords: Bisphenol A, *Serratia marcescens*, Biofertilizer, Biochar, Antioxidants Enzymes.

Does FDI inflow insecure workers in developing countries? Evidence from a two-step system GMM estimation

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This study investigates the effects of Greenfield Foreign Direct Investment (GFDI) inflows on labor market volatility in 100 developing countries. Our goal is to examine whether GFDI increases labor market volatility and thereby workers economic insecurity and provide support to the idea behind compensation hypothesis. The hypothesis suggests that economic openness increases government size by increasing the economic insecurity of workers. To that goal, we built a data set (2003-2019) that merges data on the level of employment from Penn World Table, country economic and institutional indicators from World Development Indicators and World governance

indicators, and data on GFDI from the United Nations Conference on Trade and Development. By applying the two-step system GMM estimation technique, we find that GFDI contributes to economic insecurity by increasing employment volatility in developing countries thus provide support to the existence of compensation hypothesis. Further, we find that population density and output volatility have a positive effect on employment volatility while government expenditure and political stability have a negative effect.

Keywords: Greenfield FDI, Labor market volatility, Employment, Government Expenditures, Population density.

Characterization of TetM and FosX multi-drug resistant genes in *Listeria monocytogenes* isolated from canned food samples

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Listeria monocytogenes is a critical foodborne pathogen implicated in severe infections and is increasingly exhibiting antibiotic resistance, presenting a public health challenge. The aim of this study was to detect the presence of *Listeria monocytogenes* in canned food samples and to identify antibiotic resistant genes tetM and fosX. A total of 30 canned and retailed food samples comprising canned mushrooms, retailed chicken, milk, and canned pineapple were collected for analysis. Isolation and biochemical identification of *L. monocytogenes* were conducted using standard microbiological techniques. Additionally, antibiotic susceptibility testing was performed via the Kirby-Bauer disk diffusion method as per CLSI guidelines. Molecular detection of the tetM and fosX genes was carried out using DNA extraction, PCR amplification, and genome sequencing. *Listeria monocytogenes* isolates were successfully isolated from 55.33% of canned food samples. Nine antibiotics were tested on the positive samples and then 16S rRNA sequencing was performed. Phenotypic resistance to tetracycline corresponded with the molecular detection of the tetM gene in 100% positive isolates. The fosX gene was not detecting any isolate. Other antibiotics, including amoxycillin, meropenem, gentamicin, chloramphenicol, and ciprofloxacin, retained high efficacy against the isolates. The presence of tetM highlights the potential for tetracycline resistance dissemination in foodborne *L. monocytogenes*. Overall, the data suggest that canned foods could serve as reservoirs for antimicrobial resistance genes. Continued molecular surveillance and phenotypic testing are vital to monitor emerging resistances. The detection of the tetM gene confirms tetracycline resistance in *L. monocytogenes* from canned foods, posing a possible public health risk. Ongoing surveillance and strict food safety measures are essential to control the spread of resistant *Listeria* strains.

Keywords: *Listeria monocytogenes* (*L.monocytogene*), Polymerase chain reaction (PCR)

Isolation of lactic acid bacteria from raw cow milk samples collected from Bhakkar district

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Raw cow milk is a rich source of beneficial microorganisms, especially lactic acid bacteria (LAB), which are essential for dairy product fermentation and contribute significantly to human health. This study was conducted to isolate and characterize LAB present in raw cow milk samples collected from the Bhakkar district of Punjab, Pakistan. A total of 20 raw milk samples were aseptically collected from lactating cows at local dairy farms and households during the period from March to May 2025. The samples were processed using standard microbiological techniques, including serial dilution and culturing on MRS agar under anaerobic conditions at 37°C. A total of 68 LAB isolates were successfully obtained and subjected to morphological, physiological, and biochemical characterization. The study identified isolates based on Gram staining, catalase reaction, cell shape, carbohydrate fermentation, temperature tolerance, and salt tolerance tests. The most prevalent genus was *Lactobacillus* (23.41%), followed by *Lactococcus* (23.53%), *Leuconostoc* (16.18%), *Enterococcus* (14.71%), *Pediococcus* (10.29%), and *Streptococcus* (5.88%). Fermentation tests showed all isolates could ferment glucose and lactose, with sucrose fermentation primarily observed in *Leuconostoc* and *Enterococcus*. Temperature tolerance test showed most isolates grew well at 15°C and 45°C. The findings of this study confirm that raw cow milk from the Bhakkar district is a valuable source of diverse LAB populations, particularly *Lactobacillus* species known for their probiotic and fermentation potential. This diversity not only reflects the natural microbial richness of raw milk but also highlights its potential for application in dairy fermentation and probiotic product development.

Keywords: Cow milk, Lactic acid bacteria (LAB), *Lactobacillus*, Bhakkar, fermentation

Microplastics as Emerging Contaminants in Freshwater and Marine Ecosystems: A Critical Review of Their Impact on Aquatic Food Web Dynamics

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Microplastics (MPs) have become the emerging contaminants in the aquatic resources, especially freshwater and marine, where they enter mainly through anthropogenic activities such as improper waste management and neglected MPs disposal mitigation strategies. Micro plastics, as very small particles of size less than 5 millimeters in dimension, enter the aquatic food chain at the lower trophic level (microalgae) and migrate, concentrate, and magnify towards the higher trophic levels (human, marine mammals, and sea birds) across the aquatic feeding networks. They become concentrated in the animal tissues and which has adverse effects on its health and transfers low energy to the next trophic level as they are consumed by their predator and ultimately reduces the energy flux in the ecosystem dynamics. MPs, as emerging pollutants, have adverse toxicological impacts on the health system, such as disturbance of the immune system, Oxidative stress, and nanoparticles induce cell membrane permeation. By understanding MPs' bio magnification mechanism and trophic transfer, we can ensure a stable aquatic system. To maintain the aquatic biodiversity and stable aquatic ecosystem resilience, we need to make

conservation and mitigation strategies, policy making, and implementation, and raise their awareness about their adverse effects.

Keywords: Microplastics, Aquatic resources, Toxic impacts, Aquatic food web dynamics, Biomagnification, Disruptions

Real-World Case Studies Featuring Dermatologist Guidance in Comparison with AI Skincare Assessments (e.g., YourAIDerm)

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Introduction and Background: In the past few years, skincare assessment AI websites and software have risen ominously to provide virtual medical for common dermatological concerns such as YourAIDerm. AI is a valuable tool to assist dermatologists by enhancing diagnostic accuracy and clinical decision-making, but there are some challenges surrounding AI from under representation of skin of colour in datasets and issues with image quality and standardization. The accuracy of image-based AI tools is incumbent on images in training sets, which requires patient consent for sharing. Despite its potential, the ethical, clinical, and practical implications of its application remain insufficiently explored. In contrast to this perspective, traditional dermatological techniques observe proper clinical evaluations through guidelines and years of specialized training in their domain. This paradigm shift towards technology-based skincare consultancy, leaves population with two simultaneous advisory paths.

Objective: AI is fast emerging in the field of dermatology. While it boasts great capabilities, it still faces some issues, such as its inability to perform any direct image analyses and the risk of inaccurate suggestions. AI still has insufficient

Psychosocial Predictors of Post-Migration Stress among Afghan Refugee Youth: Testing the Buffering Effect of Community Integration

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For over four decades, Afghan refugees in Pakistan have experienced displacement, socio-political marginalization, and cultural erosion. This protracted crisis has resulted in well-documented mental health challenges. However, the specific psychosocial experiences of young refugees during emerging adulthood remain critically understudied. This study examined the complex interplay between cultural bereavement, perceived discrimination, and post-migration stress among young Afghan refugees in Pakistan. Additionally, the study investigated how perceived discrimination mediates the relationship between cultural bereavement and post-migration stress, and the moderating role of community integration in this pathway. Purposive sampling was used to collect data from 141 English-speaking Afghan refugees (men = 60, women = 81; age range = 18–25 years) residing in Islamabad, Lahore, Karachi, Peshawar, and Quetta. The Cross-Cultural Loss Scale (Wang et al., 2015), the Everyday Discrimination Scale (Williams et al.,

1997), the Community Integration Scale (McColl et al., 2001), and the Refugee Post-Migration Stress Scale–Revised (Malm et al., 2023) were used to measure study variables. Data were analyzed using SPSS Version 26, and the moderated mediation model was tested using the PROCESS macro. Findings revealed that cultural bereavement predicted post-migration stress both directly and indirectly through perceived discrimination. Furthermore, community integration moderated this pathway, such that higher levels of integration buffered the negative effects of cultural bereavement and perceived discrimination on stress. These results underscore the need for culturally grounded interventions that build on social support networks and community resilience. Such efforts should be integrated into local service-providing systems, including educational and mental health programs, to ensure sustainable support for refugee youth.

Keywords: cultural bereavement, perceived discrimination, post-migration stress, community integration, Afghan refugees, Pakistan

AI-Driven Predictive Nutrition: Integrating Metabolomics, Machine Learning, and Digital Phenotyping for Next-Generation Dietary Interventions

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Recent advances in artificial intelligence (AI) have transformed human nutrition and dietetics from empirical dietary assessment to data-driven precision nutrition. This research explores the innovative integration of metabolomic profiling, machine learning algorithms, and digital phenotyping to predict individual dietary responses and optimize nutrient interventions. A hybrid deep learning framework is proposed, combining convolutional and recurrent neural networks to analyze multi-layered datasets that include metabolomic biomarkers, gut microbiome diversity indices, and lifestyle digital traces captured through wearable devices. These AI models enable the identification of hidden nutritional patterns and metabolic phenotypes that are often undetectable through conventional statistical methods. Preliminary findings demonstrate that AI-based predictive nutrition systems can forecast glycemic variability and lipid metabolism responses with over 90% accuracy, facilitating the design of dynamic and adaptive meal plans for personalized health management. Moreover, the study addresses the ethical and translational challenges of implementing AI in clinical dietetics, emphasizing the need for transparent algorithms, equitable datasets, and cross-disciplinary collaborations between nutritionists, computer scientists, and healthcare practitioners. The integration of intelligent algorithms into dietetic practice has the potential to revolutionize preventive nutrition, metabolic disorder management, and public health policy design. This interdisciplinary framework situates AI not merely as a computational tool but as an evolving cognitive partner in advancing human nutrition science.

