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ABSTRACTS BOOK OF

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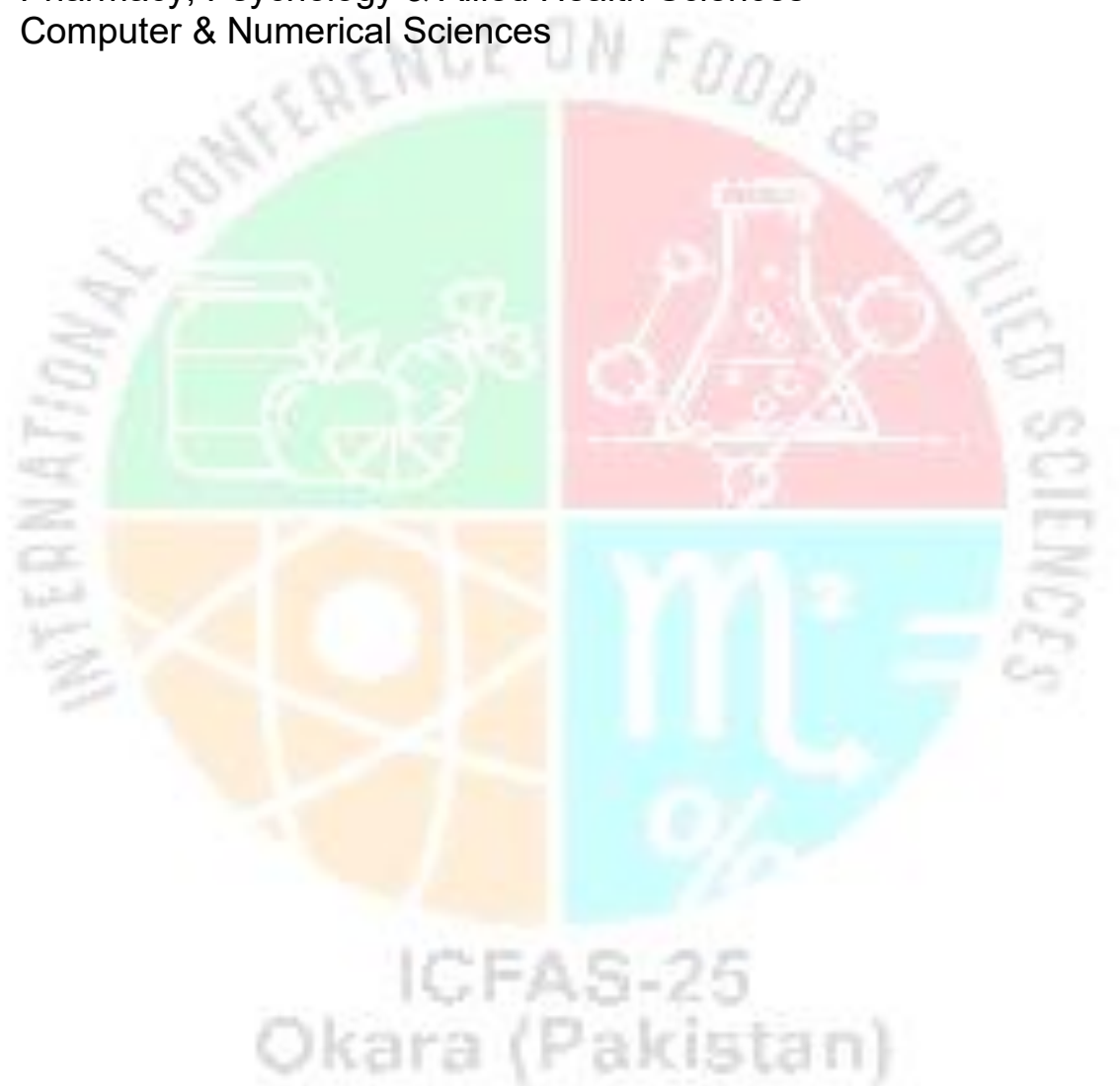
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- Chemical & Biological Sciences
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Okara (Pakistan)

Green synthesis, characterization of copper oxide nanoparticle using aqueous extract of saccharum munja and their anti-neurotoxic activity

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Copper oxide nanoparticles (CuO-NPs) with appropriate surface chemistry exhibit many interesting properties that can be exploited in a variety of biomedical applications such as anti-fungal, anti-bacterial and anti-film. The exclusive properties of copper oxide nanoparticles have potential application on, antibacterial, antifungal, drug resistance etc. In this study unexplored saccharum munja whole plant extract was found to be capable in green synthesis of copper oxide nanoparticles (CuO-NPs) and their characteristics were studied by using UV-visible spectrophotometer, SEM, EDX, XRD and FT-IR. The anti-neurotoxic activity was performed alone on copper oxide nanoparticles, the zone of inhibition was recorded which show that the copper oxide nanoparticles are more effective in anti-neurotoxic activity. CuO-NPs were prepared by green synthesis using Saccharum munja whole plant extract and characterized by various showed that green CuO-NPs are stable, spherical in shape and the size of CuO-NPs was in the range of 2.09-29.99 nm. Anti-neurotoxic activity result waited. This study constitutes an environmental friendly approach for the synthesis of CuO-NPs and their application in anti-neurotoxic activity.

Keywords: Green synthesis; Characterization; CuO-NPs; Anti-neurotoxic activity; western blotting technique

In Vitro Antifungal Potential of Caralluma Edulis Mediated Copper Oxide Nanoparticle

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Nanotechnology, through the green synthesis of nanoparticles using plant extracts rich in bioactive compounds, significantly enhances various fields such as health, agriculture, and medicine, offering sustainable and precise solutions that revolutionize drug delivery, precision agriculture, and eco-friendly medical technologies. This study explores the green synthesis of copper oxide nanoparticles (CuO-NPs) using Caralluma Edulis extract and evaluates their antifungal potential. Aimed at synthesizing and characterizing CuO-NPs, the research investigates their efficacy against fungal and bacterial pathogens. Copper oxide nanoparticles were synthesized by mixing Caralluma Edulis extract with CuSO₄, followed by characterization using X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM). The synthesized CuO-NPs exhibited significant antifungal effects against *Fusarium mangifera*, *Alternaria alternata*, *Aspergillus Niger* and *Penicillium italicum*, showing inhibition zones ranging from 15.6 mm to 18.8 mm at concentrations of 300 µg/mL SEM revealed spherical nanoparticles with an average size of 40 nm, while FTIR confirmed the presence of functional groups involved in nanoparticle synthesis. CuO-NPs synthesized from Caralluma Edulis extract exhibit potent antifungal properties, suggesting their potential as effective agents against fungal infections. This research underscores the biomedical potential of green-synthesized nanoparticles and highlights the ecological benefits of utilizing natural resources for nanoparticle synthesis. Further

investigate the mechanisms of action and explore synergistic effects with conventional antibiotics to enhance the efficacy of CuO-NPs against multidrug-resistant pathogens.

Keywords: Green synthesis, copper oxide nanoparticles, *Caralluma Edulis* antifungal activity, biomedical application.

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

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

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

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

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.

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

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 its 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

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

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

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.

Key Word: Mutational analysis, CLDN19, Nephrolithiasis, PCR, Gene

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

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

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

Demystifying Dental Caries: A Comprehensive Review of Causes, Mechanism and Treatment Strategies

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Dental caries, a chronic disease of significant global reach, represents a major public health problem affecting individuals across all age groups. The condition is characterized by the aggravating demineralization of dental hard tissues, primarily due to the acidic byproducts of bacterial metabolism. Bacterial species involved in caries development include *Streptococcus mutans*, *Streptococcus sobrinus*, and various *Lactobacillus* species. These microorganisms contain unique pathogenic mechanisms that enable them to adhere to tooth surfaces, metabolize sugars into harmful acids, and grow in acidic environments. This review analyzes the historical context and microbiology of dental caries and details the specific roles and mechanisms of *Streptococcus mutans* and *Lactobacillus* species in caries progression. It also discusses the formation and composition of dental plaque as a significant factor in caries development, as well as the stages and symptoms of dental cavity formation. The review further explores the current treatment strategies, including antibiotics, fluoride applications, and advanced dental restoration techniques, highlighting their effectiveness and limitations in managing this prevalence of oral health problems. The comprehension of dental caries has evolved significantly, it remains a widespread problem, especially in areas with limited access to dental care. Continued investigation and innovation are crucial to developing more potent prevention and treatment methods, ultimately reducing the worldwide burden of this disease.

Keywords: Dental caries, Streptococcus mutants, Lactobacillus, Dental plaque, Cavity formation.

Bridging Immunology and Oncology: The Role of Vaccines in Cancer Prevention and Treatment

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The intersection of immunology and oncology has opened new avenues for innovative cancer prevention and treatment strategies. Vaccines which were traditionally used to prevent infectious diseases, are now being developed to combat cancer by leveraging the body's immune system to recognize and destroy tumor cells. Prophylactic vaccines such as against human papillomavirus (HPV) and hepatitis B virus (HBV) have demonstrated notable success in reducing the incidence of virus-associated cancers. However, the potential of therapeutic cancer vaccines remains a growing field of exploration, which is designed to stimulate anti-tumor immune responses. Recent advances in subunit vaccines which utilize tumor-specific antigens and adjuvants, show promise in overcoming immune tolerance and boosting the efficacy of cancer immunotherapy. Additionally, novel delivery platforms including bacterial vectors and nanotechnology, enhance antigen presentation and immune activation. These approaches are particularly effective in targeting the tumor microenvironment which is a key barrier to successful immunotherapy. The study highlights the critical role of vaccines in bridging immunology and oncology, emphasizing their dual application in cancer prevention and treatment. It also explores emerging trends and challenges in vaccine design, identifying tumor-specific antigens, optimizing delivery systems, and addressing immune escape mechanisms. The integration of vaccines with existing 2 immunotherapeutic modalities, such as immune checkpoint inhibitors, holds pronounced potential for personalized and durable cancer therapies.

Keywords: Vaccine, Cancer, Immunotherapy, Tumor, Prevention

Evaluation of Efficacy of disinfectants against hospital acquired infections

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Hospital-acquired infections (HAIs) remain a significant global health concern, contributing to increased morbidity, mortality, and healthcare costs. The effectiveness of disinfectants in controlling HAIs depends on multiple factors, including their chemical

composition, spectrum of activity, resistance mechanisms, and environmental conditions. This study evaluates the efficacy of commonly used hospital disinfectants, such as alcohol-based solutions, chlorine compounds, quaternary ammonium compounds (QACs), hydrogen peroxide, and phenolics. The ability of these disinfectants to eliminate bacteria, viruses, fungi, and spores varies, with some demonstrating broad-spectrum activity while others are limited in their effectiveness against bacterial spores. Prolonged use of disinfectants can lead to microbial resistance through biofilm formation and efflux pump mechanisms, reducing their long-term effectiveness. Additionally, the efficacy of disinfectants is influenced by factors such as contact time, concentration, and the presence of organic matter. Surface compatibility is also a critical consideration, as some disinfectants may degrade medical equipment materials. Comparative studies indicate that hospitals implementing stringent disinfection protocols, including advanced technologies like hydrogen peroxide vapor and ultraviolet (UV) light, report lower HAI rates. Adherence to regulatory guidelines, such as those established by the Centers for Disease Control (CDC) and World Health Organization (WHO), is essential to maximize disinfection efficacy and minimize infection risks. This review underscores the importance of evidence-based disinfection strategies to enhance infection control and improve patient safety in healthcare facilities.

Keywords: hospital-acquired infections, disinfectants, microbial resistance, infection control, biofilm formation

Soy Milk: The Future of Dairy-Free Nutrition and Sustainability

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The increasing shift toward plant-based diets has enhanced the demand for dairy alternatives, with soy milk emerging as a leading option due to its high-quality protein, affordability, and functional properties. Compared to dairy milk, soy milk contains 7-8g of protein per 250mL, making it a nutritionally competitive alternative. It has lower calcium and vitamin B12 content, necessitating fortification. Soy milk production generates 59-71% lower greenhouse gas emissions, significantly reducing land and water use, positioning it as a sustainable choice. This review evaluates soy milk's nutritional profile, fortification strategies, and processing advancements while assessing its role as a sustainable dairy alternative. A comparative analysis of soy milk with dairy and other plant-based alternatives was conducted, focusing on protein digestibility, micronutrient composition, and sustainability impact. Processing techniques such as enzymatic hydrolysis, fermentation, and ultra-high temperature (UHT) treatment were assessed to improve texture, digestibility, and shelf-life. Fortification with calcium (120-150mg/100mL) and vitamin B12 (0.38-0.5µg/100mL) was analyzed to address nutritional gaps. Properly fortified soy milk can nutritionally match dairy milk while offering cardiovascular benefits, lactose-free advantages, and a reduced environmental footprint. Future research should focus on optimizing processing techniques, consumer acceptance, and large-scale production strategies to enhance soy milk's role in sustainable nutrition.

Keywords: Soy milk, lactose-free, Food processing, Sustainability, Plant-based milk

Extract of Guava Leaves (GLE) as a Natural Preservative for Fruits: Enhancing Shelf Life and Quality

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Fruits are naturally delicate and have a limited shelf life. GLE as preservatives to enhance the storage stability of fruits. GLE was extracted of full-grown green by the hot water (80°C) extract method. This study was planned to increase the shelf life and nutritional composition and bioactive compounds of many fruits through use GLE (natural preservatives). To analyze the impact of GLE, moisture level, weight loss percentage, PH value of fruits juice, protein amount were count after 10 days storage. Fruits samples such as banana, mango and Amla etc were treated with natural preservatives. GLE (0.5%) boiled. The study tell that moisture level ranges from 18.03% to 95.41%. During 10 days of experiment, Fruit samples are treated with GLE (boiled) 0.5%. GLE (boiled) preservatives give away better result consider the moisture level. The range of pH value varied of 2.47 to 6.01. Weight loss percentage value ranged from 3.67 to 85.71. The vitamin C level in the experiment was from 1.60 mg/100ml to 68.46mg 100ml. Guava leaves have 9.73% protein on absolute dry weight. Extracted of bio-active compounds through guava leaves include anti-cancer potential, anti-diabetic and microbial growth. Guava leaves is a rich source of bio-active compounds and used to enhance nutritional Properties and shelf life of many fruits that promote good health.

Key-Words: Extraction, Extend shelf life, Guava leaves, Natural preservatives

The Impact of Iron Overload on Red Blood Cell Membrane Stability in Beta Thalassemia

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Beta-thalassemia is an inherited hemoglobinopathy characterized by defective β -globin chain synthesis, leading to ineffective erythropoiesis and chronic hemolysis. Recurrent blood transfusions, a cornerstone of disease management, result in excessive iron accumulation, exacerbating oxidative stress and impairing red blood cell (RBC) membrane integrity. Iron overload induces lipid peroxidation and protein oxidation within the RBC membrane, accelerating hemolysis and contributing to disease pathology. This study aims to elucidate the impact of iron overload on RBC membrane stability in beta-thalassemia, highlighting the molecular mechanisms underlying oxidative damage, structural alterations, and potential therapeutic interventions. A systematic review of existing literature was conducted, focusing on the interplay between iron metabolism, oxidative stress, and RBC membrane pathology in beta-thalassemia. Key biomarkers, including ferritin, transferrin saturation, malondialdehyde, and membrane-associated proteins, were analyzed to assess RBC stability and hemolysis. Therapeutic strategies such as iron chelation, antioxidants, and emerging molecular approaches targeting iron homeostasis were also reviewed. Iron overload in beta-thalassemia significantly disrupts RBC membrane stability by promoting lipid peroxidation, protein crosslinking, and

cytoskeletal damage. These alterations lead to increased RBC rigidity, reduced deformability, and premature clearance by the spleen. Effective iron management through chelation therapy and antioxidant interventions is crucial for preserving RBC stability and improving clinical outcomes. Future research should focus on targeted therapies that modulate iron homeostasis and oxidative stress to enhance RBC survival and reduce transfusion dependence in beta-thalassemia patients.

Keywords: Beta-Thalassemia, Iron Overload, Red Blood Cell Membrane, Oxidative Stress, Lipid Peroxidation.

The Impact of Malnutrition on Mental Health: Exploring Nutritional Deficiencies and Psychological Well-being

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Malnutrition and mental health affect each other in many ways. When the body does not get the right nutrients, brain functions can suffer, leading to changes in mood, thinking ability, and emotional health. Malnutrition can occur when someone eats too little or consumes an unbalanced diet. Both situations prevent the brain from getting important nutrients such as iron, zinc, B vitamins, and omega-3 fats. These nutrients help the brain work properly, and lacking them can increase the chances of depression, anxiety, and trouble with memory or focus. In severe cases, long-term nutrient shortages can weaken the immune system, trigger inflammation, and even worsen conditions like schizophrenia or severe mood disorders. At the same time, mental health problems can make eating habits worse. They might skip meals, overeat unhealthy foods, or lose interest in eating altogether. This makes their nutrition even worse, creating a harmful cycle. On top of this, poverty, limited access to healthy foods, and a lack of knowledge about proper nutrition make the situation harder, especially in low-income communities. To address this issue, health programs need to combine better nutrition education with mental health care. Teaching people about balanced diets, encouraging healthy eating, and supporting mental health can improve overall well-being. Research should also explore exactly how nutrition affects brain chemistry and develop practical plans to include nutrition counseling in mental health treatment. Solving this problem requires looking at both physical and psychological health together, not separately.

Keywords: Malnutrition, Mental Health, Deficiencies, Unbalanced diet

The Role of Artificial Intelligence in Medical Laboratory Sciences

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Medical laboratory sciences are undergoing a revolution thanks to artificial intelligence (AI), which is increasing diagnostic precision, streamlining workflow, and assisting medical professionals in making decisions. AI-powered image analysis and pattern recognition make it possible to quickly and accurately identify anomalies in medical images, including tissue samples and blood smears. Furthermore, AI reduces human error and manual labor by automating data analysis. AI can evaluate lab data and predict

patient outcomes thanks to predictive modeling, which helps doctors make well-informed decisions. Additionally, AI-driven automation simplifies laboratory processes by handling repetitive jobs, freeing up medical personnel to concentrate on intricate procedures. AI is also essential for increasing diagnostic precision since it can detect differences in test data and minimize mistakes. Regarding patient safety, AI can identify possible hazards like drug mistakes and allergic responses, notifying medical personnel to act promptly. AI and genomics have been combined to create personalized medicine, which allows for customized treatment regimens based on each patient's unique genetic profile. Notwithstanding its many benefits, obstacles like problems with data quality, legal worries, and the requirement for ongoing validation prevent AI from being widely used in medical labs. Future developments in laboratory sciences could be greatly aided by AI, leading to improved patient outcomes, novel diagnostic techniques, and increased operational efficacy. As research and technology advance, AI is expected to become increasingly important in medical labs, transforming precision medicine and healthcare in the process.

Keywords: Artificial Intelligence, Medical Laboratory, Automation, Diagnosis

Improvements of Malnutrition in University of Okara

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Malnutrition is a serious disease causing severe health problems day by day. The consequences of malnutrition extend beyond physical growth, impact cognitive development and economic productivity. Insufficient intake of food or nutrients may lead to under nutrition which cause to low weight, stunting, wasting and deficiency of micronutrients. Excess intake of food may lead to overweight and obesity. This disease actually cause due to that area of country is very poor and people do not have enough money and their monthly income didn't afford the desired or basic things to eat. Study is limited to small sample size, self-reported data inaccuracies, and short duration hindering long-term insights. External factors like off-campus habits and limited resources could also affect results. There is also survey taken from students in which questionnaire is distributed to the random students in University and students fill and got instructions about the malnutrition and in dietary recall data is collected for making sure that how they are eating and what is their daily calorie intake According to their dietary recalled that have taken from them. Improving malnutrition is vital for better health, as it prevents diseases and supports physical and cognitive development. It enhances productivity, contributing to economic growth and reducing healthcare costs. Addressing malnutrition breaks the cycle of poverty and inequality, promoting social equity. It ensures children perform better in education, building a stronger future workforce. Additionally, tackling malnutrition aligns with global goals like the sustainable Development Goals, fostering a healthier, more sustainable world.

The impact of smoking on youth and young adults.

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The study looked at the alarming rise in smoking rate among youth and young adults especially among university students. This study also examined the impact of smoking

on the physical and mental health of youth and young adults. The qualitative approach was employed, data collected through questionnaire, interviews and surveys. Approximately 20 students of the university aged between 15 to 25 years participated in the study. Understanding Smoking rates and impacts on Youth and young adults is crucial for developing effective prevention and informing health policies and reducing smoking related illnesses and deaths.

Keyword: physical health, mental health, university students

Antimicrobial activities of Gelatin-based hydrogel Nanocomposites containing Copper Nanoparticles.

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Hydrogel-based nanocomposites have gained attention in the recent past as beneficial materials due to their versatile properties and ability to integrate bioactive nanoparticles. Gelatin hydrogel (porous) having pore size ranging in 15-100 nm, was prepared by cooling the hot solution of hydrogels at 20°C i.e. room temperature with glutaraldehyde being used as cross-linker. Hydrogels of 10 wt% and 3 wt% were prepared. The synthesized hydrogels were tested for antimicrobial studies against bacterial and fungal strains. The morphology of the gelatin-based hydrogels and copper nanoparticles presence in its matrix were observed via scanning electron microscopy (SEM). X-ray diffraction (XRD) analysis was carried out to determine the crystallographic structure of the synthesized nanoparticles. The thermo gravimetric analysis (TGA) was performed to confirm the presence of nanoparticles in the hydrogel matrix and the effect of nanoparticles on the thermal stability of hydrogels. The notable efficacy of gelatin-based hydrogels nanocomposites containing CuNPs as antimicrobial agents suggested that these nanocomposites can be considered as noteworthy materials for possible biomedical applications.

Keywords: Hydrogels, Copper Nanoparticles, Cross Linker, Antimicrobial activities

Synthesis and Characterization of Carbon dots from Melia Azedearach leaves for antioxidant and antimicrobial efficacy

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This study focused on the investigation of anti-oxidant and anti-microbial activities of carbon dots (CDs) synthesized, using Melia azdearach leaves as carbon precursors via green and facile hydrothermal method. The synthesis of CDs was confirmed by UV-visible spectroscopy and their sizes and shapes were determined by Scanning Electron

Microscope (SEM). The presence of functional groups was determined by Fourier Transformed infrared spectroscopy (FTIR) and elemental composition were determined by dispersive X-ray spectroscopy (EDX). Particle size of the CDs were found to be in the range of 1.5-2.5 nm and the emission spectrum exhibited a strong peak at 460 nm when excited at 380 nm. A notable efficacy of CDs in antimicrobial activity via minimum inhibitory concentration (MIC) suggested that the subject CDs can be considered as noteworthy materials for biomedical applications. Also, the antioxidant potential as determined by DPPH free radical scavenging assay, the synthesized CDs was found to be very promising.

Keywords: Melia azdearach, carbon dots, DPPH, antioxidant activity, antimicrobial activity

Overcoming Self-doubts

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Overcoming self-doubt is a transformative journey that empowers individuals to break free from limiting beliefs and unlock their true potential. It begins with understanding the origins of doubt, which often stem from past experiences, fear of failure, societal expectations, or comparisons with others. Recognizing these triggers is the first step toward dismantling the barriers they create. Self-awareness becomes the foundation, enabling individuals to confront negative thought patterns and replace them with constructive and empowering beliefs. This journey requires patience and a commitment to growth, often achieved by adopting habits that reinforce self-confidence, such as setting achievable goals, celebrating small victories, and embracing challenges as opportunities to learn. Building resilience is equally essential, as it allows individuals to navigate setbacks without losing sight of their progress. The support of encouraging environments, whether through relationships, mentorship, or community, strengthens the process by providing reassurance and motivation. Over time, these efforts lead to a significant mindset shift, transforming self-doubt into self-belief. Individuals begin to approach their personal and professional goals with clarity, courage, and determination, creating a more fulfilled and empowered life. By learning to trust themselves and their abilities, they not only overcome the constraints of doubt but also gain the resilience to face future challenges with confidence and optimism.

Antioxidant potential assessment of biosynthesized AgNPs and characterization of hepatoprotective phytoconstituents from Vitis vinifera extract using LC-MS/MS

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Liver disorder is the 5th common cause of death worldwide. Oxidative stress and inflammation are the core mechanisms behind the cause of liver damage induced by drugs. Vitis vinifera (Black grapes) is widely cultivated for its potential pharmacological properties. Present research revealed the potent anti-oxidant and antibacterial activity of Vitis vinifera crude extract and its biosynthesized AgNPs against all tested strains. FTIR, SEM, and XRD analysis confirmed the stabilization of biosynthesized AgNPs with an

average crystalline size (D) of 20.09 nm. Further, LC-MS/MS analysis extracted 38 phytoconstituents in the form of phenolics, flavonoids, and glycosides i.e. Resveratrol, trans- ϵ -Viniferin, Quercetin, Naringenin etc. These therapeutic phytoconstituents have potent hepatoprotective potential and pharmacokinetic importance. These findings suggested that *Vitis vinifera* crude extract as well as its biosynthesized AgNPs could be further investigated for In vitro and In vivo animal model. Moreover, these characteristic polyphenols should be isolated from *Vitis vinifera* fruit extract to carry out biosynthesis of AgNPs and used for the formulation of hepatoprotective drugs in pharmaceutical industry.

Keywords: Ag-nanoparticles, *Vitis vinifera*, hepatoprotective

The Nutritional Needs of Older Adults with Chronic Diseases

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Older adults with chronic diseases often face unique nutritional challenges that can exacerbate their conditions and reduce their quality of life. This study investigated the specific nutritional needs of this vulnerable population, focusing on identifying key nutrients, dietary patterns, and potential interventions. A qualitative research approach, involving discussions with older adults, was employed to gather rich and nuanced data. Participants shared their experiences and insights regarding the challenges they faced in meeting their nutritional needs, the impact of chronic diseases on their diets, and the support they required. By understanding the specific nutritional needs of older adults with chronic diseases, healthcare providers can develop tailored dietary recommendations and interventions to improve their overall health and well-being. This research contributed to the development of evidence-based strategies to address the nutritional challenges faced by this growing population.

Keywords: Older adults, chronic diseases, nutrition, dietary needs, health interventions

Advances in Nanotechnology-Integrated Liquid Biopsy: Enhancing Detection Sensitivity and Specificity for Cancer Biomarkers

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Although liquid biopsies are a new non-invasive method for detecting cancer, issues with their sensitivity and specificity continue to restrict their clinical application. By making it easier to detect cancer biomarkers like circulating tumor DNA (ctDNA), which are frequently found in extremely low amounts in human fluids, recent advances in nanotechnology are aiding in removing these barriers. To improve biomarker capture and magnify detection signals, researchers have investigated a variety of nanotechnology based strategies, including nanoparticles, nanowires, and graphene-based sensors. These cutting-edge methods have demonstrated significant promise in facilitating more accurate disease monitoring and early cancer diagnosis. Biomarker identification has been greatly enhanced by using several nanomaterials, including carbon nanotubes, magnetic nanoparticles, and gold nanoparticles, in optical, electrical, and electrochemical detection techniques. Although these developments have the potential to improve cancer

diagnosis, prognosis, and individualized treatment, there are still obstacles to overcome, most notably worries regarding the stability, toxicity, and viability of the large-scale clinical application of nanoparticles. The goal of ongoing research is to improve detection methods, optimize novel materials, and refine assays based on nanotechnology to increase accuracy and dependability. Notwithstanding these challenges, the combination of liquid biopsy and nanotechnology holds promise for revolutionizing cancer diagnostics by providing a highly sensitive and targeted method of biomarker identification that may eventually improve patient outcomes.

Keywords: Liquid Biopsy, Nanotechnology, Cancer Biomarkers, Nanomaterials.

Depression in youngsters (18-25years)

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Depression is becoming an increasingly serious issue for young people aged 18 to 25, affecting their emotions, relationships, and daily lives in ways that can feel overwhelming. This study takes a closer look at how common depression is in this age group, why it happens, and how it impacts the way they think, feel, and interact with the world. Through surveys and observations, we explored the emotional pain, social pressures, and environmental challenges that often lead to depression. We also looked at how therapy, support from friends and family, and even technology can play a positive role in helping young people heal and cope with these struggles. The main prospective of this research is to shed light on this deeply personal issue and offer practical ideas to help reduce depression and improve mental well-being. Understanding what young people go through is the first step toward building a world where they feel supported, understood, and hopeful about their future.

Keywords: depression, young people, mental well-being, social pressures, support

Youth screen time and sleep disturbance among students Of Okara University

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The purpose of current study to examine Youth screen time and sleep disturbance among University of Okara students. A structured questionnaire was administered to 20 students accessing the information about screen time, sleep disturbance and health problems like depression and anxiety. The findings suggest that digital screen time affect your sleep duration, increase behavioral problems and disturb your digestive system .It also affects your routine of work .Nutritionist recommended that adults (age group from 19 to 24) sleep between 7and 9 hours a night .Adults who sleep less than 7 hours a night may have more health issues than those who sleep 7 or more hours a night. Due to sleep disturbance students effected by many health disorders.

Student belief toward the healthy snack selection in university of Okara

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This study explores the beliefs, preferences, and barriers that influence healthy snack choices among students at the University of Okara. Student life, with its academic pressures and life stressors, often pushes students to consume unhealthy convenience based snacks, which poses long-term health risks such as obesity, diabetes, and heart disease. The knowledge gap, peer influence, and lack of awareness of healthier alternatives are the key factors that shape snack-related behaviors. A survey method was used to collect data from 60 undergraduate and postgraduate students to measure beliefs, attitudes, and snack selection behaviors. The results of the study emphasize the need for nutrition education programs in promoting healthier dietary habits on campus. This study highlights the need for targeted interventions to improve snack choices, thereby enhancing students' health and academic performance.

Key words: Healthy snacks, university students, dietary habits, snack-related Behavior

Comparative compositional and biological attributes of Spearmint (*Mentha spicata* L.) Leaves essential oil as a function of different agro climatic regions

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Essential oils as natural antimicrobial substances one of the alternative methods for plant disease control. Recently, the biological potential of spearmint leaves essential oil (EO), including its antioxidant, antibacterial, and hemolytic properties, are described together with its chemical composition. The spearmint leaves were gathered in Punjab, Pakistan's hilly, dry, irrigated, and drought-stricken agro climatic zones. From examined leaves from various locales, the hydro distillation process produced an EO yield that ranged from 0.41% to 0.76%. In recovered EOs, GCMS compositional analysis identified 31 components, with carvone (27.4%–47.2%), menthone (1.0%–23.9%), menthol (3.0%–14.5%), limonene (2.4%–93%), and 1, 8-cineol (0.6–8.5%) being the predominant constituents. The investigated oils displayed high levels of total phenolics (30.9–34.3 g GAE/100g), flavonoids (4.6–10.1 g CE/100g), and DPPH radical scavenging capacity (12.5–17.1 g mL⁻¹) as well as linoleic acid peroxidation inhibition (57.1–62.6%). Against particular types of bacteria and fungus, the studied EO demonstrated considerable antibacterial activity (AMA). EO extracted from a sample of a location under drought stress (Layyah) shown greater AMA, while EO from hilly regions (Murree) displayed higher antioxidant potential, total phenolics (TP), flavonoids (TF), and hemolytic activity (HA). This study recommends the use of spearmint leaves as an effective natural antioxidant and antibacterial ingredient in the development of nutra-pharmaceutical products and dietary supplements.