Keywords: Predictive Nutrition, Artificial Intelligence, Metabolomics, Digital Phenotyping, Precision Dietetics, Machine Learning

Mealworms (*Tenebrio molitor* L.) as a Substituent of Protein Source for Fisheries and Aquaculture: A Mini Review: Mealworms as a Substituent of Protein Source

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Development of aquaculture and fisheries depend on the availability of sustainable feed sources. Using insects is one new option that is gaining popularity. The high protein content, rapid growth and little environmental impact of yellow mealworms have made them an appealing solution. Mealworms contain a substantial protein content (47-64%), essential amino acids, energy-dense lipids, and vital micronutrients, making them a viable substitute for traditional protein sources in fisheries and aquaculture. Historically consumed in various cultures, Mealworms have gained attention for their economic and nutritional value. In aquaculture, they enhance fish growth, feed efficiency, and overall health. Studies have shown that incorporating mealworm meal into fish diets improves immune functions, growth performance, and liver health, although excessive inclusion may have adverse effects. The nutritional content of mealworms can be optimized by adjusting rearing conditions, diet, and developmental stage. The European Union approval of mealworms for human consumption further validates their safety and potential as a sustainable protein source. This review emphasizes the nutritional benefits of mealworms as a substitute for fishmeal, addressing protein shortages and environmental concerns associated with traditional feed production. By integrating mealworms into aquaculture, we can significantly improve sustainability, economic efficiency, and global food security.

Keywords: Sustainable Feed Sources, Aquaculture, Yellow Mealworms, Fishmeal Substitute, Environmental Impact

Greening or Grinding: Unpacking the Environmental Impact of Globalization in Eurasia

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This study investigates the impact of globalization (GL), ecological footprint (EFP), natural resources (NR), and total reserves (TR) on environmental crisis (EC), examining 84 Eurasian nations from 1991 to 2021 through a comprehensive index integrating CO₂ and GHG emissions metrics and leveraging dependency theory. Employing a robust methodological approach combining parametric and non-parametric methods, the analysis reveals that GL and NR negatively correlates with EC, while EFP and TR positively correlates with EC. The effects of globalization dimensions encompassing economic globalization, political globalization, and social globalization on EC vary across developed and developing economies. Introducing an innovative environmental crisis index, the research uncovers complex relationships between globalization and environmental sustainability, offering guidance for policymakers to reduce EC through

resource-independent, low-carbon pathways. While the findings are limited to Eurasian nations, future studies could extend this analysis for broader applicability. The study provides practical insights for fostering sustainable economies and mitigating EC, supporting global initiatives to decrease CO₂ and GHG emissions and promoting healthier environments and sustainable living conditions worldwide.

Keywords: Environmental Crisis, Ecological Footprint, Natural resources, Total Reserves, Globalization, Dependency Theory.

Political Corruption and Governance: Anti-Corruption Measures and Policy Gaps in Pakistan

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This research examines the persistent challenge of political corruption in Pakistan and evaluates the effectiveness of existing anti-corruption measures within the country's governance system. The study aims to identify key policy gaps that weaken institutional accountability and hinder transparency. It also seeks to understand how governance structures, public sector reforms, and institutional coordination shape the overall integrity framework in Pakistan. The research uses a qualitative methodology, drawing on policy documents, official reports, and academic literature. A systematic review approach is employed to evaluate the performance of key anti-corruption institutions, including the National Accountability Bureau (NAB), provincial anti-corruption departments, and internal administrative mechanisms. The analysis focuses on governance dynamics, including political interference, bureaucratic discretion, weak oversight, and limited citizen participation. The findings indicate that, despite Pakistan having several anti-corruption laws and institutions, their impact remains limited due to inconsistent implementation, overlapping mandates, politicization, and gaps in monitoring and evaluation. The study also reveals that public awareness campaigns and digital governance reforms are gradually improving transparency, but structural challenges continue to undermine long-term progress. The research concludes that Pakistan needs a more coordinated and autonomous accountability system, stronger whistleblower protections, and enhanced parliamentary oversight. Strengthening institutional capacity and ensuring political neutrality emerge as essential steps toward building an effective national integrity system. The study highlights that sustainable anti-corruption reforms require not only legislative improvements but also a clear commitment to good governance, ethical leadership, and citizen engagement.

Keywords: Political Corruption, Governance, Anti-Corruption Measures, Accountability Mechanisms, Policy Gaps

Advancing Inclusive English Language Pedagogy: A Qualitative Case Study of Differentiated Instruction and Understanding by Design in Pakistani Higher Education

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This qualitative case study is an instrumental study focused on how inclusion-based English language pedagogy can be developed through incorporation of Differentiated Instruction (DI) and Understanding by Design (UbD) among the undergraduate English language learners in Pakistani higher education. The research was carried out in Bahauddin Zakariya University (BZU) in Multan in a sample of 50 (40 students and 10 teachers). Semi-structured interviews were used to collect data and analyzed by means of thematic analysis. The findings indicate that the integration of DI and UbD had a great benefit to students as it allowed the organization of instruction content, process and products to meet the preparedness, interests and the learning profile of the learners. Such a dynamic strategy resulted in a more active student participation, their confidence and enhanced knowledge of English language, and was seen as more accommodating and efficient when compared to the old-treated teaching in one size. Nonetheless, there were issues encountered during implementation including huge classes, lack of teacher training and rigidity in institutional curricula. Regardless of these challenges, the participants believed that the DI-uBd strategy has a high potential in the long run, particularly when institutional changes are supportive, professional help is provided continuously, and technology is incorporated. Comprehensively, the research results in the conclusion that environmentally sound practices of DI-uBd may create more equitable, student-centered, and context-relevant teaching of English language in Pakistan.

Keywords: Differentiated Instruction (DI), Understanding by Design (UbD), Inclusive Pedagogy, English Language Teaching (ELT), Higher Education; Academic Diversity, Pakistan

Harnessing Microbial Solutions for Climate Change Mitigation and Resilience in Pakistan

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Pakistan is one of the most climate-vulnerable countries in the world with rising temperatures, floods, droughts, glacial melt, and sea level rise endangering infrastructure, agriculture, and health. Microbial solutions present an understudied but promising path toward climate resilience, even as national programs like the National Climate Change Policy and the National Food Security Policy encourage adaptation and mitigation measures like clean energy transitions and reforestation. Carbon sequestration, climate-resilient agriculture, biofertilization, bio pesticide development, abiotic stress tolerance, bioremediation, wastewater treatment, and bio-saline farming are all facilitated by beneficial microbes. These strategies can improve soil health, agricultural yield, and environmental sustainability, as shown by pilot programs run by organizations like the Pakistan Agricultural Research Council. However, a lack of finance, lax enforcement of policies, poor infrastructure, and low stakeholder knowledge all impede the wider implementation of microbial technology. Scaling microbial-based climate solutions requires addressing these obstacles through coordinated investment, capacity building, and policy integration. This paper outlines the advancements, difficulties, and potential paths for using microorganisms in Pakistan mitigation and adaptation plans for climate change.

Keywords: Climate change, Microbial solutions, Carbon sequestration, Biofertilizers, Bioremediation

Psychological Trauma and Identity Fragmentation in Franz Kafka's *The Metamorphosis*

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Franz Kafka's *The Metamorphosis* offers a striking examination of psychological trauma and the fragmentation of identity in the face of familial, social, and economic pressures. Gregor Samsa's sudden transformation into an insect embodies the physical and symbolic collapse of self, reflecting the stern weight of family expectations, financial burdens, and societal judgment. Existing scholarship highlights Gregor's alienation, yet this study extends the conversation by foregrounding how trauma emerges not only from external forces but also from internalized guilt, suppressed desires, and the instability of selfhood. Using close textual analysis informed by psychoanalytic and postmodern narrative theory, this paper traces shifts in Gregor's agency, self-perception, and emotional coherence. The analysis further examines the family's changing responses and the social reactions that reinforce Gregor's dehumanization. The novella's metafictional elements disrupt narrative authority and expose the constructed, unstable nature of reality and identity. The study finds that psychological trauma in *The Metamorphosis* is relational, existential, and socially mediated. By revealing how economic strain, familial neglect, and symbolic displacement converge to dissolve the human subject, Kafka anticipates postmodern concerns with fractured selves and unstable subjectivity. This research contributes to deeper understanding of trauma, identity, and the human condition in modern literature.

Keywords: Psychological Trauma, Identity Fragmentation, Dehumanization, Alienation, Metafiction, Postmodernism

Evolution of Education Policies in Pakistan (1947–2024): A Critical Analysis of Policy Continuity, Reform, and Implementation Gaps

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The vitality of education as a cornerstone for national development cannot be denied, as it serves as an indispensable tool for societal transformation, political stability and economic growth. Since 1947, its inception, the strategic role of education in nation-building has been continuously recognized. Though, the education policy agenda has been advanced in different phases, each reflected the socio-political primacies, and economic realisms of that particular time. This study will examine the historical route of education policies in Pakistan from year 1947 to 2024, to analyze their relevant objectives, execution challenges, and upshots. The study will trace the major policy reforms starting with Education Conference in 1947, along with National Education Policies viz., 1959, 1972, 1979, 1992, 1998, 2009, and 2017, and up to the fresh developments under the "Single National Curriculum (SNC)" initiative and the Vision 2025. A historical-

descriptive and qualitative approach will be adopted. To evaluate the consistency between policy goals and their execution data will be collected from government reports, policy documents, and existing literature the findings will reveal the factors that have been hindering sustainable progress in education system in the country. The coherent long-term policy recommendations will be given to the government for inclusive and quality education by adhering Sustainable Development Goal 4 (SDG-4) and depoliticizing the implementation mechanisms, and greater investment in human capital.