Keywords: Antimicrobial activity, Spearmint oil, Hemolysis Total phenolics, GC-MS Carvone

Development of a Novel Point-of-Care Diagnostic Test for Infectious Diseases Using Microfluidics and Biosensors

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The rapid and accurate diagnosis of infectious diseases is critical for effective disease management and outbreak control. Traditional diagnostic methods, including culture based techniques, polymerase chain reaction (PCR), and enzyme-linked immunosorbent assays (ELISA), often require specialized equipment, trained personnel, and prolonged turnaround times, making them less suitable for point-of-care (POC) applications. The integration of microfluidics and biosensors has emerged as a promising approach to developing novel POC diagnostic tests that offer high sensitivity, specificity, and rapid results. Microfluidic platforms enable the precise manipulation of small fluid volumes, facilitating efficient sample processing and biomarker detection. Meanwhile, biosensors, including optical, electrochemical, and piezoelectric sensors, enhance the analytical capabilities of these devices by detecting target pathogens with high accuracy. The synergy between microfluidics and biosensors has led to the development of portable, low-cost, and user-friendly diagnostic tools capable of addressing current challenges in infectious disease detection. This review explores the principles of microfluidics and biosensors, their advantages over conventional diagnostic techniques, and recent advancements in microfluidic-based POC diagnostics. Additionally, key challenges, including fabrication complexities, scalability, and regulatory hurdles, are discussed alongside future perspectives for clinical translation. The integration of these cutting-edge technologies holds immense potential to revolutionize infectious disease diagnostics, enabling real-time monitoring and improved healthcare outcomes, particularly in resource-limited settings.

Keywords: Point-of-care diagnostics, microfluidics, biosensors, infectious diseases, rapid Detection

Role of vitamin D in bone across lifespan

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Vitamin D plays a very important role in maintaining the bone health across lifespan, from fetal development to old age. This aim is to understand the vitamin D in bone health and also highlight its importance in different stages of life. The study explores the molecular mechanisms by which vitamin D regulates bone mineralization, density and its interaction with other minerals and hormones. This study also discusses the deficiency of vitamin D and its insufficiency, including many diseases like osteoporosis, osteomalacia, rickets and increased level of fracture in bone. The study reviews the recommendation for vitamin D intake and supplementation across different life stages and population. The study needs further research to indicate the optimum levels of vitamin D for bone health and to develop different effective strategies for treating and preventing vitamin D bone levels and disorder. Vitamin D must be taken through our diets in an adequate amount for every stage of life. It also matters our lifestyle, dietary habits, physical activity and environmental factors.

Key words: Children's, adults, older, irregular diets, sunlight, vitamin D.

Dietary impact on hormonal imbalance in females

Farheen Akbar

Hormones are very important in our body as they perform the main functions in performing the different functions of every organs. As the hormones disorders can create the serious health, physical and mental issues. Hormonal imbalances in females is a widespread that can affect health, the menstrual cycle , mood disturbance, reproductive organs, emotionally, mentally and physically. The study explores that the hormones imbalance is due to the stress, irregular sleep, and improper diets in females. This can explores the proper diet in influencing hormonal health, highlighting how dietary patterns and nutrients intake can exacerbate conditions like polycystic ovaries syndrome (PCOS), hyperthyroidism and estrogen dominance. Some females do not take their proper diet so that the many hormonal imbalance may occur due to which many serious problem Are occurred. If these causes are not be treated then it may lead to death. Hence this examine the relationship between the dietary materials such as healthy fats, refined sugars, phytoestrogen, vitamins and minerals. Diets rich in whole foods, omega-3 fatty acids and complete fibers need for the body for the proper way functioning. The research gives the importance of the dietary choices is very important for the proper way functioning in body.

Keywords: Females, hormonal imbalance, dietary intake, lifestyle.

A systematic study on campus food environment Eating Habits of College Students

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Eating habits among college students significantly impact both their academic performance and long-term health. College students often experience disruptions in their eating routines due to factors like stress, time constraints, financial limitations, and social pressures, which can lead to unhealthy eating patterns such as excessive consumption of fast food, sugary snacks, and caffeine. These poor eating habits are associated with negative outcomes, including weight gain, nutrient deficiencies, decreased energy levels, and mental health issues. The study explored the eating habits of 50 young college students (age 18-22). This qualitative study shows the objectives that describe to evaluate student eating habits, to identify factors that influence food choices, and to promote healthy eating in campus. This study evident on self-reported data and limited time frame from the most populated and prominent college of the area. Factors such as convince, cost, and taste emerges as the primary determinants of food choices, students more inclined to consume fast food and meal skipping. The finding highlights the prevalence of unhealthy eating behavior, driven by academic stress, financial constraints and limited access to nutritious food options. The campus must provide healthier food options. Need to conduct nutrition education programs and promote healthy eating habits thorough campus initiative. Campus should collaborate with local health organizations to support students' nutrition. Campus officials must monitor canteen cleanness.

Keywords: Eating habit, college students, academic performance, long-term health, unhealthy eating patterns, nutrition education, campus initiative, student nutrition, food choices, Health promotion.

Dietary patterns and its impact on Health among University of Okara students

Elsa Sardar, Saleha Sohail

University life often brings significant changes in dietary habits, with students frequently opting for convenience foods due to time constraints and busy schedules. This study explores the eating patterns of students at the University of Okara and their impact on health. Using a food frequency questionnaire, three main dietary patterns were identified: Western, characterized by fast food and sugary drinks; Traditional, focusing on whole grains, fruits, and vegetables; and Mixed, combining elements of both. Among the 20 participants, the Mixed pattern was most common (60%), followed by Western and Traditional (20% each). Students following Western dietary habits were found to face higher risks of obesity, nutrient deficiencies, and chronic illnesses like diabetes and heart disease. In contrast, the Traditional pattern supported better health outcomes. These findings highlight the urgent need for promoting healthier eating habits through education, better food options on campus, and personalized nutritional support to help students achieve better health and academic success.

Effect of vitamin in a patient with Xerophthalmia

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Although vitamin A insufficiency is a major cause of avoidable blindness, especially in developing nations, it is essential for preserving healthy eyesight. If xerophthalmia, a disorder brought on by a lack of vitamin A, is not treated, it can cause serious visual problems like night blindness, dry eyes, and even irreversible blindness. The effect of vitamin A consumption on eye health is examined in this thesis, with an emphasis on how it might be used to prevent and treat xerophthalmia. The study intends to emphasize the importance of sufficient Vitamin A levels in maintaining eyesight and halting the course of xerophthalmia by assessing the body of existing literature and examining data from individuals with Vitamin A deficiency. According to the results, taking vitamin A supplements on time can significantly enhance eye health in impacted people, providing an affordable and easily accessible way to stop blindness in susceptible groups. The study also highlights the necessity of public health campaigns to support vitamin A-rich diets and supplementation regimens, particularly in areas where xerophthalmia is still common. This study concludes by highlighting the vital role that vitamin A plays in protecting eyesight and offering insightful information to legislators and healthcare professionals in the battle against avoidable blindness.

Reduction in guava losses by preservation: particularly by freezing

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Guava (*Psidium guajava*) is a tropical fruit rich in nutrients like vitamin C, antioxidants and fibers. Almost 20-40% of guava fruit wastes in developing countries due to its short shelf life (3-4 days at room temperature) primarily caused by pathogens invasion and spoilage. These losses can be reduced by preserving guava fruits by freezing after pre-treatment such as washing, peeling and slicing. For freezing different types of freezers are used to meet the demand of temperature i.e., lowered than room temperature. In this way conditions become unfavorable for microorganisms to survive. So, freezing kill all the

microbial agents and protects guava fruit from spoilage. It increases the shelf life of guava fruit and also protect their nutritive value. Different freezing methods like Individual Quick Freezing (IQF), Blast Freezing and Cryogenic Freezing are used for freezing of guava. But the most appropriate or suitable of these methods is IQF which involves quick freezing of guava pieces individually. This method also preserves flavor, texture and nutrients of guava. Freezing of guava also depends on temperature. The ideal temperature for freezing of guava is 0°F (- 18°C) or below. But this temperature may cause serious chilling injury. To prevent this injury guava pieces are placed on the freezer where they exposed to temperature ranges -30°C to -40°C for shorter period of time (10-30 min) This temperature preserves guava fruit and extend its shelf life to around 20-28 days.

Keywords: Antioxidant, blast freezing, chilling injury, Cryogenic Freezing, Individual Quick Freezing (IQF), pathogen invasion

Evaluating the Impact of Cross-Contamination on Food Safety in Commercial

Kitchens

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Cross-contamination poses a serious threat to public health and food safety in industrial kitchens. This investigation looks at the effects of cross-contamination, including how it spreads, the microbes that are involved, and the risks that come with it. Contaminated surfaces, inadequate sanitation procedures, and incorrect food handling are common ways for harmful bacteria including *Salmonella*, *Escherichia coli*, and *Listeria monocytogenes* to spread. Cross-contamination can have negative consequences for food enterprises, including financial losses, outbreaks of foodborne illness, and harm to their brand. Contamination spreads due to things like improper food storage, poor cleaning practices, and a lack of personnel training. Strict hygienic procedures, appropriate food segregation, and comprehensive cleaning/sanitization procedures are necessary to lower these risks. Maintaining excellent standards in commercial kitchens requires strict adherence to food safety laws and rules. Still, there are issues including scarce resources, ignorance, and enforcement hurdles. Better training initiatives, more vigorous policy enforcement, and ongoing research are all necessary to overcome these challenges. By highlighting the pressing need for more robust food safety regulations in commercial kitchens, this analysis offers guidance for future studies and real-world implementations. Implementing thorough prevention techniques and making sure that regulations are followed can significantly lower the danger of cross-contamination, safeguarding customers from foodborne illnesses and improving public health.

Keywords: Cross-contamination, food safety, commercial kitchens, foodborne illnesses, hygiene practices, regulatory frameworks

Silicon Based Induced Resistance in Integration with Trichogramma on Maize against Spodoptera Frugiperda

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Spodoptera Frugiperda (Lepidoptera: Noctuidae) is a serious maize pest that originated in North America and has now developed into an economically significant maize pest worldwide. To date, pesticides have been the basis of pest control efforts, with a varied range of efficacy. The development of silicon-based induced resistance in the plants might be a viable option for controlling the fall armyworm. In addition to silicon, integration of bio-control agent *Trichogramma* can be a potential long-term management solution to fall armyworm. In the current study silicon based induced resistance in integration with *Trichogramma* on maize against *S. Frugiperda* was assessed both under semi natural and field conditions. The study was conducted in a potted experiment using Randomized Complete Block Design (RCBD) layout with three replications in each treatment. The experiment was conducted at the Entomology Research Farm of the Department of Entomology, University of Agriculture Faisalabad. Different concentrations of silicon (400, 800 and 1200 ppm) were used. *Trichogramma* egg cards were used alone and in integration with silicon against fall armyworm. Data was recorded on regular basis and was subjected to statistical analysis. The results showed that the foliar application of silicon dioxide at 800 ppm significantly reduced larval survival rate of fall armyworm after 45 days of exposure period (54%) compared to other treatments. Similarly, results showed that the foliar application of silicon dioxide at 800 ppm significantly reduced oviposition rate of fall armyworm after 45 days of exposure period (0.5%) compared to other treatments. After 45 days of foliar application, potassium silicate was not significantly affecting the fall armyworm populations while lower numbers of fall armyworm populations were recorded at 800 ppm concentration which was noted as (0.35 ± 0.05) . After 45 days foliar application of potassium silicate significant decrease in the fall armyworm populations as compared to control. The lowest number of populations was recorded in 800 ppm integrated with *Trichogramma* egg cards treatment with 0.25 ± 0.07 specimens. The study needs to be evaluated further in different field conditions for the suitable management of fall armyworm.

Keywords: Silicon Dioxide, Potassium Silicate, *Trichogramma*, Fall armyworm, Maize

The Rising Tendency of Fast Food Consumption and Its Influence on Health among the Students of the University of Okara

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The widespread consumption of fast food, despite its unhealthy ingredients such as sugar and high-fat beef, was a pressing concern. Individuals with hectic schedules, particularly those from affluent student backgrounds, often opted for fast food as a convenient and enjoyable option, unaware of the potential health risks. The purpose of this research is to find out the tendency toward fast food consumption and to analyze the effects of fast food consumption on health among the students of the University of Okara. To conduct this research, a quantitative research approach was employed, utilizing a close-ended questionnaire to collect data from 200 undergraduate students. The sampling technique was random, ensuring a representative sample. This study provided valuable insights into the role of fast food in undermining proper dietary habits. Moreover, it served as a catalyst for raising awareness about the detrimental effects of fast food consumption among university students.

Keywords: Fast food consumption, University students, Dietary habits, Health risks

Exploring Social Media's Impact on Personal Relationships, Mental Health, and Misinformation

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Social media has transformed modern communication, offering platforms for socialization, information sharing, and creativity. This study examines the dual effects of social media use on personal relationships, mental health, and the dissemination of misinformation. A mixed methods approach, combining self-reported data from a group of friends and a literature review, reveals both benefits and drawbacks. Positive effects include enhanced social connections, knowledge sharing, and emotional support. Conversely, excessive use is linked to anxiety, depression, and decreased productivity. Literature reviews corroborate these findings, highlighting the importance of moderate use to foster a sense of belonging while minimizing mental health risks and social comparison.

Keywords: social media, personal relationships, mental health, misinformation, communication, information sharing

Comparative Bio-control potential of *Listronotus setosipennis* and *Zygogramma bicolorata* against *Parthenium* weed under lab conditions

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Parthenium weed, *Parthenium hysterophorus*, is notorious for its adverse ecological and agricultural impacts, including competition with major crops and a significant reduction in crop yield and quality. This research investigates the efficacy of two bio control agents, *Listronotus setosipennis* (a stem-boring weevil) and *Zygogramma bicolorata* (a leaf-feeding beetle), in mitigating the growth and spread of Parthenium weed. Parthenium plants of different height and stem thickness were collected and were cultivated in 3-liter capacity plastic pots under controlled conditions, and both bio control agents were reared on these plants using a completely randomized design layout. The observation were recorded weekly and after weekly servicing the agents were transferred to new cages with fresh plants. The study assessed the feeding potential and impact of these biocontrol agents on various growth parameters of Parthenium, including foliar damage and stem tunneling. The results demonstrated a significant impact of both bio control agents on Parthenium hysterophorus. After two, three, and four weeks of release, *Listronotus setosipennis* showed varying degrees of damage correlated with plant height and stem thickness. The highest damage percentages recorded were 14.69%, 50.63%, and 83.75% for plant heights of 55 cm at two, three, and four weeks, respectively. Conversely, *Zygogramma bicolorata* exhibited an increasing trend of damage with plant height, with the highest damage percentages being 35.573%, 57.40%, and 87.40% at plant heights of 90 cm after two, three, and four weeks, respectively. Similarly, the impact on stem thickness varied, with *Listronotus setosipennis* causing the highest damage (82.33%) at a thickness of 3 cm after four weeks, whereas *Zygogramma bicolorata* inflicted the most significant damage (60.77%) at a thickness of 7 cm. These findings indicate that

Listronotus setosipennis is more effective on shorter, thinner plants, whereas *Zygogramma bicolorata* performs better on taller, thicker plants. This study provides valuable insights into the potential of utilizing *Listronotus setosipennis* and *Zygogramma bicolorata* as sustainable bio control agents to manage *Parthenium* weed infestations. The differential impact of these bio control agents based on plant height and thickness underscores the importance of tailored bio control strategies for effective weed management.