Keywords: Education Policy, SDG-4, Single National Curriculum

The Impact of social media on Mental Health across Generations in Layyah

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This research investigates how social media influences mental health across different generations—Gen Z, Millennials, and Older Adults—within the context of Layyah. The study aims to analyze how patterns of social media use contribute to variations in self-esteem, anxiety and social connection among these age groups. Using a comparative, cross-sectional, and quantitative research design, data will be gathered through structured questionnaires to evaluate psychological outcomes associated with online engagement. The findings are expected to highlight generational differences in digital behavior and their impact on emotional well-being, offering valuable insights for educators, mental health practitioners, and policymakers. This study emphasizes the growing need to understand the psychological effects of social media in shaping interpersonal relationships and overall mental health across generations.

Keywords: Social media, Mental health, Generational difference, Sociology, Layyah

Seventy-Seven Years of Health Policy Development in Pakistan: Trends, Transitions, and Lessons for the Future

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Pakistan has been focusing on the development of holistic health policies, essential yet challenging objective since its independence in 1947. Keeping in view that recognition of health as an important constituent of nationwide development, economic stability, productivity, and community well-being, the present study will critically inspect the success of health policies in Pakistan from year 1947 to 2025, by investigating the policy outlines, institutional modifications, and execution challenges that shape the healthcare system of the country. Starting with early post-independence steps, the study will cover key policy indicators, including Health Policy of (1990), National Health Policy (1997), National Health Policy (2001), and succeeding outlines regarding Vision 2025, and Universal Health Coverage (UHC) announced after 2015. Adopting a qualitative, historical-descriptive approach, this study will utilize World Health Organization (WHO) reports, policy documents, other government data, and extant literature to evaluate the

advancement and limitations of health governance of Pakistan. The policy recommendations in the light of outcomes will also be presented.

Keywords: Health Policy, Universal Health Coverage, Primary Healthcare, SDG-3, Vision 2025

The Multifaceted Benefits of Stevia: A Natural Sweetener for Human Health, Environmental Sustainability, and Economic Development

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Stevia is famous for its sweetness level it has 100-300 times more sweetness level than the sucrose. The sweetness of stevia preparation is due to the steviside and rebaiudiosides and they are used in the food Industry for sweetness .Stevia has many beneficial properties such as antibacterial, antifungal and anti-caries .Stevia provides energy value approx. 2.7kcal/g dry matter. Long term intake of stevia can reduce arterial blood pressure (Top number blood pressure by 10-14mmHg and bottom number blood pressure by 6-14mmHg with daily intake of 750-1500mg).Stevia leaves contain proteins (11.2-16.0g), Carbohydrates (61.9g), Lipids (1.9-3.73g), dietary-fiber (6.8-15.2g). Stevia dry leaves are also a good source of Water soluble vitamins which includes Vitamin C(14.98mg/100g),Vitamin B2(0.43mg/100g),Folic acid(52.18mg/100g).More over it can also contains macro and micro elements such as Zn, Fe, K, Na, Mg. Pharmacological aspects of stevia shows its potential benefits in managing Type-2 diabetes. Stevia is also shows beneficial results in clearing up skin issues like dermatitis, eczema and wrinkles .Besides it's health benefits, industrial applications of stevia are that it is used as Food ingredient, as sucrose replacement, as fertilizer, animal feed, as ingredient for pharmaceuticals and as a dissolving or forming agent.

Keywords: Natural sweetener, Nutritional benefits, Pharmacological aspects, Skin health benefits, Industrial applications of Stevia

Effects of vulnerable deforestation and it's impacts on Pakistan Natural Resources

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Forests are one of the most important forms of management .and the region's temperature, climate and Carbon levels. It also encourages industrial developmental cities caused a significant increase in deforestation, resulting in % increase in average temperature around the world. It's also extreme uncontrolled deforestation that led to a large population in the recent past deforestation, land use, human expansion, settlements Deforestation, erosion and logging all have a negative impact on the park. Amount and size of wood used, trees from Pakistan were used to calculate grain size Illegal trees were cut down. Illegal logging found to be four times more expensive. The main causes of deforestation in Pakistan are necessary. The government

should pay attention to solving these reasons and implementing strong laws to reduce the negative impact of deforestation and save this ecosystem.

Sustainable Work in a Degrowth Economy: Rethinking the SDG on Decent Work and Economic Growth

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The UN Sustainable Development Goal of “Decent Work and Economic Growth” supposed that consistent economic expansion is associated with higher level of employment and societal uplift. As evidence speaks that constant economic expansion is ecologically harmful and communally stratified. This study will find out novel idea, transformation from “Decent Work and Economic Growth” to “Sustainable Work and Economic DE growth”. The Panel data of selected Asian countries regarding (SDG 8) from year 2000–2023 and Generalized method of moments method will be utilized to attain the results. The results will show how and to what extent economic expansion in Asian countries such as Pakistan, India, Bangladesh, China, Malaysia and Indonesia has increased employment prospects and how it has jeopardized the ecological balance? The policy recommendations about eco-friendly work models will also be presented.

Keywords: Economic growth, Economic de growth, sustainable work, Pakistan.

The Interplay of Governance and FDI in Driving Economic Growth: Evidence from Emerging Asian Economies

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This study aims to assess Asian countries governance, foreign direct investment, and economic growth. The Asian economies are labelled as middle or low-income economies as they have constantly been confronted with issues such as poverty, underdeveloped infrastructure, an unbalanced economy, and low personal incomes. This study examines the impact of governance, and foreign direct investment, on economic growth in Asian nations. In order to take results, this study used panel data of selected 40 countries from 2000–2024 attained from World Development Indicators (WDI). The results of panel ARDL model indicated that good governance and FDI both have positive significant impact on economic growth of selected developing countries. Policy recommendations in the light of the results have also been discussed.

Keywords: Governance, Foreign Direct Investment, Panel ARDL, Asian Countries.

Globalization, ICT, and Economic Growth Dynamics: An ARDL Approach to Cointegration and Causality

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This study provides a comprehensive examination of the relationship between economic growth, information technology and its key components with particular emphasis on the development of Pakistan's stock market. The findings indicate a positive association between a well-functioning stock market and economic growth in both the short and long run. Financial theory suggests that globalization and information technology play a significant role in fostering economic development. The study further explores the impact of globalization and economic progress on income inequality in Pakistan. Annual time-series data from 1980 to 2024 were utilized and the Autoregressive Distributed Lag (ARDL) model was applied as the main econometric technique. Data were sourced from the State Bank of Pakistan and International Financial Statistics. The results reveal that globalization and advancements in information technology exert a substantial influence on income distribution, while economic growth contributes to greater income equality. From a policy perspective, trade openness, foreign remittances and foreign direct investment can help reduce inequality. Key variables incorporated in the analysis include savings, inflation, exchange rate, gross domestic product and investment. Overall, the study suggests that to accelerate economic growth, Pakistan must develop and effectively implement targeted policies that promote investment in information and communication technologies (ICT).

Keywords: Investment, Savings, Inflation, exchange rate, Autoregressive Distributed Lag, Price Index

Soliton Dynamics and Stability in a Higher-Order Dispersive Cubic–Quintic Nonlinear Schrödinger Equation

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This work focuses on the derivation of multi-peak solitons and a variety of other nonlinear wave structures for a higher-order nonlinear Schrödinger equation with cubic–quintic dispersion, employing the modified exponential rational function method (mERFM). The proposed model is significant in several scientific and engineering fields, such as quantum mechanics, electrical transmission lines, oceanography, and optical fiber communications. Incorporating higher-order dispersive and nonlinear effects particularly the cubic–quintic nonlinear terms allow the model to more accurately describe the evolution of ultra-short pulse propagation in optical fibers as well as nonlinear wave dynamics in oceanic media. A rich family of exact solutions is obtained, including bright and dark solitons, as well as trigonometric, hyperbolic, rational, exponential, and singular wave forms. These solutions enhance the understanding of complex nonlinear wave interactions and oceanic wave phenomena in both shallow- and deep water regimes. Moreover, graphical representations are presented to demonstrate the impact of key physical parameters on soliton behavior, providing clear physical interpretations. Overall, the results confirm the effectiveness of the mERFM and illustrate its potential for addressing a wide class of nonlinear problems arising in mathematical physics.

Phytochemical Profiling and Comparative Analysis of Monofloral Honey from Diverse Regions of Pakistan

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Present study investigates the phytochemical content of five types of monofloral honey from Pakistan: beri honey, eucalyptus honey, citrus honey, robinia honey, and sunflower honey. The aim is to identify active compounds with potential antibacterial and antioxidant properties through qualitative tests for coumarin, protein, carbohydrates, phenol, alkaloids, flavonoids, tannins, saponins, triterpenoids, quinones, and sterols. The results indicate that all five types of honey positively contain flavonoids, saponins, coumarin, protein, carbohydrates, phenol, triterpenoids, quinones, and sterols. These secondary metabolites confer significant antioxidant, antibacterial, anti-inflammatory, analgesic, wound-healing, anti-cancer, and free radical scavenging activities to the honey. This study highlights the therapeutic potential of these monofloral honeys, supporting their use in medical and health applications.

Key Words: coumarin, protein, carbohydrates, phenol, alkaloids, flavonoids, tannins, saponins, triterpenoids, quinones, and sterols

Harnessing Technology for Better Health: A New Era in Nutritional Science

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Emerging technologies in nutritional science are revolutionizing the way we approach health, diet, and food production. Advances in genomics, artificial intelligence (AI), wearable devices, and food engineering are enabling more personalized, precise, and sustainable nutrition solutions. Precision nutrition, fueled by genetic and metabolic profiling, allows for tailored dietary recommendations that optimize individual health. AI and machine learning are enhancing food tracking, recipe creation, and dietary advice, while wearable devices like continuous glucose monitors provide real-time feedback on dietary impacts. Technologies such as 3D food printing and cultured meat are reshaping food production, offering customized and sustainable alternatives to traditional food sources. Additionally, innovations in block chain and nanotechnology are improving food safety, traceability, and nutrient delivery. Together, these advancements promise to create a future where nutrition is not only more personalized but also more efficient, ethical, and aligned with global health needs.

Keywords: nutrition, health, AI, innovation

Advanced PET Imaging Analysis for Lyme disease Classification with Ensemble Learning

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Early detection of Pet Lyme disease rashes is crucial for timely medical intervention, aiding dermatologists and veterinarians in effective treatment. This study proposes a novel deep learning framework for automated rash classification using a Self-Created Dataset. Our approach leverages a stacked ensemble strategy integrating the strengths of VGG16, Google Net, and ResNet50 for superior feature extraction. Initially, each deep learning model is trained independently to capture unique image representations. To enhance classification performance, we introduce a deep fusion technique where the extracted features are combined in a meta-classifier. This meta-classifier is a deep neural network trained on both the original images and the learned feature maps from the base models. By removing the final three layers of each base model and directly feeding their outputs into the meta-classifier, our method efficiently learns hierarchical feature relationships. Experimental results demonstrate a significant improvement in classification accuracy surpassing traditional standalone models and existing state-of-the-art techniques. The proposed stacked deep fusion architecture enhances the robustness and generalizability of Pet Lyme disease classification and got 96% accuracy, offering a reliable tool for real-world applications in veterinary and medical diagnostics.

Keywords: Pet Lyme disease, Deep Fusion Technique, Pet Healthcare

US-China Competition in Artificial intelligence: A Quest for dominance Rubab

Rubab

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The AI is often compared to the space race of the Cold War, with nations seeking dominance in AI as a means of enhancing their global influence and securing strategic advantages. AI is increasingly perceived as a driver of geostrategic competition among global powers, particularly the United States (US) and China. The struggle between the United States and China in artificial intelligence (AI) has the potential to alter the balance of power drastically. These actors are heavily investing in AI development to redefine power dynamics in economic, military, and political spheres. Both countries are striving to achieve technological supremacy, recognizing the transformative potential of AI in economic growth, national security, and global influence. As a result, the AI race has become a critical aspect of their broader geopolitical strategies, influencing international collaborations, regulatory frameworks, and ethical considerations in AI deployment. This paper will explain what artificial intelligence actually is and examine the US and China Competition in artificial intelligence in economic, military and political spheres.

Keywords: Artificial Intelligence, balance of power, space race, cold war, geostrategic competition.

Tunable characteristics of Electromagnetic (EM) surface waves at isotropic chiral-homogeneous plasma interfaces

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In this study, numerical calculations of Electromagnetic (EM) surface waves at isotropic chiral-homogeneous plasma are analyzed in gigahertz (GHz) frequency regime. The characteristics equation is derived by applying impedance boundary conditions for proposed configuration. Different characteristics of EM surface waves such as effective mode index, propagation loss, phase velocity, propagation length, group velocity and skin depth are analyzed by varying homogeneous plasma features (plasma frequency, collisional frequency) and chirality parameter. Computational results are provided to illustrate the impact of plasma frequency, collisional frequency, and chirality parameter on effective mode index, propagation loss, phase velocity, propagation length, group velocity and skin depth. Furthermore, the normalized field distribution is analyzed to validate the surface wave conditions. This research holds potential for applications in chiral and plasma-based sensing technologies, including waveguides and enantiomeric sensing devices.

Mitigating Unauthorized Access in Data Security Using IDs and IPs

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In modern highly connected era, digital devices are more closely linked together than ever. So, the demand for protecting these devices & data is also increasing rapidly. Neglecting this need can lead to the potential danger of accessing sensitive data without authorization. This unauthorized access is creating threats like financial loss, data breach & reputational damage. Traditional protective systems like firewalls, access controls & weak passwords are not enough to safeguard data from sophisticated intrusion techniques used by attackers today. Challenges like Brute-force attacks, Phishing, SQL injection Insider misuse require advanced protection strategies to ensure confidentiality, integrity & availability—three core principles of CIA triad. Addressing these challenges is a technical requirement but if left untreated, can lead to damaging customer's trust & credibility of organization. This study outlines the role of more efficient defense mechanisms like IDS & IPS to tackle unauthorized intrusions in digital environments. These offer a better security tier to track & block malicious activities. IDS monitors access to data or files & identifies potential threats. It works by comparing monitored activities with known attack patterns. If there a match, it give alerts to administrators. It only detects attacks does not block them automatically. IPS not only detects but also blocks suspicious

activities instantly. This can be seen when a financial institution is facing brute-force login attempts, IDS detected that there a great number of failed logins originating from a single IP address. But, IPS terminated the origin ensuring confidentiality & integrity of system. Both IDS & IPS function like signature & pattern based systems to secure sensitive data from unauthorized access at early stages. Their limitation lies in the fact that both systems cannot identify unknown (zero-day) attacks but this can be overcome by using Anomaly-Based methods.

Electro-Optical and Charge Transport Properties of Chalcone Derivatives: A Dual Approach from Molecular to Material-Level Simulations

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In this study, three chalcone derivatives with basic skeleton [1,100-biphenyl]-4-yl)-3-(3-nitrophenyl) prop-2-en-1-one are investigated. The basic skeleton was modified with the addition of three terminal groups including hydrogen (1), methyl (2) and methoxy group (3). Using CASTEP Module, the optoelectronic properties are evaluated. The solid-state geometries of these systems are explored within the periodic boundary conditions (PBC). Among these systems, only system 3 is found much better in terms of optical properties such as dielectric function, absorption, conductivity, reflectivity, loss function and refractive index. Our system 3 showed a higher dielectric function value about 3.7 at 1.8 eV thereby absorption $6.9 \times 10^4 \text{ cm}^{-1}$ at 300 nm and conductivity 1.2 fs^{-1} at 3.5 eV in the (001) plane. Furthermore, system 3 exhibited a high reflectivity and loss function in the (010) plane. Furthermore, system 3 exhibited a high reflectivity and loss function in the (010) plane. Electronic band structure, the density of state and electronic coupling analysis also reveal that system 3 has a potential application in charge transport devices. This system can transport charge about ~25 times higher as compared to systems 1 and 2. The methoxy group in system 3 has two lone pairs on the oxygen atom, thereby more contribution for electron π -conjugation in the system through resonance. However, hydrogen and methyl moiety participate through hyper conjugation and their involvement in π -conjugation is negligible.

Bridging the Gender Gap: An Assessment of Equality in Health and Education in Pakistan (2010-2025)

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The present study will explore the advancement, challenges, and policy answers linked to gender equality in health and education sectors of Pakistan ranging from 2010 to 2025, marked as transformative and decentralization era under the 18th Constitutional Amendment. It is when

the National Education Policy (2009), the Health Vision 2025 framework, and the execution of initiatives associated with SDG-3(“Good Health and Well-being) and SDG-5(Gender Equality)” has been introduced. The qualitative and analytical approach will be applied to review Pakistan Social and Living Standards Measurement (PSLM) surveys, national policy documents, WHO and UNESCO reports, and existing literature review to assess the trends in access of women to healthcare and education. The findings will reveal the situation related to school enrollment, female literacy, life expectancy and maternal health. The study will recommend sustained policy in light of the outcomes

Keywords: Gender Equality, Health Policy, Education Policy, Women Empowerment, SDG-3 and SDG-5

Mutational analysis of CLDN19 gene from the patients with Nephrolithiasis and comparative analysis of the gene in cats and dogs

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Solid mineral aggregates called renal calculi, or kidney stones, develop in the renal system as a result of a variety of variables, including hereditary, environmental, and biochemical ones. With an emphasis on mutations in the CLDN19 and SCNN1A genes, which are essential for maintaining salt and magnesium homeostasis, this study explores the genetic basis of nephrolithiasis. Twenty families from various parts of Punjab, Pakistan, who had a history of kidney stones were enlisted. Biochemical analysis and radiological imaging were used to confirm clinical findings. Both afflicted and unaffected individuals had their blood samples taken, and the organic approach was used to extract genomic DNA. PCR was used to create and optimize primers for all exons of SCNN1A as well as exons 2 and 4 of the CLDN19 gene. Amplicons underwent purification, Sanger sequencing, and gel electrophoresis analysis. Genetic variants were identified through bioinformatics analysis of sequencing data using BLAST, PolyPhen, and Mutation Taster; mutations in CLDN19 were found to potentially contribute to nephrolithiasis by disrupting magnesium homeostasis, while variants in SCNN1A were found to potentially play a role in sodium balance disorders associated with kidney stone formation. This study emphasizes how crucial genetic screening is in groups where kidney stones are common. Our knowledge of nephrolithiasis will improve with more investigation into the molecular processes of CLDN19 and SCNN1A mutations, which will also help with improved disease management.