Keywords: *Listronotus setosipennis*, *Zygogramma bicolorata*, *Parthenium* weed, Infestation, Bio control agents

Biological Study of Stem-Boring Weevil *Listronotus Setosipennis* under Lab Conditions

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The stem-boring weevil, *Listronotus setosipennis*, is a potential bio control agent for the management of invasive *Parthenium hysterophorus*, a weed with significant ecological and economic impacts worldwide. Current study investigates the biological parameters of *L. setosipennis* under controlled laboratory conditions to enhance its population growth and efficacy as a bio control agent. The research focuses on understanding key aspects of *L. setosipennis* behavior, including oviposition, larval development, pupation, and adult emergence, on different plant height, stem thickness, and flower density of *Parthenium* plants. The experiment was conducted using a completely randomized design (CRD) with three treatments and three replications. The biological parameters were assessed on *Parthenium* potted plants with 100 caged weevils per cage. Weekly service of those plants were done regularly in which weevils were collected to release them on fresh plants. After three weeks of service the plants were dissected to assess the larval attack and larvae were collected from stem to pupate them in pupation boxes where from new adults were emerged. Results revealed significant impacts of stem on the reproductive success and development of *L. setosipennis*. Notably, moderate flower density was found to be conducive to optimal egg laying, with the highest number of eggs recorded at plants with a medium number of flowers (56.66). Similarly, taller plants (60 cm) supported increased larval development and pupation, suggesting that height plays a crucial role in providing adequate resources and suitable habitats for *L. setosipennis* development. Moreover, moderate stem thickness (6 cm) was associated with higher egg laying (59.33), larval development, and pupation rates, indicating the importance of structural support and habitat quality. For instance, plants with a stem thickness of 6 cm exhibited the highest number of eggs, larvae, and pupae per plant. These findings underscore the complex interplay between plant traits and weevil behavior, highlighting the need for a comprehensive understanding of these interactions to optimize the effectiveness of *L. setosipennis* as a sustainable and environmentally friendly bio control solution for *Parthenium* management. By identifying the factors influencing the reproductive success and development of *L. setosipennis*, this research contributes valuable insights towards the development of targeted bio control strategies, ultimately aiding in the sustainable

management of Parthenium infestations and their associated impacts on ecosystems and agriculture.

Keywords: stem-boring weevil, Parthenium weed, Infestation, Biological parameters, Controlled Environment

Challenges faced by higher national diploma (HND) students entering the work force

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The transition from education to employment is a critical phase in an individual career development. However, HND students often encounter significant challenges when entering the workforce. This study investigates the challenges faced by HND students in transitioning to employment and explores employer perceptions of HND graduates' skills. Mixed-methods approach was employed, combining surveys and Semi- Structured interviews with HND graduates and employers from industries. The findings highlight significant obstacles, including skill gaps experience- lack of work experience.

The study recommends targeted interventions to enhance employability Skills career industry partnerships and guidance. Educators should integrate practical training and internships into HND programs, Develop industry and Specific training programs.

Skiping Breakfast among University of Okara Students and its Association with Irregular sleep

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This research seeks to look into the links between the omissions of breakfast and sleep disturbances among the university students. The chief objective is to ascertain whether there are inter-relationships between the patterns in breakfast eating and the reports of sleep difficulties among this population group. 19 students of the University aged between 17 and 26 years participated in the study. In terms of living arrangements, 84.2% were staying on daily commuting basis, whereas 15.8 % were residing in hostels. Among the daily commuters 57.9% used to skip breakfast in a week once, 15.8%-twice, another 15.8%-four times and 10.5% five times. All hostilities (100 percent) had breakfast in a week on one occasion. Other data used included their sleep patterns collected through questionnaires, dietary history recalls and anthropometric measures. The effects of breakfast rituals on students' health and wellness, sleep and studying performance were the reasons for conducting such a study. Considering the increasing concern regarding students' performance as well as their wellness, it makes sense to study the variables of their way of life which may be responsible for such behavior. The findings emphasize the need of taking breakfast every day in relation to general health and quality of sleep. The establishment of regular breakfast intake among students can go a long way in improving their performance and scholastic abilities and nutrition levels. These insights may assist in formulating the university policies and health programs that develop students' health as well as support their studies.

Keywords: skipping breakfast, irregular sleep, university students

Chronic Diseases and Nutritional Health

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The aim of writing this article is to summarize its impact of chronic diseases on Nutritional health. Chronic diseases are very common now-a-days in our society and leaves an impact on Nutritional health. These diseases affecting the quality of life. A research was held on small scale by collecting data by discussions and counseling's and using some old researched data.

Nutrition and Immune system

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Nutrition plays a critical role in regulating immune system function, as adequate intake of essential micronutrients like vitamins, minerals, and certain macronutrients is necessary for optimal immune cell development and response to pathogens; malnutrition, including deficiencies in key nutrients, significantly impairs immune function, while over nutrition and obesity can also negatively impact immunity, highlighting the importance of a balanced diet to maintain a robust immune system.

Keywords: Nutrient impact, Macronutrients role, Malnutrition effects, Gut microbiome connection.

Innovative Treatments for Obesity

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Obesity is a major health and economic crisis facing the modern world. It is associated with excess mortality and morbidity and is directly linked to common conditions such as type 2 diabetes mellitus, coronary heart disease and sleep apnoea. The management of obesity and its associated complications has evolved in recent years, with a shift towards more definitive strategies such as bariatric surgery. This review encompasses the dietary, pharmacological and surgical strategies currently available for the management of obesity. Our analysis suggests that innovative treatments hold promise for improving weight loss outcomes, reducing comorbidities, and enhancing quality of life for individuals with obesity. However, further research is necessary to fully realize the potential of these emerging therapies.

An examination of societal behavioral changes in the development of agriculture

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The study was carried out in 2024 to examine societal behavioral changes in the development of agriculture: Lessons from the Global Society (Pakistan, China, and Sri Lanka). Improved food and quality production have been challenging in the supply chain.

This paper attractions on existing theories of behavioral change to construct a conceptual framework that explores pathways to initiate and sustain change through the lens of empowerment. This research agenda has potential for provide valuable insight for policymakers, researchers, and stakeholders in agriculture and beyond. Both types of data were used for the work and attained using structured questionnaire through different sampling methods to rural farmers in the study area of Pakistan, China and Sri Lanka. Recommendations were made for farmers within the study area to seek attitude and behavioral change for decision in agricultural strategies. We struggle that behavioral and social change needs to be clearly adopted in such endeavors to achieve better and longer-term outcomes for the people in the development of agriculture. Logistic mangers preferred to use decision support system to enhance approach for confirming the demand of food quality and care. Public sector Agricultural Extension, academia (research institutions/Universities) and stakeholders should launch massive campaign to considering concrete ways to engage youth farmers in agricultural policy processes and advocating for the active engagement of youth in the agricultural value chains.

Keywords: Behavioral change; Decision-making; Decision Support System; Rural farmers, Agricultural Development

Impact of Activation Energy on Hybrid Nano fluid Flow Dynamics at Stagnation Point in Porous Media: A Darcy-Forchheimer and Bio-Convective Approach

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This article presents the stagnation point and the boundary layer flow associated with two-dimensional Williamson Hybrid Nano fluid flow over a stretching cylinder substrate situated within a porous medium. The examination of heat and mass transfer concerning convective boundary conditions is presented. The primary governing equations are solved using established boundary layer approximations. Consequently, when the principal variables of the Williamson fluid Hybrid Nano fluid model are treated as analogous, the governing equations for this model are transformed into ordinary differential equations. For the numerical solutions, the widely recognized numerical method 'Bvp4c' is employed within MATLAB software. Hybrid nano fluids find practical applications in various sectors, including the automotive industry, transportation systems, military, healthcare, microfluidics, and other industrial fields. An increase in the buoyancy parameter, Williamson fluid coefficient, and curvature parameter results in an enhancement of the fluid's velocity, whereas the velocity distribution diminishes with rising porosity, stretching parameters, and Forchheimer effects. Consistent with previous research, the temperature profile of both basic and hybrid nano fluids decreases as the values of the Prandtl parameters increase. Additionally, the fluid temperature exhibits an upward trend in response to variations in the curvature parameter for both nano and hybrid nano fluids. Moreover, the mobility of swimming cells diminishes as the Peclet number increases. To ensure graph convergence, the range for η is set from 0 to 7. The results obtained have been validated against existing literature for accuracy.

Safety Assessment of Quality parameters of sugarcane jaggery and its by-products.

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Jaggery is a natural sweetener obtained from sugarcane juice concentrated at high temperatures for a specific period, it has been known from ancient times due to its unrefined nature and it is considered the powerhouse of essential nutrients like protein, carbohydrates, vitamins, calcium, phosphorus, and manganese with no fat. In rural areas, it is manufactured with chemicals like lime (soda), sodium hydrosulphite to improve its color, potassium metabisulphite, and benzoic acid added as additives to deceive consumers into calling jaggery as organic. In this research, the sonication technique treats sugarcane juice to ensure the safety and quality of jaggery with minimal processing. It improves the shelf life of jaggery by improving the homogeneity and cloud stability of sugarcane juice and can serve as a substitute for chemicals used in its preparation. Jaggery formed with this method was softer and more appealing to consumers and can be marketed as a safe and sound substitute for artificial sweeteners. Research results revealed that sonication was proven a significant alternative to the chemicals added to jaggery production. Samples were prepared solely from sugarcane juice without the addition of any chemicals, clarification agents, or frothing agents. Sonication treatment for 15 minutes showed the best TPC, TFC, and microbial analysis results. pH and color of jaggery were also improved with sonication treatment in three samples potassium metabisulphite was added to check its effect but sonication showed the best results without preservatives too. The research results show that sonication was more effective than heat treatment in reducing sugarcane juice's microbial count (total aerobic bacteria and yeast and mold) to zero. This indicates that sonication is a more efficient method for microbial control in jaggery production.

Keywords: Sugarcane, Jaggery, Sonication, TPC, TFC

Earliest Detection of Diabetic Retinopathy to Prevent Blindness Using Deep Learning

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Diabetic retinopathy (DR) is a major global cause of vision loss and requires efficient and accurate methods for its early detection and treatment. The present study aims to develop an improved deep learning framework for detecting and classifying DR using convolutional neural networks (CNNs) along with transfer learning. Current diagnostic methods, either manual or automated, have limitations in terms of detecting early-stage DR, data variability, and class imbalance. To overcome these challenges, this research suggests a novel approach that combines deep CNN architectures like DenseNet and ResNet with advanced data augmentation and attention mechanisms to enhance sensitivity and accuracy. The approach includes retinal image collection and preprocessing from publicly available databases, such as APTOS, EyePACS, and MESSIDOR, and training and validation of deep learning models. The most important performance indicators, such as, sensitivity, accuracy, F1-score, and specificity are used to assess the effectiveness of the proposed system. The ResNet structure achieves an accuracy rate of 98%, hence emphasizing its performance in diabetic retinopathy classification. A comparative study with top-of-the-line models explains the scalability and soundness of such an approach, especially in cases of early-diabetic retinopathy detection as well as variability in datasets being used. Results show a huge improvement

in accuracy of detection as well as credibility, with the model showing appreciable performance using a variety of datasets. The combination of transfer learning with attention mechanisms guarantees the system's flexibility to actual clinical settings, making it a suitable candidate for the deployment of large-scale diabetic retinopathy screening programs. The impact of this research on the field of medical imaging is significant, as it fills crucial gaps in automated diabetic retinopathy detection, ultimately leading to better patient outcomes and a decrease in the burden of diabetic complications on the healthcare system.

The Role of Artificial Intelligence in Medical Laboratory Sciences

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Artificial intelligence (AI) revolutionizes medical laboratory sciences by improving diagnosis accuracy, optimizing workflow, and supporting medical professionals' decision-making. AI-powered image analysis and pattern recognition make it possible to quickly and accurately identify anomalies in medical images, including tissue samples and blood smears. Furthermore, AI reduces human error and manual labor by automating data analysis. Additionally, AI-driven automation simplifies laboratory processes by handling repetitive jobs, freeing up medical personnel to concentrate on intricate procedures. AI is also essential for increasing diagnostic precision since it can detect differences in test data and minimize mistakes. Regarding patient safety, AI can identify possible hazards like drug mistakes and allergic responses, notifying medical personnel to act promptly. AI and genomics have been combined to create personalized medicine, which allows for customized treatment regimens based on each patient's unique genetic profile. Notwithstanding its many benefits, obstacles like problems with data quality, legal worries, and the requirement for ongoing validation prevent AI from being widely used in medical labs. Future developments in laboratory sciences could be greatly aided by AI, leading to improved patient outcomes, novel diagnostic techniques, and increased operational efficacy. As research and technology advance, AI is expected to become increasingly important in medical labs, transforming precision medicine and healthcare in the process.

Keywords: Artificial Intelligence, Medical Laboratory, Automation, Diagnosis

Fabrication of Cerium Oxide Nano sheets for the Colorimetric Sensing of Hydrogen Peroxide

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In living organism, hydrogen peroxide produced as a byproduct during oxidative metabolism reaction. The abnormal level of hydrogen peroxide can cause various diseases like cancer, diabetics, and cell damaging. The diagnosis of hydrogen peroxide is very necessary within human bodies. For determination of H_2O_2 , simple, less expensive, and fast method want to be developed. Cerium oxide nano sheets have been utilized to evaluate the peroxides' like enzymatic action for the colorimetric sensing of hydrogen peroxide. CeO_2 NSs was fabricated by parallel flow precipitation method and

characterized by SEM, XRD, FTIR, and EDX analytical techniques. H₂O₂ sensing was performed by using of cerium oxide NSs with help of TMB solution and UV-Visible technique were used to examine the results. The optimum colorimetric response various parameter have been use including, effect of Time, pH effect, loading of NSs, and TMB concentration effect. The suggested sensor best work at 9 mM TMB, pH 5.2 mg of NSs and 1.5 minutes incubation time period at room temperature. The linear range of suggested sensor is 5-40 μ L with an R² value 0.9974 and LOD 1.7×10^{-6} and LOQ 5.2×10^{-6} . The suggested sensor give high selectivity and sensitivity and was used for the H₂O₂ detection in diabetic patients of blood serum sample.

Magneto hydrodynamic and Thermal Stratification Impacts on Williamson Nano fluid Flow over a Porous Surface with Bio-Convection and Activation Energy

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Stratification significantly affects how the fluid operates by impacting its stability, mixing capabilities, and heat transfer properties. This phenomenon is crucial across various disciplines such as oceanography, atmospheric science, industrial applications, and environmental engineering. This study investigates the magneto hydrodynamic behavior and thermal characteristics of Williamson Nano fluid flow across porous sheets considering double stratification, suction/injection processes, bio-convection phenomena, activation energy aspects, and thermal radiation. The novelty of this study lies in its comprehensive integration of multiple complex phenomena influencing the behavior of Williamson Nano fluids under MHD conditions. The governing equations are simplified into an ordinary differential equation system (ODEs) by applying similarity transformations; the BVP4C method is used to solve the ODEs, effectively capturing the intricate interactions between MHD forces, temperature stratification, and microorganism dynamics. Important results reveal that the magnetic field induces Lorentz forces, reducing fluid velocity. Thermal stratification enhances heat transfer, which is essential for precision thermal management, while bioconvection optimizes microorganism distribution, benefiting biotechnological applications like nutrient cycling and bioreactors. Activation energy and thermophoresis parameters enhance the concentration profile. Williamson parameter enhances the skin friction, and the motile density profile decreases with the enhancement of Lewis number.

Caffeine and Migraine: A Complex Relationship

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Caffeine, a widely consumed stimulant, has a complex and paradoxical relationship with migraines. While it is often used to relieve migraines due to its analgesic-enhancing properties, it can also act as a trigger for migraines in certain conditions. This study explores the dual role of caffeine in migraine management, examining its physiological effects, the factors influencing its efficacy, and its role as both a remedy and a trigger. A comprehensive literature review highlights the mechanisms of caffeine's impact on migraines, including its effect on adenosine receptors, blood flow regulation, and dependency-related withdrawal. The research synthesizes findings on caffeine's therapeutic potential, its risks of overuse, and its demographic variability among migraine

sufferers. Recommendations for moderate caffeine intake, personalized treatment plans, and public awareness initiatives are discussed, alongside the need for further research into its long-term effects. This study aims to provide insights for healthcare providers and patients to make informed decisions regarding caffeine use in migraine management.