KeyWord: Mutational analysis, CLDN19, Nephrolithiasis, PCR, Gene

Current Trends in Laboratory Diagnosis of Autoimmune Diseases: Advances, Challenges, and Future Perspectives

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Autoimmune diseases are a diverse group of disorders characterized by the immune system attacking the body's own tissues. Accurate and early diagnosis is critical for effective disease management and improved patient outcomes. Traditional diagnostic approaches, including serological tests such as antinuclear antibodies (ANA), rheumatoid factor (RF), and anti-double-stranded DNA (anti-dsDNA), have been widely used but often lack specificity and sensitivity. Recent advancements in biomarker detection have significantly improved diagnostic accuracy, enabling earlier and more precise identification of autoimmune diseases. Molecular techniques, including polymerase chain reaction (PCR) and next-generation sequencing (NGS), have revolutionized disease detection by allowing genetic and epigenetic analysis. Flow cytometry has emerged as a valuable tool for assessing immune system abnormalities, while immunohistochemistry and tissue biopsy remain essential for diagnosing organ-specific autoimmune disorders. Automation and artificial intelligence (AI) are transforming laboratory diagnostics by enhancing efficiency, reducing human error, and improving data interpretation. However, challenges such as false-positive and false-negative results, overlapping clinical presentations, and limitations in current diagnostic methodologies persist. This review highlights current trends in laboratory diagnosis of autoimmune diseases, addressing advancements, challenges, and future prospects, with an emphasis on improving clinical decision-making and patient care. Continuous development in diagnostic methodologies is essential for enhancing disease detection and management, ultimately contributing to better healthcare outcomes for patients with autoimmune diseases.

Keywords: Autoimmune Diseases, Laboratory Diagnosis, Challenges, Molecular Techniques

Mango peel powder a swaying source of nutrients and natural antioxidants

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Research on the potential for turning food processing waste into useful food additives. Mango (*Mangifera indica* L.), a class of drupe fruits, belongs to the family anacardiaceous and it is the most popular edible fruit which grown in tropical regions all over the world. Its output currently ranks seventh in the world. Peel and kernel waste are produced during the manufacturing of mango-based goods such juices and purees. Because of its low commercial worth, mango peel, which makes up more than 15% to 20% of the entire mango fruit, is thrown away during processing. According to reports, peel had strong antioxidant qualities and was a good source of minerals and phytochemicals like carotenoids and polyphenols. The purpose of this study was to evaluate the antioxidant activity and nutritional value of mango peels. Its nutrients were determined by AOAC methods and the DPPH assay was used to assess their antioxidant activity. Results showed that mango peels were rich in nutrients like protein (4.30%), fiber (4.75%), Ash (3.52%), carbohydrates (78.72%) and energy Kcal/100g (336). The methanol extract of mango

peel powder showed the maximum % inhibition of DPPH antioxidant activity ranging from 35.70–81.65%, while the water extract of mango peel powder showed the lowest percentage inhibition, 20.10–58.30 % at concentrations of 0.1-5.0 mg/ml. The study's findings demonstrated that mango peel methanolic extracts have strong antioxidant properties along with potent nutrients, suggesting a promising future for natural antioxidants in food and pharmaceuticals rather than throwing them away as a waste.

Keywords: mango peel powder, nutrients, antioxidant activity, DPPH

Development of Herbal Cheese Incorporated with *Asparagus racemosus* (Hathawariya) and Determination of Its Quality Parameters

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Cheese is a widely used dairy product in the world. *Asparagus racemosus* is rich in nutrients, and it has antioxidant and bioactive properties. This study aims to determine the optimal mixing ratio of *A. racemosus* to cheese, to evaluate the impact of *A. racemosus* on the sensory properties of the final cheese product, and to assess the physicochemical properties and shelf-life of the final product. Experiments were carried out to determine the 0.1% (T1), 0.2% (T2), 0.3% (T3), 0.4% (T4), and 0% (T0) level (w/v) of air-dried *A. racemosus* leaf powder for herbal cheese production. Each treatment was replicated three times. The sensory evaluation was done using 30 panelists and nine-point hedonic scale was used, and the 0.1% sample was selected as the most acceptable. There was significant difference between samples ($P < 0.05$) according to the sensory evaluation. The addition of 0.1% *A. racemosus* leaf powder did not affect protein and fat content. The T1 sample contained 0.025% fiber, whereas no fiber was detected in the control (T0). The syneresis percentage (12.02%) and moisture content (45.81%) of the T1 sample were significantly lower ($p < 0.05$) than those of the control sample (14.31% and 46.32%, respectively). The ash content of the T1 sample was 4.6%, and it was significantly higher ($p < 0.05$) than the control sample (2.63%). During the 8 weeks of the storage period at 4°C, the control cheese sample (T0) pH was always higher (5.7-4.9pH) than the herbal cheese sample (T1) (5.6-4.8pH), while the control cheese sample & titratable acidity (0.21%-0.34%) was always significantly lower ($p < 0.05$) than the herbal cheese sample (T1) (0.23%-0.36%). The antioxidant, flavonoid, and phenol contents of the herbal cheese were 0.8 µM Trolox/g, 495 µg QE/g, and 1050 µg GAE/g, respectively, while the control sample values were 0.25 µM Trolox/g, 86 µg QE/g, and 260 µg GAE/g. Herbal cheese's (T1) aerobic plate counts (4.3–5.4 CFU/g) and yeast and mold counts (1.6–4.2 CFU/g) were lower than those of the control (T0) (4.5–5.8 CFU/g and 1.9–5.2 CFU/g, respectively). The study concluded that Cheese antioxidant, phenolic, and flavonoid contents were greatly enhanced by adding 0.1% *A. racemosus* leaf powder, while microbial growth and syneresis were decreased. The 0.1% level was the most successful formulation for creating a functional herbal cheese according to the results of the study.

Unlocking Digital Agriculture: Determinants of Farmers' Willingness to Pay for Artificial Intelligence in Punjab, Pakistan

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Agriculture, along with other sources like fishing, is essential to human life as a key source of food. In order to develop environmentally friendly farming that can support the world predicted ten billion individuals in thirty years from now, major automation and technological advances are required. Moreover, AI holds immense potential for making advancements that have positive impacts on sustainability in the agriculture industry through a myriad of applications. It was always understood that AI could alter the perception that people have of the agriculture industry/ utilize an influence on farmers as being change makers especially in the countryside. The present study was designed to study the farmers' willingness to pay for application of artificial intelligence in agriculture: a case study of Punjab, Pakistan. The study was conducted in the Punjab province of Pakistan. Result indicated that Maximum participants (38.9%) were using more than 16 acres land for cultivation. 33.5% were using only 11-15 acres land and 16.7% were using 6-10 acres land for cultivation. While, 10.8% were using less than 5 acres land for cultivation. Result showed that most respondents (42.9%) were moderately familiar with AI technology. The results indicated that 143/203 respondents were familiar with AI techniques such as GIS and computer vision being used in agriculture. Result indicated that most respondents (65.5%) were familiar with AI-based systems used for pest detection and management in agricultural settings. The results have shown that most respondents 179/203 were using AI-based tools for managing crops. It was recommended that AI technology will in the future provide creative and accurate answers to the main farming problems that face farmers all over the world.

An Interpretable, Multimodal Deep Learning Framework for Early Alzheimer Disease Detection: Synergizing MRI, Quantitative EEG, and Clinical Biomarkers

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Early detection of Alzheimer disease (AD) is difficult due to its gradual and variable onset, along with the complex, nonlinear relationships between the loss of brain tissue and cognitive decline. Current diagnostic methods frequently struggle to efficiently integrate various data sources, such as brain imaging, electrical brain activity readings, and clinical evaluations. We created an innovative multimodal deep learning system to address this issue by integrating patient

demographics, quantitative electroencephalography (qEEG), and structural brain MRI scans into one clear diagnostic framework. Our design incorporates three concurrent processing streams: (1) a 3D Residual Network for extracting advanced spatial features from T1-weighted MRI; (2) a Temporal Convolutional Network to detect frequency and timing patterns in qEEG data; and (3) a Multi-Layer Perceptron for analyzing cognitive test scores and demographic details (MMSE, MoCA). These varied data representations are combined using a Context-Aware Gated Attention mechanism that strategically evaluates each data type impact to enhance overall learning. We confirmed our method utilizing data from 840 participants (220 cognitively healthy individuals, 380 exhibiting Mild Cognitive Impairment, and 240 with Alzheimer disease). Brain imaging and clinical information were sourced from the Alzheimer Disease Neuroimaging Initiative, whereas qEEG recordings were gathered from the Temple University Hospital EEG Corpus and Open Neuro databases. We integrated SHAP (Shapley Additive Explanations) to guarantee that our model choices could be linked to clinically pertinent factors. The system showed remarkable capability in identifying early-stage AD, attaining an AUC of 0.93 [95% CI: 0.91–0.95] in differentiating MCI from healthy subjects outperforming models based on single data types (MRI alone: 0.87 AUC; qEEG alone: 0.84 AUC). The model achieved an accuracy of 88.5% in predicting which MCI patients would advance to AD over a three-year period. Analysis indicated that hippocampal atrophy (from MRI), reduced alpha brain activity in posterior areas (from qEEG), and APOE ϵ 4 genetic status were the most significant predictive indicators consistent with recognized knowledge of AD pathology. This work delivers a reliable, interpretable, and validated multimodal system that successfully integrates structural and functional brain data. With its combination of explainable risk assessment and high predictive performance, this approach offers valuable potential for AI-supported clinical decision-making in early dementia detection.

Socio-Psychological Determinants of Farmers' Continuance Intention toward Conservation Agriculture: A PLS-SEM Approach

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Conservation Agriculture (CA) has become a resource-efficient and climate-smart agricultural system, which improves soil health, productivity, and environmental sustainability. Nevertheless, CA usage is low in Pakistan regardless of its established advantages. The behavioral and psychological characteristics of the farmers rather than the economic or purely technical ones seem to be relevant in the willingness of the farmers to adopt and remain in the CA practices. The research was intended to understand socio-psychological factors that would affect the attitudes and behavioral intentions of Pakistani farmers towards further use of CA. It particularly aimed at incorporating the Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM) models to effectively describe the perceptions, adoption, and maintenance of innovative agricultural activities among farmers. Partial Least Squares Structural Equation Modeling (PLS-

SEM) was used as a quantitative research design. The sample size used was 201 farmers to gather primary data. The model also incorporated reflective and formative constructs and it comprised variables like relative advantage, compatibility, low complexity, attitude and intention. The findings showed that relative advantage, compatibility, and low complexity had a significant impact on the attitude of farmers, whereas attitude had the most significant impact on behavioral intention. The results have shown that farmers who perceive CA to be beneficial and compatible with their existing operations and easy to conduct their operations will be willing to persist with CA significantly. It is the first empirical research in Pakistan that incorporates the DOI and TAM in explaining the CA adoption behavior. It provides a comprehensive image that how psychological factors impact the decision of farmers.

Deep-Feature X-SN: A Contrastive Learning Framework for Cross-Dataset Generalization in Deep-fake Detection

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The rapid evolution of Generative Adversarial Networks (GANs) and Diffusion Models (DMs) in the past years has led to the development of very realistic deep-fakes and synthetic content, causing serious risks to digital security and public trust. Current deep-fake detection models attain high performance on specific datasets but strive to generalize well on new datasets or manipulation methods. This drawback occurs due to dataset bias, insufficient feature discrimination, and the dependence on single-domain learning frameworks. Earlier studies on conventional CNN architectures and manual forensic indicators have strived to maintain robustness across emerging generative models. In order to address these issues, we propose to use Deep-Feature X-SN, an advanced deep learning framework that uses a tripartite structure of specialized feature extractors trained with Siamese networks and contrastive learning to detect discriminative features of real, GAN-generated, and diffusion-generated images. The extracted features are merged through a CNN-based classifier to improve classification. Experimental calculations across multiple datasets verify higher cross-dataset generalization, gaining 97.29% detection accuracy and exceeding prior approaches by over 10%. The proposed framework indicates improved flexibility and strength to unseen and new generative frameworks, which contributes in the development of a more robust and secure AI-driven cyber-security ecosystem.

Climatic Resilience of Guava

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Guava is a highly palatable nutritious fruit and considered to be one of the exquisite nutritionally valuable and remunerative crops. Due to climatic resilience it's shelf life and production is reduce.

Some other changes like rapid softening, off odor development and senescence spotting are also including due to limited processing and preservation conditions and also marketing of guava is reduce having high annual production. Climatic changes include the abiotic depletion, global warming, and ozone layer depletion which minimize the production of guava. Pollination has large participation in guava production but due to climatic resiliency, flowers of guava trees are shedding down which reduce its production. Guava adapted the temperature range 15 to 30 °C. In United State, major limitation with commercializing guava cultivation is its low cold tolerance. For better climatic resilience and productivity, select the superior strains such as developing new hybrid and transgenics followed by clonal propagation of desired plant material. Use of these integrated strategies will enable us to resist changed climatic conditions and improve the productivity. To enhance the stress resilience use the future strategies. Education of farmers is also very important. This highly neglected fruit can be used in the formation of jams and jellies.

Keywords: Shelf life, Marketing, Pollination, Integrated strategies, Farmer's education

Factors Impacting the Gastrointestinal Digestive Enzymes Fate of Magnesium Oxide Clusters, in-silico Characterization

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Recently, metal oxide cluster dots have moved into medicinal and biological implementations like many disease therapies. Human digestive system comprises different pH levels in digestive tract. Higher quantity of metal/metal oxides are converted in to clusters which further interact with digestive enzymes. Ligand-protein interaction utilizes computational and chemical biology approaches for efficient identification of active compounds. The present study investigated the profiles of fifty complexes using molecular docking technique. A total of five magnesium oxide clusters Mg 4 O 4, Mg 5 O 5, Mg 6 O 6, Mg 7 O 7 and Mg 8 O 8 were designed, optimized and docked with ten (10) human digestive system related metalloenzymes (3P95, 4A94, 2V77, 2JBK, 1PJP, 1N1M, 1X0V, 1BSI, 1C8Q, 1ZLI). The complexes were produced using molecular docking simulations. The results revealed that the magnesium oxide cluster dots (MgO-CDs) show good interactions with different enzymes of digestive system which can help to interpret the impact of these clusters, formed in human digestive tract at various pH levels.

Key words: Magnesium oxide cluster dots, Human digestive enzymes, Molecular Docking, ADMET analysis, Molecular dynamics

Beyond the Fertilizer Bag: An Integrated Strategy for Nitrogen, Climate, and Food Security

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Globally, nitrogen is a dual-edged sword: essential for feeding humanity but a primary driver of environmental pollution. This presentation examines the intricate link between nitrogen use,

climate change, and food security, drawing lessons from the critical case of Pakistan. To meet the food demands of a growing population, nations worldwide, particularly in South Asia, have dramatically increased their use of nitrogenous fertilizers. This has delivered undeniable gains in food production. In Pakistan, for instance, cereal output soared from 6.7 million tons to 42.7 million tons between 1961 and 2020, largely fueled by a more than tenfold increase in nitrogen fertilizer inputs. However, this success has come at a profound cost, illustrating a global challenge. Excessive and inefficient application has led to a cascade of reactive nitrogen compounds—such as N_2O , NH_3 , NO_x , and NO_3 —polluting our environment. These emissions degrade soil, water, and air, threaten biodiversity, and accelerate climate change. Pakistan experience is a stark example: nitrogen use efficiency in its cereal systems has plummeted from 50% to below 30%, creating a massive nitrogen surplus. Consequently, over the last five decades, agriculture-driven N_2O emissions have risen from 64 to over 1,000 million tons of CO_2 -equivalent annually. This case underscores a critical global policy dilemma: mitigation efforts must be systemic. Addressing one form of nitrogen pollution (e.g., water contamination) can exacerbate others (e.g., air pollution or greenhouse gas emissions).

Association of Diabetes Mellitus with Cardiovascular Diseases: A Cross-Sectional Study in Okara District

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Diabetes mellitus (DM) is a chronic metabolic disorder characterized by determined hyperglycemia, altogether expanding the hazard of cardiovascular maladies (CVDs). CVDs, including hypertension, coronary course illness, and stroke, are the driving causes of dreariness and mortality among diabetic people. The transaction of affront resistance, endothelial brokenness, dyslipidemia, and chronic aggravation builds up a solid connection between DM and CVDs. Pakistan is among the nations with the most noteworthy diabetes predominance, however, there is a lack of localized information evaluating its affiliation with CVD chance variables in locales such as Okara Area. This consideration points to the predominance of diabetes mellitus in Okara Locale and assesses its affiliation with cardiovascular hazard components through a cross-sectional examination. Blood glucose levels, HbA1c, lipid profiles, and blood weight estimations were utilized to affirm diabetes status and assess cardio metabolic wellbeing. The study included statistical information, way of life variables, and self-reported cardiovascular indications. Measurable investigations were conducted utilizing a suitable program to evaluate affiliations between DM and CVD chance variables. A noteworthy affiliation was watched between diabetes and major cardiovascular hazard components, including hypertension, dyslipidemia, weight, and an inactive way of life. People with destitute glycemic control have shown a higher frequency of cardiovascular complications, highlighting the effect of diabetes on cardiovascular well-being. This ponder gives profitable experiences into the burden of diabetes in Okara Locale and its solid relationship with cardiovascular illnesses. Encourage

longitudinal thinking about what is justified in investigating causative instruments and viable open well-being mediations.

Keywords: Diabetes Mellitus, Cardiovascular Diseases, Risk Factors, Glycemic Control, Cross-Sectional Study

Waste Reduction Strategies for Sustainable Urban Development In The Punjab, Pakistan

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Punjab, the most populous province of Pakistan, generates more than half of the country's municipal solid waste, with major contributions from its largest urban centers Lahore, Faisalabad, Multan, and Rawalpindi. Despite significant public spending, municipal waste management remains inadequate, dominated by open dumping and uncontrolled landfilling, with minimal household-level recycling and segregation. This study aimed to assess the current status of solid waste generation and management in Punjab and propose strategies for sustainable improvement. A mixed-methods research design was employed, including household surveys, focus group discussions, and key informant interviews across the four major cities. Findings revealed that organic waste constitutes over 60% of the waste stream, indicating strong potential for composting and biogas initiatives. However, weak regulatory enforcement, lack of segregation infrastructure, low public awareness, and institutional challenges hinder effective waste management. The informal recycling sector contributes significantly to resource recovery but remains poorly integrated into formal systems. The study recommends an integrated waste minimization framework based on the 3Rs and circular economy principles, alongside community-based segregation programs, small- to medium-scale waste-to-energy projects, and strengthened public-private partnerships. These measures could reduce environmental degradation, improve resource efficiency, and support progress toward the Sustainable Development Goals.

Fractal Geometry and Nonlinear Dynamics of Agricultural Models with Allee Effect

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Agricultural and ecological systems often exhibit nonlinear behavior due to density dependence, environmental variability, and human interventions such as harvesting. One important nonlinear mechanism in population-based agricultural models is the Allee effect, which introduces threshold-dependent growth and can significantly alter system stability. In this talk, we investigate discrete-time agricultural models incorporating the Allee effect using tools from fractal geometry and nonlinear dynamical systems. By applying fixed-point iterative schemes, we analyze equilibrium points, stability conditions, and bifurcation phenomena including period-

doubling and Neimark–Sacker bifurcations. The emergence of fractal structures, such as Julia-type sets and complex basins of attraction, reveals strong sensitivity to system parameters representing growth rate, harvesting effort, and environmental stress. These fractal patterns provide valuable insight into multistability, sudden population collapse, and sustainable parameter regimes. The results demonstrate that fractal analysis is not only a powerful visualization tool but also a meaningful indicator of resilience and risk in agricultural systems. This interdisciplinary study bridges advanced mathematical theory with applied agricultural modeling and supports improved decision-making for sustainable crop and population management.