Harnessing Soybean Diversity: Evaluating Introduced Genotypes for Sustainable Yield in Pakistan

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Food security is an increasing issue amid climate change, especially in the developing countries. Soybean (*Glycine max* L), with high protein and edible oil content, has high potential but is underutilized in Pakistan due to the lack of diverse, locally adapted genotypes. Its incorporation into current cropping systems has the potential to enhance sustainability and resilience. This research assessed 15 exotic genotypes of soybean for their genetic potential under the agro-climatic conditions of Okara, in the research field of University of Agriculture Faisalabad Constituent College Okara, Pakistan under a Randomized Complete Block Design with three replicates. Eight morphological traits of data were collected viz, Number of primary branches per plant, plant height (cm), Number of pods per plant, Number of seeds per pod, Number of leaflets, Pubescence, Leaf pubescence, and Leaf pubescence density. Statistical analysis revealed significant genetic variation in plant height ($p=0.0004$), whereas other traits showed non-significant differences. Principal component analysis (PCA) revealed plant height and pod per plant as key contributors to the variance. Cluster analysis divided the genotypes into three cluster groups, of which cluster II (genotypes 7, 8, 9, and 15) had more plant height and pod numbers that indicate their higher yield potential. Primary branches and seeds per pod exhibit poor correlations, reflecting the intricacy of yield-related interactions. The findings suggested that genotypes 8 and 9 hold promise for future breeding programs focused on improved productivity.

Keywords: Soybean, Genotypic Variation, Yield Traits, Principal Component Analysis, Cluster Analysis.

Genotypic Exploration of Brassica Campestris L.: Morphological, Biochemical, And Physiological Variations

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Brassica campestris L. or desi sarson is one of the significant crops famous for its oil-rich seeds and nutritious leaves. This study aimed to explore the unique morphological and biochemical profiles of *Brassica campestris* L. accessions, evaluate their variability, and analyze trait associations under the agro-climatic conditions of Okara. Additionally, the

abiotic stress response of selected accessions was assessed. Eighty genotypes, obtained from the gene bank at the National Agricultural Research Center, were grown in an augmented block design. Standard field practices were employed to raise crop and record data on various morphological traits i.e. days to flowering, days to maturity, plant height, number of pods per main raceme, silique length, primary branches per plant, number of seeds per silique, main raceme length and 100 seed weight. Moreover, oil content, oleic acid, linoleic acid, linolenic acid, erucic acid and glucosinolates% were quantified. This study aimed to identify significant morphological and biochemical variations among *Brassica campestris* L. accessions, emphasizing elite genotypes with traits such as early maturity, high oil content, low erucic acid, superior grain yield, and resistance to abiotic stress. The statistical analysis is underway. The findings will contribute significantly to future breeding programs focused on developing *B. campestris* L. cultivars with improved resilience to environmental stresses and enhanced food security.

Keywords: Brassica, genetic variability, abiotic stress, food security

Estimation of Trait Association among Yield Contributing Traits in Tomato (*Solanum Lycopersicum* L.)

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Tomato (*Solanum Lycopersicum* L.) belongs to Solanaceae family and genus *Solanum*, possessing the chromosome $2x-2n=24$. All over the world, tomatoes are grown for a variety of purposes. The second-largest crop of vegetables is tomatoes, after potatoes. Yield component has been choosing for tomato crop assessment. In the current investigation, thirteen genotypes of tomato with the best breeding potential will be chosen. Analysis of variance revealed that highly significant difference among all traits except time to 50% flowering and No. of locules. Phenotypic coefficient of variation is higher than the genotypic coefficient of variation for all the traits under investigation. Time to 50% flowering had positive correlation with No. of flower at each plant, number of flower cluster/plant, fruit/truss, and diameter of fruit, size of pericarp thickness, No. of locules, plant height and No. of fruit at each plant. Number of clusters of flower/plant had positive correlation with fruit/truss, fruit initiation and No. of fruit. Fruit/truss had positive correlation with fruit initiation, No. of fruit, No. of fruit and height of plant. Diameter of fruit had positive correlation with fruit size, size of pericarp and fruit weight. Fruit size had positive correlation with size of pericarp and fruit weight. Size of pericarp had positive correlation with fruit weight. Fruit weight had negative correlation with fruit initiation and no. of fruit at each plant. Number of locules had negative correlation with first picking time. Fruit initiation had positive correlation with No. of fruit at each plant. Number of fruits at each plant had negative correlation with first picking time and yield per plant. First picking time had negative correlation with yield. Results depicted that the tomato genotype TM- 13221 best for fruit weight, fruit length and fruit diameter, TM-12521 and TM-2301 best for yield per plant. So, TM-13221, TM- 12521 and TM-2301 can be used in breeding program for improvement of fruit characters.

Key Words: Tomato, Yield, Trait Association, Genotypes, Breeding

Genetic Variability and Character Association Studies for Grain Yield in Maize (Zea Mays L.)

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Maize crop ranks 3rd after wheat and rice. It's a cereal grain not only for human consumption, livestock feed, and silage but also as a considerable source of many fundamental vitamins and minerals, along with high-value proteins. Some of the important objectives of the present research study are to find out genetic variation in the maize accessions and find out the association of other traits with yield. Evaluation of the genotypes was performed based on the RCBD model with three replications. The number of plant attributes recorded were 13, including days to germination, plant height, days to 50% tasseling, days to 50% silking, tassel length, ear length, ear diameter, ear height, rows per ear, kernels per row, 100-grain weight, and grain yield per plant. The ANOVA results indicated that there was a substantial and highly significant variation in the traits observed among the different genotypes studied. The tests for mean comparison by Tukey's HSD Test were also found significant. R software was used for the calculation of phenotypic and genotypic correlation. For most of the studied traits, except for days to germination and days to 50% silking, the association was positive with grain yield. Principal Component Analysis was subjected to two sets of variables in the same manner. From the observation, it had been found that the two major components obtained explained 37.5% and 18.5% of the total variance. The genotypic as well as phenotypic correlations among the characters, viz. ear-length, ear-diameter and rows per cob, were significantly high and positive. Such relationships suggest that, with time, breeders could utilize these traits for yield improvement through future breeding programs.

Keywords: Maize, Grain Yield, Genetic diversity, Genotypes, Breeding

Enhancing wheat (Triticum aestivum L.) Resilience to salt stress, through foliar application of silicon-dioxide nanoparticles

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Nanotechnology is an emerging field of science. In agriculture, nanoparticles can be used to mitigate the effects of biotic and abiotic stresses in plants and improve their productivity. Silicon dioxide nanoparticles are getting more attention because of their ability to cope with abiotic stress and eco-friendly nature. This study was carried out to check the effects of silicon-dioxide nanoparticles on different wheat (Triticum aestivum L.) varieties under salt stress. Three levels of nanoparticles (0, 50 and 100 mg/L) were applied foliarly when plants were subjected to control and 150 mM NaCl. Under stress condition reduction in biomass (root/shoot fresh and dry weight, root and shoot length, leaf area) and yield was observed in all varieties of wheat, but with the application of silicon-dioxide nanoparticles remarkable increase in plant morpho-physiological attributes was witnessed. Enhanced activities of antioxidant enzyme (SOD, POD), more soluble sugars/proteins, less oxidants

(MDA and H₂O₂), more anthocyanin and flavonoids, increased photosynthetic pigments was appeared by the foliar treatment of silicon-dioxide nanoparticles when plants were facing saline conditions. Due to salt stress mineral ion concentration get disturbed, more sodium ion (Na⁺) and less calcium and potassium ions (Ca²⁺, K⁺) accumulation in roots and leaves of plants was observed, but silicon-dioxide nanoparticles caused decline in root and leaf sodium ion, furthermore, increased calcium and potassium ions were found in plant under stress condition as compare to control.

Keywords: Nanotechnology, Wheat, Salt stress, Silicon-dioxide nanoparticles, Antioxidants

To exploring the potential role of exogenously applied glycine betaine as foliar spray in raya [Brassica juncea (L.) Czern] under saline conditions

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Salinity stress is a significant environmental constraint that negatively affects raya [Brassica juncea (L.) Czern] worldwide. The use of osmoprotectants as foliar treatments to enhance salinity tolerance in plants has been widely studied. This experiment aimed to investigate the effect of glycine betaine (GB) on raya under salinity stress conditions at the Old Botanical Garden, University of Agriculture, Faisalabad. Two hybrids of Raya (H1=40S42 and H2=3024) were grown in pots filled with sand and subjected to two salinity levels (control and 100 mM NaCl). Foliar treatments of glycine betaine (control: distilled water and 10 mM GB) were applied. Salinity stress significantly reduced shoot fresh and dry weight, shoot length, number of siliquae per plant and number of seeds per siliquae. However, the application of glycine betaine significantly enhanced these growth parameters under salinity stress. Additionally, glycine betaine increased chlorophyll content and the activities of antioxidants such as POD and SOD under salinity stress, while reducing the concentrations of reactive oxygen species like H₂O₂ and MDA, thus mitigating the negative impacts of salinity. Organic osmolytes such as total free proline, total free amino acids, endogenous glycine betaine, anthocyanins, total soluble sugars (TSS) and flavonoids were markedly improved with glycine betaine treatment under salinity stress. Moreover, glycine betaine decreased shoot Na⁺ concentrations while significantly increasing shoot K⁺ and Ca²⁺ levels under salinity stress. These findings indicate that the application of glycine betaine effectively mitigates the detrimental impacts of salinity stress on raya.

Keywords: Glycine betaine, Raya, Salinity, Organic osmolytes, Foliar treatments

The response of foliar application of indole-3-acetic acid (IAA) on spinach (Spinacia oleracea L.) under drought stress conditions

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Spinach (*Spinacia oleracea* L.) is a versatile leafy plant, abundant in crucial vitamins, minerals and antioxidants making it a staple in healthy diets. It is valued for its ability to enhance overall well-being and its flexibility in culinary uses. Spinach thrives in cool climates with well-drained soil and regular moisture. However, drought stress can severely impact its growth by reducing water and nutrient availability leading to wilting smaller leaves and stunted growth. A pot experiment at the Old Botanical Garden, University of Agriculture, Faisalabad studied impact of indole-3-acetic acid (IAA) on spinach under drought stress. Two spinach varieties (Desi and Lahori Palak) were planted in 8 kg soil pots. Drought conditions were set at 50% and 100% field capacity with indole-3-acetic acid (IAA) treatments of 0 (Control), 50 and 100 mg L⁻¹. Findings indicate that drought stress notably decreased the fresh and dry weight of both shoot and root, shoot length and plant height but did not affect root dry weight and length. Chlorophyll a and carotenoid content decreased under drought stress while chlorophyll b and total chlorophyll content increased. Additionally, antioxidants like SOD and POD also decreased under drought conditions. However, IAA application improved these attributes, the accumulation of osmolytes (TSS, TSP, anthocyanins and flavonoids) and increased antioxidant activity in both control and drought-stressed plants. Drought stress increased leaf Na⁺ levels without affecting leaf K⁺ and Ca²⁺ ions. The treatment of IAA maintained K⁺ and Na⁺ levels and significantly improved Ca²⁺ levels in both plant parts. The Desi variety was more drought tolerant than the Lahori variety and IAA application helped reduced the negative consequences of drought stress.

Keywords: Spinach, Indole-3-acetic acid, Drought, IAA, Lahori Palak, Field Capacity

Role of foliarly applied methionine in pea (*Pisum sativum* L.) under chromium stress

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An experiment was performed to explore the role of foliarly applied methionine in pea (*Pisum sativum* L.) under chromium stress. Two varieties of pea (Pea 09 and Meteor) were obtained from the Ayyub Agriculture Research Institute. The experiment took place in the Old Botanical Garden at the University of Agriculture, Faisalabad. The seeds were grown in plastic pots filled with soil, and each pot was sown with 10 seeds. After 25 days, a careful thinning process limited each pot to six plants with a uniform distance between each plant. Stress was initiated after 35 days of germination, followed by chemical application the next day. Three levels of chromium stress were applied (0, 100 and 200 µM). Methionine was introduced at concentrations of 0 and 150 mg/L through foliar spray and simple foliar application of distilled water was also done. The harvesting was carried out after two weeks of application and various parameters were measured. Following the harvest, data were compiled for morphological, physiological, chemical, yield attributes and a comprehensive statistical analysis of the gathered attributes was done using. Chromium stress decreased shoot fresh weight and root fresh weight, while exogenously applied methionine also decreased shoot fresh weight. Foliar spray of methionine

enhanced the shoot length and chlorophyll a content. Chromium stress did not significantly change photosynthetic pigments overall. Chromium toxicity did not affect antioxidant enzymes (SOD and POD), but it increased malondialdehyde, flavonoids and total soluble sugars. Nutrient analysis revealed trivial changes in leaf Na⁺, Ca²⁺ and K⁺, but increased in root Na⁺ and decreased in K⁺. Foliarly applied methionine also increased the K⁺ in meteor. Chromium decreased seeds weight but there was not any effect on seeds per plant and 100 seeds weight. In conclusion, foliar methionine spray showed limited significant effects, while chromium stress had visible impacts. At 200 µM Meteor showed superior performance compared to Pea 09 under Cr stress along with foliar spray of methionine. This experiment enhances our understanding of chromium's role and plant tolerance to this toxic heavy metal stress by methionine application.

Keywords: Pea, Chromium stress, Methionine, Meteor, Photosynthetic pigments

The ameliorative effect of thiourea (TU) against cadmium stress in garlic (*Allium sativum* L.)

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An experiment was conducted in Old Botanical Garden, University of Agriculture Faisalabad to examine the effect of foliar spray of thiourea on *Allium sativum* L. under cadmium stress. Cloves of two varieties, "Desi" and "Chinese" of *A. sativum* were collected from Ayyub Agricultural Research Institute, Faisalabad. A total of 36 pots were used for the experiment. Every pot was filled with 6.5 kg of soil. Cloves were sown by the surface sowing method. In 18 pots, 6 cloves per pot of Desi garlic were sown and in another half 18 pots had the cloves of Chinese variety, 6 cloves in each pot similarly. Irrigation was done normally until the growth of garlic. Pots were arranged according to a completely randomized design (CRD). After 30 days of sowing cadmium stress (0 and 20 mg/kg) was maintained and then the foliar spray of thiourea having three levels (0, 5 and 10 mM) was applied on the plant. Harvesting was done after 15 days of thiourea spray for the observation of various parameters such as biochemical, morphological, physiological and yield parameters i.e. clove diameter and clove weight. This research indicated that the impacts of cadmium result showed significant decrease in growth, enzymatic antioxidants, ions and metabolic variables. Thiourea treatment was beneficial in mitigating the impact of cadmium stress and plants acquired stress tolerance. Thiourea treatment significantly increased root fresh weight, dry weight, and length. Chlorophyll levels remained largely unaffected. The activity of antioxidant enzymes SOD and POD increased by thiourea application in cadmium-stressed plants. Furthermore, hydrogen peroxide and MDA contents were decreased by thiourea supplementation. Sodium ions decreased in both garlic varieties by thiourea application. Mineral ions like calcium and potassium and total soluble sugars were not significantly altered by cadmium or thiourea supplementation. Thiourea-treated plants showed higher levels of antioxidant enzymes, SOD and POD, suggesting improved stress tolerance and antioxidant capacity.