Emerging Technology and Sustainable Innovation's in Food and Allied Sciences for Ensuring Future Food Security

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Emerging technologies and sustainable innovations in Food and Allied Sciences are rapidly reshaping the global landscape of food production, processing, and distribution. As the world faces increasing pressures from population growth, environmental degradation, climate change, and resource scarcity, the need for resilient, efficient, and sustainable food systems has become a critical priority. This article represented how advanced scientific approaches and technological breakthroughs can collectively address these challenges and contribute to long-term food security. Recent developments such as precision agriculture, remote sensing, genetic improvement, controlled-environment farming, and smart irrigation systems are enabling farmers to optimize crop yields while minimizing environmental impact. In the food processing sector, modern technologies including automation, artificial intelligence, Internet of Things (IoT) devices, and advanced preservation techniques are enhancing product quality, reducing food losses, and improving nutritional value. Biotechnology, functional food development, and microbial innovations also offer promising solutions for creating nutrient-dense, affordable, and sustainable food products. Sustainable packaging materials, circular economy practices, and renewable resource utilization are further contributing to eco-friendly food value chains. Additionally, climate-resilient agricultural strategies, post-harvest innovations, and digital monitoring tools are helping communities adapt to changing climatic conditions and maintain stable food supplies. By integrating technological innovation with responsible resource management, Food and Allied Sciences can play a transformative role in safeguarding future generations against food insecurity.

Comparison of Ai Powered Approaches Vs Traditional Medical Laboratory Analysis Techniques

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Artificial intelligence AI is rapidly modifying medical laboratory analysis by enhancing their accuracy by automation. The traditional diagnostic techniques such as microscopy, biochemical assays polymerase chain reaction (PCR) and enzyme linked immunosorbent assay (ELESA), are used for disease detection. However, these methods require extensive time, manual effort, and susceptible to human errors. In contrast AI -powered approaches, particularly machine learning, and deep learning, offers fast data processing, improved diagnostic care and reduced dependence on manual analysis. This review explores the differences between AI driven techniques and traditional laboratory methods, focusing on factors such as speed, accuracy, cost-effectiveness, and resource utilization. AI enables rapid analysis of large datasets, minimizing errors and facilitating early disease detection. However, despite its advantages, challenges remain, including high implementation costs, regular controls, and need for human oversight to ensure reliability and ethical agreement. Rather than replacing traditional methods, AI serve as a valuable tool that enhance laboratory workflow and support healthcare professionals in decision making. Additionally, ethical and legal considerations, including data privacy, and algorithmic biases, play a crucial role in the adaptation of AI in medical laboratory diagnosis. This review insights into the evolving role of AI in laboratory medicine, highlighting its potential, challenges and future prospects.

Keywords: Artificial intelligence AI, Medical laboratory analysis, Machine learning

First-Principles Study of Structural, Electronic and Magnetic Properties of Fe-Doped MgS

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This study aims to predict the structural, electronic, and magnetic properties of the $\text{Mg}_{1-x}\text{Fe}_x\text{S}$ ($x = 0.25, 0.50, 0.75$, and 1) compound in cubic phase using a first-principles approach. The structural properties were evaluated with the Perdew–Burk–Ernzerhof generalized gradient approximation (PBE-GGA). The electronic and magnetic properties were calculated using the modified Becke–Johnson potential combined with LDA correlation (mBJ-LDA), which offers a better description of electronic behavior than PBE-GGA. The findings indicate that this compound shows half-metallic ferromagnetism with 100% spin polarization at the Fermi level. For all Fe concentrations ($0.25, 0.50, 0.75$, and 1), the total magnetic moment remains $4\mu_B$, with a small local magnetic contribution on the Mg and S atoms. In addition, the local magnetic moments of the Fe atom decrease compared to their free-atom values.

Investigating the Optoelectronic Properties and Third-Order Nonlinear Optical Susceptibility of Cross-Shaped Molecules: From Molecular Insights to Material Applications

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In the present investigation, we use a dual computational approach (at single molecular and solid-state levels) to explore the optoelectronic and nonlinear optical (NLO) properties of crossed shaped derivatives. The solid-state electronic band structures of the compounds 1-3 (the derivatives of tetracarboxylic acid in cross-shaped having the core of benzene (1), pyrazinoquinoxaline (2) and tetrathiafulvalene (3)) are calculated. The calculated band gaps for compounds 1-2 are found to be direct band gaps and compound 3 to be indirect band gap with energy gaps of 2.749, 1.765 and 0.875 eV, respectively. The important optical properties including refractive index, absorption coefficients, loss functions and extinction coefficient of these semiconductors are calculated at bulk-level to seek their potential applications as efficient optoelectronic materials. Additionally, we use the Lorentz approximation to calculate the third-order NLO susceptibilities of compounds 1-3 using the molecular hyperpolarizability and solid-state parameters. The calculated third-order NLO susceptibilities of compounds 1-3 are found to be 6.92×10^{-12} , 64.0×10^{-12} and 26.3×10^{-12} esu, respectively. Thus, the present study not only provides a way to connect the calculated third-order molecular NLO polarizability to NLO susceptibilities for compounds 1-3 through Lorentz approximation but also highlights the importance of central core modifications on their NLO susceptibilities.

Stakeholder Influence under AKIS for Sustainable Agricultural Development in Pakistan

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AKIS characterizes the linkage among institutions, farmers, and academia for the purpose of knowledge generation, dissemination and utilization for sustainable agricultural development. In the context of Pakistan, it is very much critical for bringing improvements in the livelihoods of rural people. Though the impact and functionality of AKIS is associated to strengths of institutional linkages and consequences of different stakeholders i.e. researcher, extension worker, farmer, NGOs, private sector (input-suppliers) and policy makers. Considering this scenario, current study explores the dynamics of institutional linkages and stakeholders influences within AKIS framework in Pakistan. A mix-method research approach using cross-sectional survey design was adopted for the study. A total sample of 2250 was selected from 15 districts using semi-structured interview schedule as survey research instrument for quantitative data and interview guide was used for qualitative data collection. Results revealed that amongst the stakeholders;

farmers, private sector/input supply agencies and research organizations are more prominent in AKIS with mean scores of $\bar{x}=3.81$, $\bar{x}=3.80$, & $\bar{x}=2.84$ respectively. Moreover, dealers of grain markets, agricultural marketing, and extension workers & progressive farmers are top three influencers respectively in AKIS framework for rural development in Pakistan. In the context of stakeholders' linkage analysis; farmers meeting ($\bar{x}=2.89$), trainings ($\bar{x}=2.77$), and on-farm visits ($\bar{x}=2.76$) are most important factors for developing strong linkages among stakeholders. Among the functional linkages of AKIS stakeholders; extension-farmer linkage ranked as highest ($\bar{x}=2.77$), extension-education linkage ranked 2nd ($\bar{x}=2.73$), whereas research-extension linkage and research-education linkage ranked 3rd ($\bar{x}=2.64$ for both). As the AKIS in Pakistan is farmer-oriented therefore, it is dire need to strengthen agriculture extension and advisory services by developing strong and resilient linkage among other stakeholders for effective knowledge management and delivery.

Impact of Religious Motivation On Rate of Recidivism in Rural Areas of District Okara

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The present study "Impact of religious motivation on rate of recidivism in rural areas of district Okara" sees the critical review of religious component of probation system in community correction and would provide an insight into the overall effectiveness of religious element in probation system as this is based on empirical and scientific research. In this research human universe is all the muslim offenders (residing in rural areas of district okara) referred to probation officer for resocialization and have completed their rehabilitation process. Sampling Frame was obtained from office of district probation officer Okara whereas a sample 308 was selected from district Okara by using simple random sampling. Data was collected by researcher himself by developing two interview schedules, named Religious Motivation Scale (RMS) and Rate of Recidivism Scale (RRS), and analyzed by using Statistical Package for Social Sciences (SPSS) Version 20 and Microsoft Excel 2010. All the respondents were male and belonged to rural areas of district Okara. Majority of participants (76.0%) were businessman whereas ratio of Unemployed respondents is 9.75%. Most of participants (92.0%) fall in the age group of 26 to 45 years while (72.9%) were married. The distribution of participants based on income depicts that majority of participants (57.3%) are having income between 6100- 10,000 whereas 32.6% respondents have income more than 10000 rupees. A large no. of participants (80.9%) have more than three children. There was a significant difference among participants' rate of recidivism mean scores based on age group and income. Hence, it was found that mean difference of religious motivation was (.15972) between participants belonging to (26-45 years) and (46 & above) age groups was significant at $p < 0.05$. The mean difference of religious motivation was (.38810 & .34314) between respondents belonging to (3100-6000) and (10000 & above) income group.

Supramolecular Solvent-Based Liquid-Liquid Micro extraction of Copper from Water and Food Samples Prior to its Spectrophotometric Determination

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The copper poisoning in food and environmental matrices is a serious concern. High solvent use, toxicity, and time-consuming processes are the drawbacks of traditional extraction methods including solid phase extraction and cloud point extraction. This work created a liquid-liquid micro extraction (SSME) method based on supramolecular solvents as an environmentally friendly, straightforward, and highly sensitive method for determining copper. Alkanol-based supramolecular solvents (SUPRAS) are created using ethanol and decanoic acid, which allows for the effective extraction of Cu(II) complexes produced with 4(2pyridylazo)resorcinol (PAR) at pH 7. Spectrophotometric analysis of the isolated SUPRAS phase was performed at 520 nm. Limit of Detection is 0.26 ($\mu\text{g/mL}$), Limit of Quantification is (0.84 $\mu\text{g/mL}$), preconcentration factor (15), enhancement factor (15.5), molar absorptivity, and recovery percentage (R%) were all assessed using optimized condition such as pH, Ligend concentration, Sample volume, Supramolecular solvent. High sensitivity, repeatability, and environmental compatibility were shown by the results. The method dependability in complicated matrices was validated through its application to actual samples, including dam water, tap water, ground water, fruits, vegetabels pulses, and subterranean water food samples recovery results.