Keywords: Garlic, Cadmium stress, Thiourea, Desi, Chinese, Stress tolerance

Application of methionine as foliar spray on pea (*Pisum sativum* L.) under salt stress

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To analyze the efficiency of methionine on structural parameters of pea plant under salt stress. Research trial was conducted in Old Botanical Garden university of Agriculture Faisalabad. Seeds of two varieties Meteor and Pea 09 of pea were collected from Ayyub Agriculture Research Institute Faisalabad. Thirty-six pots were filled with sand and pre watering was executed to the filled pots. After that seeds of two varieties were sown as eighteen pots were filled first variety (Meteor) and other eighteen pots were filled with second variety (Pea 09). Hoagland's nutrient solution was added after every 10 days. Salinity levels (0 mM and 120 mM) were imposed. Similarly, three levels of methionine (0 mg/L, 100 mg/L and 200 mg/L) were applied. When the seedlings of pea were 38 days old first treatment of salinity and methionine were applied. Factorial structured treatments with three replications were used. Salt stress did not significantly affect root and shoot fresh and dry weight, shoot and root length in pea plants, but foliar application of methionine increased these parameters. Chlorophyll a, total chlorophyll and chlorophyll a/b content were unaffected by salt stress, while chlorophyll b and carotenoids showed slight increases. Antioxidant enzymes SOD increased and POD decreased with methionine spray, while TSP, TSS, MDA, H₂O₂, flavonoids and anthocyanin showed varied responses under saline conditions and after methionine application. Ion levels (Na⁺, K⁺ and Ca²⁺) in leaves, shoots, and roots generally exhibited non-significant changes under both conditions, except for K⁺ which increased under saline conditions. Seed metrics showed decreased number of seeds per plant and total seed weight under salt stress, with 100 seed weight increasing; methionine application led to an increased number of seeds per plant but no significant changes in total seed weight or 100 seed weight.

Keywords: Pea, Salinity stress, Methionine, Meteor, TSS, SOD

Alleviation of adverse effect of copper stress on spinach (*Spinacia oleracea* L.) by foliar application of melatonin and ascorbic acid

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Spinach is an herbaceous plant it contains manganese, magnesium, iron, potassium, manganese, B2, C and K vitamin, spinach is a significant source of micronutrients. Copper a dense metal or metalloid, is categorized as a heavy metal because of its potential for toxicity. Melatonin promotes plant patience to various challenges caused by stresses acting as an antioxidant. Ascorbic acid is a flexible and multifunctional substance that is crucial for regulating some aspects of plant biochemistry. Alleviation of adverse effects of copper stress on spinach (*Spinacea oleracea* L.) by foliar application of

melatonin and ascorbic acid, an experiment was conducted using of twenty four plastic pots at Old Botanical Garden at the University of Agriculture Faisalabad. Seeds of one variety called Lahori palak was obtained from the Ayyub Agricultural Research Institute, Faisalabad. Twenty four pots were filled with soil and each pot contained 8000 g soil in it. 15 seeds were planted in each pot. After 25 days of seedling establishment thinning was carried out leaving 9 plants per pot with equal spacing. After 40 days of sowing two levels of copper stress was applied (0 and 150 ppm). Next day foliar application of melatonin (0 and 10 μ M), ascorbic acid (250 ppm) and melatonin + ascorbic acid (0 and 10 μ M + 250 ppm) was imposed. Harvesting was done after two weeks of treatment application for the measurement of morphological, physiological and biochemical traits. The experiment was set up with a completely randomized design (CRD) with three replications. Copper stress decreased the shoot fresh weight, shoot dry weight, shoot length, plant height, leaf ions and hydrogen peroxide in spinach plant. The superoxide dismutase, root ion concentrations increased significantly in spinach it also increased the amount of malondialdehyde but peroxidase remained unchanged. Application of ascorbic acid and melatonin reduced the negative impact of copper stress in spinach and increased super oxide dismutase and root ions. Overall, the experiment indicated that copper stress caused reduction in various attributes of spinach. Individual and combined application of melatonin and ascorbic acid increased that attributes of spinach.

Keywords: Spinach, Copper stress, Ascorbic acid, Melatonin, Melondialdehyde, Hydrogen peroxide

Modulation in physiochemical attributes of sunflower (*Helianthus annuus* L.) through foliar application of thiourea under saline conditions

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Present research was conducted to check the response of salinity stress on two hybrids of sunflower FH-710 and FH-809 by foliar application of thiourea as growth regulator. To evaluate the potential role of thiourea on sunflower under salt stress, experiment was performed by Completely Randomized Design (CRD) having three replication in old botanical garden of University of Agriculture, Faisalabad. Two hybrids of sunflower FH-710 and FH-809 were imposed to two level of salinity (0 and 120 mM NaCl) and three level of thiourea (0, 50 mM and 100 mM) were applied to overcome the effect of salt stress. Harvesting was done after two weeks of foliar application of thiourea for the estimation of different parameters. Morphological (shoot fresh weight, root fresh weight, shoot dry weight, root dry weight, shoot length, root length and plant height) were declined under salt stress. Photosynthetic pigments (chlorophyll a, chl b, Total chl, carotenoids and Chl a/ b ratio) showed no changes under saline conditions. While biochemical attributes (SOD, POD, TSP, H₂O₂, malondialdehyde, TSS, anthocyanin and flavonoid) enhanced under saline conditions. Mineral ions of root and shoot Na⁺, K⁺ and Cl²⁺ were all declined under salt stress. Yield parameters (Capitulum weight, capitulum diameter, Achenes/capitulum, total achenes weight and 100 achenes weight) were declined under salt stress. Foliar applied thiourea enhanced shoot fresh weight, root fresh weight,

chlorophyll b, SOD, POD, TSS and flavonoids. While mineral ion of Na⁺, K⁺, Cl²⁺ showed no alter after foliar application of thiourea. Yield parameter (Capitulum weight, capitulum diameter, achenes/capitulum, total achenes weight and 100 achenes weight) were increased under foliar application of thiourea.

Keywords: Sunflower, Salinity stress, Thiourea, Biochemical attributes, Capitulum diameter

Genetic analysis of yield and yield-related traits in hexaploidy wheat (*Triticum aestivum* L.)

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Wheat, a significant cereal crop, plays a crucial role in providing ample nutritious calories for both animal and human consumption. The utilization of sophisticated techniques holds significant potential as a viable approach to enhance crop productivity. The comprehension of the associations between crop yield and specific traits indicates their significance in facilitating effective selection methods for enhancing overall crop productivity. The study was conducted at the University of Agriculture Faisalabad. In this study, a total of fifteen distinct genotypes (along with check variety) were assessed using a Randomized Complete Block Design (RCBD) methodology, with each genotype being replicated three times. Morphological traits were meticulously documented, and the assessment of genetic variation was conducted through the application of analysis of variance. Path analysis and correlation were conducted to examine the associations between various traits. Results revealed that some genotypes among these are high yielding (performing better than check variety). Correlation revealed that the number of tillers per meter square, peduncle length, plant height, spike length, number of grains per spike, number of spikelet's per spike, grain weight per spike and thousand grain weight correlated with grain yield per plant. While path analysis showed that plant height, spike length, number of grains per spike, grain weight per spike and thousand grain weight had a direct positive effect on grain yield per plant.

Keywords: Wheat yield, Genetic Variation, morphological trails, Yield component, Crop Improvement.

Evaluation of bacterial consortium on rock phosphate solubilization and its uptake by potato (*Solanum tuberosum* L.)

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The scarcity of plant available P in agricultural soils necessitates the application of P fertilizer to meet the demands of crops. However its low efficiency in alkaline soils remains a challenge. Phosphorus solubilizing bacteria (PSB) are known to have a substantial impact on increasing the availability of P in soil by breaking down mineral forms. The primary aim of this research endeavor was to assess the efficacy of a bacterial consortium in facilitating the solubilization of phosphorus from rock phosphate (RP), as well as enhancing the uptake of phosphorus. Conducted at the research farm of the University of Agriculture Faisalabad using Randomized Complete Block Design (RCBD) with twelve treatments, including different combinations of PSB, Rock Phosphate (RP), and

Diammonium Phosphate (DAP) fertilizers. The application of PSB in combination with 50% RP and 50% P from DAP (T10) exhibited the most favorable outcomes in terms of plant growth and crop yield. This treatment resulted in the highest fresh and dry weight of plants, indicating improved nutrient uptake and utilization and ultimately leading to enhanced plant biomass. The combination of PSB, RP, and DAP demonstrated a synergistic effect, resulting in optimal phosphorus availability for plant growth and development. This approach not only enhances phosphorus availability in the soil but also promotes plant growth and crop productivity. Moreover, the utilization of PSB as a bio fertilizer offers an eco-friendly and sustainable alternative to chemical fertilizers, thereby reducing environmental impacts.

Keywords: Phosphorus, Bacterial Consortium, Rock phosphate, Potato, Bio fertilizer

Investigation of Potential Zinc Solubilization of Rhizobacteria Isolated from Wheat (*Triticum aestivum* L.)

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Although zinc (Zn) is an essential element for plant growth, crop yield is frequently hampered by its inadequate availability in soil. The potential of zinc-solubilizing rhizobacteria that were isolated from the rhizosphere of the 2016 Borlaug variety of wheat (*Triticum aestivum* L.) is investigated in this work. Finding bacterial strains that may increase zinc bioavailability was the goal of the study, which was carried out at the Soil Biology Program, Land Resource Research Institute (LRRI), National Agricultural Research Center (NARC), Islamabad. In addition to being evaluated for other characteristics that promote plant growth, such as phosphate solubilization, nitrogen fixation, ammonia generation, and indole acetic acid (IAA) synthesis, the isolates were screened for their capacity to solubilize zinc. According to the findings, several bacterial strains demonstrated potent zinc-solubilizing properties in addition to advantageous characteristics that aid in plant growth. These results imply that rhizobacteria solubilize zinc. According to these results, rhizobacteria that solubilize zinc may be a viable and environmentally benign substitute for synthetic fertilizers, leading to higher wheat yields. To learn more about their mechanisms and wider agricultural potential, future studies should concentrate on field applications and molecular characterization.

Keywords: biofertilizers, plant growth promotion, wheat

Chiral Carbon Dots: Synthesis, Properties, and Emerging Applications in Sensing, Bio imaging, and Catalysis

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Chiral carbon dots (CCDs) are a novel luminescent zero-dimensional carbon-based nanomaterial with chirality. They not only have the advantages of good biocompatibility, multi-color-emission, easy functionalization, but also exhibits highly symmetrical chiral optical characteristics, which broadens their applicability to enantioselectivity of some chiral amino acids like cysteine and lysine, asymmetric catalysis as well as biomedicine in gene expression and antibiotics. In the main part of this review we focus on chiral carbon dots, introducing their fabrication techniques such as bottom-up and top-down chemical syntheses, their morphology, and optical/chiroptical properties. Furthermore, we address the prevailing challenges and propose future research directions pertaining to CCD development, thereby advocating for more profound explorations. With the aspiration of fostering collaborative endeavors across diverse disciplines, we aim to invigorate investigations into the controllable and precise synthesis of CCDs, ultimately propelling the advancement of CCD-based applications. We are emerging applications of chiral carbon dots in sensing, bio imaging, and catalysis, and conclude this review with a summary and future challenges.

Keywords: Chiral Carbon Dots, synthesis, carbon dots, Bio imaging, Sensing

Functionalized Single-Layer Graphene for High-Performance Supercapacitors

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High-performance supercapacitors, which are receiving a lot of interest as cutting-edge electrochemical energy storage devices, now use single-layer graphene (SLG) as a common electrode material. Due to its exceptional qualities, which include high energy/power density, excellent series stability, and fast charge/discharge rates, these supercapacitors are well-suited for various applications. They offer benefits including high power output, extended lifespan, a wide working temperature range, lightweight, flexible design, and low maintenance requirements. They can be used alone or in conjunction with batteries or fuel cells. High-quality functionalized SLG for commercial supercapacitor applications can now be produced on a large scale because of recent developments in synthesis processes such as chemical vapor deposition, electrochemical exfoliation, and chemical functionalization. Numerous functionalization techniques, such as heteroatom doping, defect engineering, heterostructure synthesis, and pore construction, have been investigated to address present issues and improve charge storage capacity and efficiency. Supercapacitors still have a lot of obstacles to overcome, though, like low energy density and a high cost-to-performance ratio, which have prevented them from being widely used in a variety of industries. To overcome the current constraints, future research efforts should create novel strategies to increase energy density, lower prices, and improve the stability and durability of graphene-based electrodes.

Keywords: single-layer graphene, supercapacitors, synthesis, application

Interactive Learning in STEM: Graphical Analysis of Radioactive Phenomena Using Spreadsheet

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The graphs of various physical phenomena can help us understand their unique behavior. One of the phenomena is radioactive decay and radioactive equilibrium. Manually plotting their graphs could be cumbersome work, and users or learners do not have the freedom to change a parameter and see the behavior for many conditions due to time consumption. The presented study combines the theoretical equations with graphical representations for better learning, as well as demonstrates the commonly available software packages, such as spreadsheets, to make such simulations that improve understanding in science, technology, engineering, and mathematics (STEM) education. In an interactive environment, the learner can change various parameters on spreadsheets used to create graphs of radioactive decay and radioactive equilibrium phenomena. With such an interactive learning approach, different comparisons could be visualized and changes in the behaviour of graphs could be studied easily. Also, the instructor and learners could visualize different radioactive decay and radioactive equilibrium that may be compared with manual charts as well. Simulation-based learning is an effective method for educating students about radioactive phenomena. This approach enables a more interactive learning experience and reduces the burden of manual plotting. Such simulations could be made on spreadsheets due to their user-friendly nature and available tools. Instructors can use these simulations to illustrate radioactive-related phenomena and enhance students' understanding. The study provides a valuable tool for both teaching and learning and through such simulations, complex concepts are more accessible and easier to understand.

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 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, 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.

Keywords: Shelf Life, Marketing, Pollination, Integrated Strategies, Farmer's Education

Synthesis and Characterization of Zinc Oxide Decorated Graphene Oxide Composites for Photocatalytic Degradation of Congo red

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The addition of dyes to the environment especially in aqueous environment alarming a potential threat to human and aquatic life. Because these dyes are toxic, hazardous and poisonous to living organisms causing various health issues including skin irritation, respiratory problems and even can cause cancer in severe cases. These dyes are releasing from different industries like paper industry, textile mills and printing industries etc. As most of the dyes are resistant to biodegradation and its persistence in land and soil make it a concerned issue for human health. Therefore there is an urgent need to develop sustainable and ecofriendly method for dye removal, so we report a simple and affordable way to synthesize Graphene oxide –zinc oxide (GO-ZnO) composites and use it as photo catalyst for the photocatalytic degradation of Congo red dye, one of the most poisonous dye. The zinc oxide was prepared by green synthesis using Melia Azedarach plant extract and zinc acetate as zinc source while graphene oxide was prepared by modified tours method. GO-ZnO were prepared by the addition of synthesized ZnO and GO in different ratios and ultra-sonicating it. Their characteristics were analyzed using Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD), Fourier-transformed Infrared (FTIR) spectroscopy and UV Visible spectrophotometer. The GO has high surface area and ZnO has high catalytic properties so this synergic property results in great degradation efficiency of GO-ZnO against Congo red dye. This study involve an eco-friendly approach for the synthesis of GO-ZnO composites and their application in degradation of dye.

Keywords: Water pollution, Characterization; ZnO-GO; Composites; Dyes Degradation

Comparison of different processing techniques on the quality and stability of Whey-based Strawberry juice

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The dairy industry faces a significant challenge in managing the large volumes of whey generated as a by-product. Despite its high nutritional value and health benefits, whey is often underutilized. Whey-based beverages present a promising alternative to traditional drinks, but microbial safety remains a major concern. This study evaluates the effects of different processing techniques—thermal treatment (T1:80°C for 10 min) and ultra-sonication (T2:5 min at 25 kHz, T3: 10 min at 25 kHz)—on the shelf life, stability, and quality of whey-based strawberry juice. A control sample (T0) was used for comparison. Physicochemical, phytochemical, sensory, and microbial analyses were conducted over

28 days of refrigerated storage. Results showed that ultra-sonication for 10 min (T3) significantly enhanced sensory attributes, including taste, color, and overall acceptability. The interaction between whey components and strawberry juice influenced product stability, with T 3 exhibiting the lowest sedimentation rate. A decline in pH was observed across all treatments during storage, while T3 retained the highest Brix value. DPPH analysis indicated that T 3 had the highest antioxidant activity. Bioactive compounds, including total phenolic content (TPC) and total flavonoid content (TFC), increased with ultra-sonication but gradually declined during storage. Microbial analysis confirmed that T3 achieved the greatest reduction in bacterial count, ensuring better safety, with minimal microbial growth observed. Overall, ultra-sonication (T3) proved to be the most effective technique for enhancing microbial safety, quality, and stability in whey-based strawberry juice, making it a viable approach for waste utilization and functional beverage development.

Keywords: Whey based Strawberry juice, Waste management, Health benefit, Thermal Treatment, Ultra sonication, Microbial Safety, Bioactive compounds

Unlocking the Health Benefits of Fruit Derived Enzymes

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Fruits possess a wide range of remarkable enzymes that contribute to optimal health. The enzymatic content in fruits aids in efficient digestion, nutrient absorption, and overall digestive health. Furthermore, these enzymes exhibit antioxidant effects, protecting against chronic diseases. Specialized enzymes found in specific fruits offer unique benefits, such as anti-inflammatory and immune-modulating effects. By incorporating enzyme-rich fruits into our diet, we can promote efficient digestion, reduce inflammation, enhance antioxidant defenses, and ultimately improve our overall health and vitality. This comprehensive review underscores the paramount importance of fruit enzymes as a pathway to achieve and maintain optimal health. However, given the vast variety of fruits available and the challenges associated with identifying them based solely on their enzymatic content, this review focuses on highlighting fruits according to their specific enzymatic profiles. Understanding the significance of fruit enzymes in promoting well-being empowers individuals to make informed dietary choices that optimize their health and vitality.

Keywords: Fruits enzymatic profiles, Clinical effects, Body immune and defense system, Vitality, Dietary choices and well-being.

Air Frying Technology as a Healthier Alternative to Deep Frying with Reduced Toxic Compounds and Enhanced Nutritional Benefits

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This review explores the impact of air frying technology on human health, emphasizing its potential to reduce total fat content and mitigate the formation of harmful compounds compared to traditional deep frying. Conventional deep frying exposes food to high temperatures and prolonged contact with oil, leading to the formation of toxic compounds such as heterocyclic amines (HCAs), polycyclic aromatic hydrocarbons (PAHs), advanced glycation end products (AGEs), and acrylamide. These compounds are associated with increased risks of cancer, cardiovascular diseases, and metabolic disorders. Additionally, deep frying depletes essential nutrients, including vitamins and minerals, thereby reducing the overall nutritional value of food. The repeated use of frying oil further exacerbates health concerns by increasing levels of oxidized lipids and Trans fats, which contribute to inflammation, obesity, and chronic illnesses. In contrast, air frying utilizes rapid air circulation to cook food with minimal or no oil, significantly reducing calorie intake while preserving texture and flavor. Studies suggest that air frying lowers the formation of toxic compounds, making it a safer alternative to deep frying. Moreover, it presents an economical and sustainable cooking option by reducing oil consumption and waste. However, further research is needed to fully understand the long-term health effects of air-fried foods and to optimize cooking parameters for maximum nutritional benefits.

Keywords: Air frying, Heterocyclic Amines, Polycyclic Aromatic Hydrocarbons, Acrylamide, Trans fats, Cardiovascular diseases, Nutritional benefits, Oxidized lipids

Mycotoxin Contamination in Spices as a Growing Food Safety Concern in Developing Countries with a Focus on Pakistan

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Spices are an integral part of culinary practices worldwide, especially in developing countries like Pakistan, where they are used extensively not only to enhance flavor but also for their perceived medicinal properties. However, the widespread and often unregulated use of spices raises significant food safety concerns due to potential contamination with mycotoxins—secondary metabolites produced by fungi such as *Aspergillus*, *Penicillium*, and *Fusarium* species. These toxic compounds, including aflatoxins, ochratoxins, fumonisins, and zearalenone, can contaminate spices at various stages of production, processing, and storage, particularly under the hot and humid conditions prevalent in many low-income regions. Chronic exposure to mycotoxins has been associated with serious health risks, including hepatotoxicity, nephrotoxicity, immunosuppression, and carcinogenicity, posing a significant public health threat in populations with high spice consumption and limited regulatory oversight. This review aims to highlight the prevalence, types, and health impacts of mycotoxins in commonly used spices, with a special focus on the challenges faced by developing countries like Pakistan. It also discusses current detection methods, regulatory standards, and mitigation strategies to ensure spice safety and reduce mycotoxin-related health risks in vulnerable populations.

Keywords: Mycotoxins, Spices, Aflatoxins, Food safety, Developing countries, Fungal contamination, Post-harvest practices, Spice regulation

Solar Drying as a Sustainable Post-Harvest Solution for Resource-Limited Settings in Developing Countries

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Solar drying is increasingly recognized as a sustainable, low-cost, and environmentally friendly method for preserving agricultural commodities, particularly in regions with high solar radiation and limited access to conventional energy resources. In many developing countries, high post-harvest losses, energy constraints, and inadequate infrastructure significantly hinder food security and agricultural profitability. Solar drying offers a practical and accessible solution by utilizing abundant solar energy to extend the shelf life of perishable products such as fruits, vegetables, herbs, and grains. This review explores the types of solar drying technologies, their applications, and their benefits for smallholder farmers in resource-constrained settings. Emphasis is placed on the suitability of solar drying in hot and humid climates, where traditional drying methods often compromise product quality and safety. The article also examines key barriers to adoption—including lack of awareness, technological limitations, and policy gaps—and proposes strategies to promote solar drying as an integral part of post-harvest management in developing regions. By leveraging solar energy, countries with limited resources can enhance food preservation, reduce waste, and support rural livelihoods in a sustainable manner.

Keywords: Solar drying, Post-harvest losses, Sustainable agriculture, Food preservation, Renewable energy, Low-cost technology, Climate-smart agriculture

Application of Nanotechnology for Quality Assessment and Safety Evaluation of Dried Food Products

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Nanotechnology has emerged as a powerful tool in the food industry, offering innovative solutions for quality assessment and safety monitoring of dried food products. Ensuring the nutritional integrity, microbial safety, and overall quality of dried foods is crucial, especially given their widespread consumption and economic significance in global markets. Traditional testing methods, though effective, often require extensive sample preparation, are time-consuming, and may lack real-time monitoring capabilities. In contrast, nanotechnology-based approaches—such as nanosensors, nano-biosensors, and smart packaging—enable rapid, non-destructive, and highly sensitive detection of key quality parameters, including moisture content, microbial contamination, oxidation, and nutrient degradation. These technologies utilize functional nanomaterials such as gold nanoparticles, carbon nanotubes, and quantum dots to achieve enhanced analytical performance. This review highlights recent advances in the application of nanotechnology

for the quality evaluation of dried fruits, vegetables, herbs, and spices, with particular emphasis on its potential to ensure food safety and support regulatory compliance. The integration of nanotechnology into dried food quality control not only enhances consumer confidence but also contributes to the development of smart, traceable, and sustainable food systems. Challenges related to cost, regulatory approval, and implementation in resource-limited settings are also discussed to provide a comprehensive overview of the field.

Keywords: Nanotechnology, Dried food quality, Nanosensors, Moisture detection, Smart packaging, Non-destructive testing, Food preservation, Microbial contamination, Functional nanomaterials

Valorization of Nutrient-Rich Fruit Peels as Functional Ingredients for Food Fortification and Waste Reduction

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Fruit peels, often discarded as waste, represent a valuable yet underutilized resource, rich in essential nutrients and bioactive compounds such as dietary fiber, antioxidants, vitamins, and polyphenols. With growing concerns about food waste and increasing demand for functional foods, incorporating fruit peels into food products as natural fortifying agents offers a sustainable solution to enhance nutritional quality while reducing environmental impact. This review explores the nutritional profiles of commonly discarded fruit peels—including those of mango, banana, citrus, pomegranate, and apple—and examines their potential applications in the fortification of bakery products, snacks, beverages, and dairy alternatives. It highlights recent advances in processing techniques that improve the bioavailability and safety of fruit peel powders and extracts. Furthermore, the review discusses consumer acceptance, sensory impacts, and regulatory considerations related to the integration of fruit peels into food systems. By promoting the valorization of fruit waste, this approach contributes to a circular food economy and supports the development of cost-effective, health-promoting food products.

Keywords: Fruit peels, Food fortification, Food waste valorization, Dietary fiber, Antioxidants, Functional ingredients, Sustainable nutrition, Circular economy, Natural fortifiers, Food innovation

Freeze Drying as an Innovative Technology for Food Preservation and Culinary Applications

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Freeze drying, also known as lyophilization, has emerged as a cutting-edge technology in food preservation due to its exceptional ability to retain the nutritional, sensory, and structural qualities of food products. Unlike conventional drying methods that involve high temperatures and often result in significant nutrient loss and textural degradation, freeze

drying operates by sublimating ice directly into vapor under low-temperature and low-pressure conditions. This process minimizes thermal damage and preserves heat-sensitive compounds such as vitamins, antioxidants, and enzymes. In addition to extending shelf life and reducing food spoilage, freeze drying is gaining popularity in ready-to-eat meals, functional foods, and gourmet culinary applications due to its superior flavor retention and rehydration capacity. This review explores the principles, advantages, and limitations of freeze-drying technology, with an emphasis on its role in preserving fruits, vegetables, dairy products, meats, and cooked meals. It also discusses recent innovations, cost-related challenges, and future prospects of freeze drying—particularly in the context of enhancing food security, minimizing post-harvest losses, and meeting consumer demand for high-quality, minimally processed foods.

Keywords: Freeze drying, Lyophilization, Nutritional quality, Shelf life, Innovative drying methods, minimally processed foods, Post-harvest loss reduction, Functional foods, Thermal degradation

Impact of Drying Temperature on the Quality Attributes of Dried Fruits

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Drying is one of the oldest and most widely used methods for preserving fruits; however, the temperature applied during the drying process plays a critical role in determining the final product's quality. Variations in drying temperature significantly influence the nutritional, sensory, and structural characteristics of dried fruits. While high temperatures may accelerate the drying process and reduce microbial activity, they can also degrade heat-sensitive nutrients such as vitamin C, polyphenols, and antioxidants, and lead to undesirable changes in color, texture, and flavor. In contrast, low-temperature drying methods better preserve nutritional and sensory qualities but generally require longer drying times and higher energy input. This review summarizes the effects of various drying temperature ranging from low-temperature techniques like freeze drying to high-temperature conventional drying on key quality parameters, including nutrient retention, color stability, rehydration capacity, and textural integrity. It also discusses the trade-offs between processing efficiency and product quality, offering insights to help food processors and researchers optimize drying conditions for different fruit types. The goal is to support the production of high-quality dried fruit products that meet consumer expectations and extend shelf life.

Keywords: Fruit drying, Drying temperature, Nutrient retention, Quality degradation, Texture, Color stability, Rehydration capacity, Thermal processing, Dried fruits, Food preservation

Poor Food Sanitation Practices in Street Restaurants and Food Stalls as a Major Public Health Concern in Developing Regions

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Food sanitation is a vital part of public health, yet it's often neglected in many developing regions. Poor hygiene practices—especially in street food stalls and small eateries pose serious health risks. In many cities and towns, food is prepared and served in unhygienic conditions, with little regard for basic safety standards. Unwashed hands, contaminated water, improper storage, exposure to dust and pests, and the repeated use of dirty utensils all contribute to the spread of foodborne illnesses. These unsanitary practices are key drivers of diseases like diarrhea, typhoid, cholera, hepatitis A, and food poisoning. The impact is especially severe for low-income communities that rely on affordable street food for daily nourishment. Even though street food plays an important economic and cultural role, there's often a lack of regulation and public awareness around food safety. This review sheds light on the major gaps in food sanitation, the health risks involved, and the urgent need for stronger safety rules, better vendor training, and regular inspections to protect public health and prevent outbreaks.

Keywords: Food sanitation, Street food, Foodborne diseases, Hygiene practices, Food safety, Street vendors, Disease outbreaks, Urban food systems

Alpha Amylase Production, Purification and Characterization Using Indigenous *Bacillus Subtilis*

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The α -amylase enzyme hydrolyzes starch and glycogen into maltose, isomaltose and glucose. It is produced from plants, animals and microbes but microbial α -amylase has highest commercial and industrial value. *Bacillus subtilis* was identified on the basis of 16S rRNA. Further, characterization of *Bacillus subtilis* was done using BLAST tool and phylogenetic tree with MEGA X. Different carbon and nitrogen sources were supplemented to the LB medium. The supplemented LB medium was sterilized and used for the growth of *Bacillus subtilis*. High yield of α -amylase was produced at 3% molasses and 3% peptone. Alpha Amylase was precipitated at 60% ammonium sulphate concentration then partially purified α -amylase was further purified through column chromatography. The optimum pH and temperature for alpha amylase was found to be 9 and 55 °C respectively. Kinetic studies of alpha amylase were performed to check K_m and V_{max} values. Impact of different metal ions were observed on α -amylase activity and high α -amylase yield was recorded in the presence of Fe²⁺ ions. SDS-PAGE technique revealed the molecular weight of α -amylase which was ~46kDa. The purified α -amylase utilized for characterization studies. The role of α -amylase was analyzed in detergent industry with different company detergents. Enzyme activity was estimated by checking release of reducing sugars which had application in textile industry. The enzyme

capability with detergents and release of reducing sugars in de-sizing step in textile industry makes alpha amylase suitable for local industries in Pakistan.

Keywords: Alpha Amylase, Bacillus subtilis, optimization, characterization, detergent industry, metal catalysts, phylogenetic tree

Prevalence and influence of insomnia on human intellectual well-being

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Insomnia, categorized by methods of determined complications in origination or retaining sleep, inspires just about 20% of the general population. Particularly, about 50% of individuals detected with insomnia are additionally talented with comorbid psychiatric circumstances, most regularly hopelessness. The bidirectional association between restlessness and intellectual well-being distress is nicely documented; insomnia now not first-class impairs psychiatric symptoms but also assists as a common risk aspect for the improvement of situations consisting of depression and anxiety. Additionally, insomnia is correlated to damage to intellectual capabilities, collected with wandering memory, episodic memory, and govt operation, which could unfavorably have an effect on everyday outdoor and regular first-class routines. The high prevalence of insomnia amongst humans with intellectual problems pressures the reputation of early individuality and arranged interferences. Making speech insomnia via evidence-based medicines, together with cognitive-behavioral treatment for insomnia (CBT-I), has established efficiency in attractive sleep and modifying psychiatric symbols, thereby improving intellectual fitness results. Given the widespread effect of insomnia on mental health, participating in sleep valuations into repeated psychiatric evaluations is vital for broad-affected attractiveness care. This paper examines the control and impact of insomnia on persons with highbrow fitness conditions, highlighting the consequences of primary investigation and personalized therapy approaches to enhancing regular welfare and intellectual strength.

Keywords: insomnia, intellectual well-being, depression

Seasonal distribution patterns of hard tick infesting sheep and goats in Baluchistan

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Ticks are well known to transmit tick-borne diseases to wild animals, domestic animals and humans. This study was conducted in seven districts of Baluchistan during 2024-2025. We examined the prevalence of tick populations on small ruminants including sheep and goats. Ticks were identified based on their morphological characteristics. The results revealed that Hyalomma and Rhipicephalus are the most common tick genera, with their populations peaking during the summer months. Least number of ticks were recorded in winter. Around 40.34% of animals were infested with these tick genera. Ticks

were predominantly reported on the legs and belly regions. Our research highlights the growing prevalence of ticks in small ruminants. It is therefore recommended the proper use of acaricides is needed in order to effectively prevent tick infestations in this region.

Keywords: Ticks, tick-borne diseases, farm animals, sheep, goats.