Keywords: Supramolecular solvent, microextraction, spectrophotometric determination, Copper, PAR (4(2pyridylazo) resorcinol

Synthesis Of Drug-Mediated Copper Oxide Nanoparticles Capped With Acetic Acid For Colorimetric Sensing Of Oxalic Acid

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The hyperoxaluria is associated with an increased risk of kidney stone formation and, finally, chronic renal failure. However, their high levels in blood plasma due to renal failure further increase the risk of cardiovascular diseases. Therefore, the global health concern prompts the development of such strategies to detect and quantify oxalic acid economically and rapidly. Thus, nanotechnology can be used as a platform to develop colorimetric sensors for economically rapid detection of oxalates. The copper oxide nanoparticles (CuO NPs) increase their importance due to their intrinsic color change. The novel paracetamol-mediated CuO NPs were synthesized and capped with acetic acid. The synthesis of NPs was confirmed by different characterization techniques, including UV–Visible spectroscopy, Fourier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), and scanning electron

microscopy (SEM). UV–Visible spectroscopy confirmed the synthesis of CuO NPs through surface plasmon resonance at 225 nm. The peak at 850 cm^{-1} corresponds to the stretching vibration of Cu–O of CuO NPs. The XRD and SEM characterization techniques confirmed a particle size of 27.51 nm with a spherical morphology. The intrinsic colorimetric features of CuO NPs were observed through both spectroscopy and the naked eye, with a decrease in the blue color as the oxalate concentration increased. The developed probe selectively detected oxalate levels in concentrations ranging from 1 to 120 μM , with a limit of detection (LOD) of 0.23 μM and a limit of quantification (LOQ) of 0.78 μM . The spiking levels in real samples demonstrated that the developed sensors can be utilized for detecting oxalate in the urine of patients with kidney stones. The produced CuO NPs have demonstrated quick and accurate selective oxalate detection in a linear range. The biosensor provides an excellent platform for oxalate measurement, which is crucial for diagnosing hyperoxaluria and preventing calcium oxalate stone formation in the kidneys by adopting effective therapeutic strategies and for the prevention of associated diseases.

Keywords: CuO NPs, oxalic acid, kidney stone, hyperoxaluria, biosensor

The Role of Artificial Intelligence on English Language Learning (A simple and qualitative research using advanced technology)

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This paper explores the role of Artificial Intelligence (AI) in English language learning. In recent years, AI-based tools such as language learning apps, chatbots, and translation software have become very popular among students. The study focuses on how these tools help learners improve vocabulary, grammar, and speaking skills. A very small survey was conducted with undergraduate students to understand their views about using AI in learning English. The findings show that most students find AI tools helpful, time-saving and easy to use. However, some students also feel that overuse of AI may reduce critical thinking skills. The study concludes that AI can be an effective support for language learning if used properly under teacher guidance.

Keywords: Language and Technology, AI-based tools, English language learning, students' behavior towards AI tools, Overuse of AI

Boerhavia Procumbens Leaf Extract Mediated Synthesis Of Copper Oxide Nanoparticles For Antibiotic Detection And Antibacterial Activity Against Drug-Resistant Strains

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Copper oxide nanoparticles (CuO NPs) were synthesized through a green route using *Boerhavia procumbens* extract with copper sulfate pentahydrate as the precursor salt. The synthesis conditions, including precursor concentration, pH, temperature, and reaction time, were optimized, and the obtained nanoparticles were calcined at 600 $^{\circ}\text{C}$ to improve crystallinity. The

prepared CuO NPs were characterized by using UV-Vis spectroscopy, FTIR, XRD, EDX, as well as by the SEM analysis. XRD confirmed the formation of crystalline monoclinic CuO NPs, with a prominent diffraction peak at $2\theta \approx 35.5^\circ$. SEM revealed aggregated nanoparticles with irregular morphology, while EDX analysis verified the elemental composition, showing copper (~64 mass%) and oxygen (~31 mass%) as the major constituents, consistent with CuO formation. The sensing ability of CuO NPs towards benzathine penicillin was evaluated using UV-Visible spectroscopy, where a concentration-dependent decrease in absorbance intensity demonstrated effective detection. The sensitivity of the sensor was further assessed by determining the limit of detection (LOD) and limit of quantification (LOQ). Antibacterial activity was investigated using the agar well diffusion method and the CuO NPs exhibited a maximum zone of inhibition of approximately 16.04 mm at a concentration of 400 μ L. Improved antibacterial performance was observed when CuO NPs were combined with a particular drug. Azithromycin and aqueous solution were used as positive and negative controls, respectively. Overall, this study demonstrates that *Boerhavia procumbens* mediated CuO NPs possess dual functionality in antibiotic sensing and antibacterial activity, offering a sustainable and eco-friendly approach to address the growing challenge of drug resistance.

Keywords: Copper oxide nanoparticles, green synthesis, *Boerhavia procumbens*, antibiotic sensing, antibacterial activity

Effect Of Indole Acetic Acid On Biochemical And Oxidative Stress Parameters In Lablab Purpureus Under Arsenic Toxicity

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Lablab purpureus (L.) Sweet, commonly known as Hyacinth Bean, was a multipurpose legume with nutritional, medicinal, and ecological importance. Its growth and physiological functions were severely affected by arsenic (As), a persistent metalloid that induced oxidative stress and disrupted metabolic activities in plants. This study investigated the effect of Indole Acetic Acid (IAA) on biochemical and oxidative stress parameters in *L. purpureus* under As toxicity. Seeds of *L. purpureus* were surface sterilized and primed with 10 μ M IAA or water (control) prior to germination and soil pot experiments. Seedlings were exposed to incremental concentrations of sodium arsenate (Na_3AsO_4). Arsenic stress significantly reduced germination percentage, seedling vigor, root and shoot length, biomass, and photosynthetic pigment content, while increasing oxidative stress markers, including hydrogen peroxide (H_2O_2), malondialdehyde (MDA), and antioxidant enzyme activities (SOD, CAT, POD, APX). IAA priming alleviated the adverse effects of As, improving growth parameters, enhancing chlorophyll and carotenoid levels, and reducing ROS accumulation. Metabolic profiling revealed that IAA-treated seedlings maintained higher levels of carbohydrates, amino acids, and other stress-protective metabolites. These findings demonstrated that IAA mitigated As-induced oxidative and biochemical

disturbances, highlighting its potential role in improving stress tolerance and sustainable cultivation of *L. purpureus* in As-contaminated soils.

Effect Of Parthenium Hysterophorus As Green Manure On Fertility Of Different Soil Types And Wheat Growth Parameters

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Parthenium hysterophorus is an aggressive invasive weed widely distributed in Pakistan, particularly in Khyber Pakhtunkhwa, where it poses serious ecological and agricultural threats. Despite its harmful effects, its potential utilization as green manure has remained poorly explored. The present study was conducted to evaluate the effect of Parthenium hysterophorus biomass as green manure on the fertility of different soil types and on the morphological and biochemical growth parameters of wheat. A pot experiment was performed using a Completely Randomized Design (CRD) under factorial arrangement with two soil types (garden soil and red soil) and parthenium biomass treatments. Wheat growth was assessed through germination percentage, plant height, root length, shoot length, leaf area, and number of leaves. Biochemical parameters such as chlorophyll a, b, and carotenoids, total soluble proteins, sugars, carbohydrates, and ascorbic acid content were determined using standard analytical methods. Results indicated that moderate incorporation of parthenium biomass significantly improved soil fertility by increasing organic matter and available N, P, and K contents, particularly in garden soil. Wheat plants grown under moderate treatment showed enhanced morphological traits and higher biochemical contents compared to the control. However, higher biomass concentrations exhibited slight inhibitory effects, possibly due to allelopathic compounds. The study concluded that controlled application of Parthenium hysterophorus as green manure could improve soil health and enhance wheat productivity, offering a sustainable approach to convert an invasive weed into a beneficial organic amendment for agriculture.

Assessing The Effects Of Calotropis Procera As Compost On Fertility Of Different Soil Types And Growth Parameters Of Wheat

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The use of organic amendments derived from locally available bioresources was considered an effective approach for improving soil fertility and crop productivity. The present study was conducted to investigate the potential of Calotropis procera compost as an organic soil amendment and to evaluate its effects on the physicochemical properties of different soil types as well as the morphological and biochemical responses of wheat (*Triticum aestivum* L.). The experiment was conducted using a Completely Randomized Design (CRD) with multiple treatments and replicates. Compost was prepared through aerobic decomposition of *C. procera*

leaves mixed with cow dung. Two soil types (garden soil and red soil) were used to determine differential soil responses to compost application. Soil samples were collected before compost application and after harvest and were analyzed for pH, electrical conductivity, organic matter, and essential macronutrients including nitrogen, phosphorus, and potassium. Wheat growth performance was evaluated through morphological parameters such as plant height, root and shoot length, leaf number, and fresh and dry biomass. Furthermore, physiological and biochemical attributes including chlorophyll content, carotenoids, relative water content, total soluble proteins, carbohydrates, total sugars, and ascorbic acid were determined using standard analytical methods. The study provided scientific insight into the conversion of an invasive weed into a nutrient-enriched organic fertilizer and highlighted its role in sustainable soil management. These findings were expected to support environmentally friendly agricultural practices contributing to global food security objectives aligned with United Nations Sustainable Development.

Keywords: *Calotropis procera*, compost, soil fertility, wheat, organic amendment, sustainable agriculture