Importance of Bioequivalence Studies in Functional Foods and Dietary Supplements

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The global market for functional foods and dietary supplements is rapidly expanding, driven by increasing consumer demand for health and wellness products. However, the therapeutic efficacy and safety of these products heavily depend on their bioequivalence the extent to which they deliver consistent bioavailability of active ingredients. Unlike pharmaceutical drugs, dietary supplements often lack stringent regulatory oversight, resulting in variability in composition, absorption, and clinical outcomes. This presentation emphasizes the critical role of bioequivalence studies in ensuring product quality, safety, and consumer confidence. It explores key factors influencing bioequivalence, including formulation, dissolution rates, and individual physiological variations. Furthermore, it highlights regulatory challenges and the need for standardized guidelines to evaluate the pharmacokinetics of functional foods and supplements. The discussion will underscore how bioequivalence assessments bridge the gap between scientific validation and market claims. Ultimately, establishing robust bioequivalence criteria is essential for promoting transparency, protecting public health, and maintaining trust in the growing nutraceutical industry.

Knowledge, attitude, and practices (KAP) among farmers of sheep and goats in Costal District, Baluchistan

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A comprehensive study conducted in costal district of Baluchistan aimed to assess farmers' awareness and practices regarding the spread of ticks and tick-borne diseases (TBDs) in small ruminants including sheep and goats in rural Baluchistan. The findings revealed that although 75% of farmers were able to identify tick species but many of them were unable to distinguish the appropriate specie of ticks that are responsible for disease transmission. Furthermore, 72% of respondents did not employ proper precautions while handling their farm animals. This study also highlighted a significant lack of knowledge about the spread of ticks and TBDs, which increased the likelihood of farmers being exposed to TBDs. Indiscriminate use of acaricides was also reported, and many highly infected animals were sold that can potentially involve in the spread of TBDs. These poor practices suggest that a lack of education and proper information may contribute to the spread of TBDs including CCHF in this region. To address this health-related issue, NGOs, local government, and health experts should collaborate to provide targeted educational programs and support, helping farmers to improve their awareness and practices to reduce disease transmission.

Keywords: Ticks, tick-borne diseases, farmers, KAP, sheep, goats.

Role of mushrooms in environmental sustainability

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Industrialization and over population has brought drastic effect on the environment because of the excessive use of its resources. Our environment is now over burdened with several pollutants like heavy metals, volatile organic compounds (VOCs), synthetic dyes, pesticides, etc. In order to reduce their harmful consequences on the ecosystem and environmental sustainability, degradation of these pollutants is essential. There are several techniques including physical, chemical and biological are in use with certain benefits. Bioremediation including Mycoremediation, is considered better as it is safe, cheaper and easy compared to physical and chemical. Brown rot fungi (BRF) and White Rot Fungi (WRF) are group of fungi, commonly called mushrooms, that produces non-specific ligninolytic enzymes that can oxidized the synthetic dyes. The current research was aimed to access the bioremediation potential of different indigenously isolated brown rot and white rot fungi and study of their ligninolytic enzymes system involved in the process. We have isolated 6 indigenous species of BRF and WRF, checked their textile dyes/ effluents biodegradation potentials. Classical Response Surface Methodology (RSM) was used to optimize the process through optimization of growth and nutritional conditions. The efficacy of the process was monitored by the determination of BOD and COD of the effluents. The resultant by-products were determined through HPLC analysis. The results were very much promising with 60-70 % biodegradation of the various industrial effluents/ dyes that increased up to 15-25% with optimization process at two levels. The determination of values of BOD and COD of treated effluents confirm that process was very effective and values of both parameters reduced well below WHO recommended level for the effluents. Further, analysis through HPLC indicated the production of less or non-toxic by-products, indicated the efficacy of the process. These findings concluded that mushrooms could be good candidate to maintain sustainability in the environment by reduction of pollution.

Keywords: Brown rot fungi, White Rot Fungi, Bioremediation, Response Surface Methodology, Environmental sustainability

Synthesis of Copper Oxide Deposited Covalent Triazine Frame Work for the Colorimetric Sensing Of Uric Acid

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Uric acid is the end product of purines metabolism in the body. The normal range of (UA) is very essential for health and wellnesses. For accurate detection of U.A many methods are used, which is previously reported. But in recent years, Covalent Organic Frame work (COF) which is crystalline porous material, have very significant attentions. For the first

time, we synthesized the Copper Oxide deposited covalent triazine framework (CuO@CTF) with Co-precipitation method. For the preparation of CuO@CTF we take Dicyanobenzene and zinc Chloride on 1:1 and heated up at 400 o C in furnace. The obtain product washed many time with HCl to ensure the neutral pH for further processes, filtered the solution and dried at 150 0 C for 30 minutes in oven and then for the deposition of Copper Oxide, we take Copper Sulfate and Covalent triazine frame work in 1:9. In this stage we proceed the Co-precipitation method for getting Copper Oxide deposited covalent triazine Frame work CuO@CTF. Then ensure the neutral pH and dried the solution at 60 o C for 5 hours, while the successfully prepared nanocomposite CuO@CTF are used for the accurate colorimetric determination of uric acid. We perform the UV-Vis Spectroscopy for the conformation of Uric acid detection, nanocomposite stability and sensitivity, and detection limit and selectivity. The fabricated Cu@CTF has characterized by using many other techniques including, X-ray diffraction (XRD) used to conform the nanocomposite crystalline structure, while FTIR Analysis perform to identify the characteristic peaks of the material and Scanning Electron microscope (SEM) were carried out for the morphology of CuO@CTF nanocomposite. Additionally, XPS were performed for the material surface chemistry. The notable efficiency of CuO@CTF nanocomposite as peroxidase mimic enzyme can be considered as noteworthy material for the purpose of colorimetric determination of Uric acid and for biological applications.

Keywords: Dicyanobenzene, Zinc Chloride, HCl, NaOH, Copper Sulfate, colorimetric determination of Uric Acid.

Exploring Genetic Diversity for Morpho Yield Traits and Resistance Potential for Yellow Rust Disease in Bread Wheat Germplasm Under Agro-Climatic Condition Of Kohat

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Development of new high-yielding and disease-resistant varieties is a prerequisite for on a sustainable basis and feeding an ever-increasing population. Among wheat rust diseases, yellow rust is one of the major diseases affecting wheat production, especially in Khyber Pakhtunkhwa. In the present study, a set of 25 diverse bread wheat genotypes having 20 new bread wheat advanced lines and 05 check cultivars, i.e., Kohat-2017, Gulzar-2019, Pirsabak-2019, Tanda-2023, and Khyber -2023, were evaluated at Barani Agricultural Research Station Jarma Kohat Khyber Pakhtunkhwa-Pakistan during 2023-24. Analyzed data revealed highly significant differences among the wheat genotypes for the studied traits i.e., Days to heading, days to maturity, plant height, grain yield, Yellow rust severity, and coefficient of infection. While spikelets per spike was found non-significant. Significant differences were observed in agronomic traits, with grain yield ranging from 3540 to 4574 kg/ha and yellow rust severity varying from 1.5% (resistant) to 70% (susceptible). Top-performing lines included KTL-1 (highest yield: 4547 kg/ha) and KTL-9 (lowest rust severity: 1.5%), both exhibiting strong resistance. Broad-sense heritability was high for rust resistance (0.86–0.88) and grain yield (0.63), indicating these traits are highly inheritable. The study identified KTL-1, KTL-2, KTL-7, and KTL-9 as

promising candidates for future breeding programs due to their superior yield and disease resistance.

Keywords: Genetic Diversity, Heritability, Resistance potential, Triticum aestivum, Yellow rust

Exploring Genetic Diversity for Morphological and Grain Yield Attributes in Diverse Wheat Genotypes Grown under Rain fed Production System

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In the changing scenario of unpredictable climatic conditions, development of new high yielding and drought tolerant wheat varieties is one of the best strategies to improve wheat production on sustainable basis and food security situation in the country. In the current study, a set of 30 diverse wheat genotypes along with six check cultivars i.e. Kohat-2017, Gulzar-2019, Pirsabak-2019, Abaseen-2021, Tanda-2023 and Khyber -2023 were evaluated under field conditions for morphological traits and yield potential under rain fed production system. Data were recorded on days to heading, days to maturity, plant height, spike length, leaf length, leaf width, leaf area and grain yield and varied from 119-138 days, 174-184 days, 83- 112 cm, 6.95-11.95 cm, 13.8-26.1 cm, 1.2-1.8 cm, 17.6-43.5cm² and 1147-3400 kg ha⁻¹ respectively. Significant variations were observed among genotypes for all the studied traits except days to maturity and leaf width. Early heading and maturity were associated with drought escape mechanisms and genotypes B2-V-31 and B2-V-1. Plant height and spike length contributed to biomass accumulation. Maximum plant height was recorded for B1-V-1 and B1-V-7. Highest spike length was observed for genotype B2-V-31 (11.84cm) and B1-V-8 (11.40cm). Leaf-related traits played a crucial role in photosynthetic efficiency; affecting overall yield. Maximum leaf length was recorded for B2-V-6 (26.1cm). For grain yield, genotypes B1-V-3 & B1-V-7 (3400 kg/ha), and B1-V-23 (3380 Kg/ha) were found high yielding as compared to check cultivars Khyber 2023 (3140 kg/ha). Hence these genotypes can further be evaluated in plant breeding programs to release as climate resilient wheat genotypes for the overall yield improvement, yield stability. The findings provide valuable insights for wheat breeding programs and identified lines after proper testing having high yield potential could be released as a new varieties suited for rain fed environments.

Keywords: Bread wheat, Genetic diversity, grain yield, production system, rain fed

Genetic Potential and Variability for Flowering and Yield Attributes In Diverse Bread Wheat Germplasm

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Development of new high yielding and widely adopted varieties in wheat is prerequisite for increasing productivity on sustainable basis. In the present study a set of eighteen diverse wheat genotypes selected from diverse sources were evaluated at Barani

Agricultural Research Station Jarma Kohat during 2023-24. Highly significant differences ($P \leq 0.01$) were observed among the germplasm for the studied traits i.e. Days to heading, days to maturity, plant height, biological yield and grain yield varied from 128 to 140 days, 178 to 189 days and 105.62 to 144.67 cm, 9700.0 to 14366.7 Kg ha⁻¹ and 2626.7 to 4540.07 Kg ha⁻¹ respectively. Based on mean performance for days to heading and days to maturity, Gulzar-2019 was found best as it headed and matures earlier. For reduced height, MPT-1 was found best as it short stature. Mean comparisons of grain yield showed that KPKL-2 had the highest grain yield (4540.0 Kg ha⁻¹), followed by MPT-1 (4026.67 Kg ha⁻¹) than the other lines and check cultivar Abaseen-2021 (3640 Kg ha⁻¹). Current study revealed that the identified wheat germplasm i.e. MPT-1 and KPKL-2 after proper testing and evaluation could be released as a new varieties and future wheat breeding program for improving grain yield and food security situation in the country.

Key words: Diversity, Genetic potential, Grain yield, Triticum aestivum, Variability

Antibacterial Evaluation of Magnesium Oxide Nanoparticles against Fish Pathogenic Bacteria Using Ifloga Spicata Aqueous Extract

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Nanotechnology is a field of science and engineering that focuses on materials with dimensions on the scale of 100 nanometers or smaller. As nanotechnology advances, nanoparticles exhibit unique characteristics compared to bulk materials. This research involves the green synthesis of Magnesium oxide nanoparticles by using Ifloga spicata aqueous as biocompatible reducing and stabilizing agents against infected fish pathogenic bacteria. These nanoparticles were examined using The synthesized MgO nanoparticles were characterized using various analytical techniques: UV-visible spectroscopy to detect surface plasmon resonance and confirm nanoparticle formation, Fourier Transform Infrared Spectroscopy (FTIR) to identify functional groups involved in nanoparticle reduction and stabilization, X-ray Diffraction (XRD) to examine crystalline structure and phase purity, Scanning Electron Microscopy (SEM) to assess particle size, shape, and morphology, and Energy Dispersive X-Ray Spectroscopy (EDX) to verify the elemental composition of MgO nanoparticles. Magnesium oxide nanoparticles showed effective antibacterial properties against the Klebsiella aeroy, Proteus vulgaris, and Aeromonas veroni. This approach serves the dual purpose of decreasing the environmental effects and improving the biocompatibility of the nanoparticles, making them suitable for applications in environmental remediation, biomedicine.

Keywords: Nanoparticles, Ifloga spicata aqueous, Magnesium oxide, antibacterial properties, Klebsiella aeroy, Proteus vulgaris, Aeromonas veroni,

Green synthesis of silver nanoparticles and their activity against multi drug resistant fish bacteria

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The objective of this study was to assess the impact of silver Nano particle extracted from *Euphoria serpens* on fish resistance bacteria like *Proteus vulgaris*, *Huaxibacter chenosis*, *Enterobacter frealii* and *Klebsiella pasteurii* to determine whether silver Nano particle kills these resistance bacteria. Antimicrobial activity techniques were employed to evaluate the effects of silver Nano partials and culture sensitivity of six different antibiotics like azithromycin, clarithromycin, ciprofloxacin ampicillin, amikacin and were done against these resistance bacteria. It is evaluated that all these antibiotics were found resistance against these bacteria's and showing no killing effect. Silver nanoparticles (AgNPs) exhibit significant antimicrobial activity against a variety of bacterial strains, including *Huaxibacter chenosis*, *Enterobacter frealii*, and *Klebsiella pasteurii*. The antimicrobial effects are primarily attributed to AgNPs's ability to disrupt bacterial cell membranes, generate reactive oxygen species (ROS), and release silver ions that interfere with cellular processes. AgNPs are particularly effective against Gram-negative bacteria due to their interaction with the outer membrane and subsequent membrane destabilization. It is evaluated that (AgNPs) show significant antimicrobial activity, with particularly strong effects against Gram-negative bacteria, including *Huaxibacter chenosis*, *Enterobacter frealii*, and *Klebsiella pasteurii*. Among these, AgNPs exhibit the most pronounced activity against *Klebsiella pasteurii* due to the nanoparticles's ability to disrupt the bacterial cell membrane and inhibit biofilm formation. Although AgNPs show efficacy against all three bacteria, *Klebsiella pasteurii* appears to be the most susceptible. These findings highlight the potential of silver nanoparticles as an effective antibacterial agent, particularly against *Klebsiella pasteurii*, with applications in medical treatments and infection control.

Keywords: Nano particle, ciprofloxacin, ROS, Antimicrobial activity and resistance

Fish gut bacterial diversity with special emphasis on organochlorine degrading bacteria

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The gut microbiota of fish plays a crucial role in host health, nutrient metabolism, and environmental adaptation. This study aimed to characterize and identify the taxonomic composition, diversity, and phylogenetic structure of fish gut microbial communities using high-throughput sequencing and bioinformatic analyses. Microbial communities were assessed via 16S rRNA gene sequencing, followed by taxonomic profiling (phylum to species), alpha/beta diversity metrics, phylogenetic analysis (FastTree, GraPhlAn), and multivariate ordination (PCoA, NMDS, UPGMA). Key findings revealed a dominance of Proteobacteria, Actinobacteria, and Firmicutes at the phylum level, with Alphaproteobacteria, Bacteroidia, and Bacilli as prevalent classes. Genus-level analysis identified *Sphingomonas*, *Pseudomonas*, and *Bacillus* as core taxa. Alpha diversity indices (Chao1, Shannon) indicated significant variation in richness and evenness across samples, with Ind3₃ showing the highest diversity. Beta diversity analysis (PCoA/NMDS)

demonstrated distinct clustering by sample groups, suggesting environmental or host-specific influences on community structure. Phylogenetic trees highlighted evolutionary relationships, while UPGMA clustering reinforced sample-group similarities. The Krona plot visualized hierarchical abundance, emphasizing Proteobacteria's ecological dominance. These results underscore the complexity and adaptability of fish gut microbiota, with implications for host-microbe interactions, ecosystem resilience, and aquaculture management.

Keywords: Fish gut microbiota, Microbial diversity, 16S rRNA sequencing, Taxonomic profiling, Phylogenetic analysis

Investigating the alleviating effect of selenium on biochemical characteristics and chlorophyll fluorescence in maize exposed to drought

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The aim of this study was to evaluate the effects of drought stress on maize plant photosynthesis and determine whether selenium recover, the photosynthetic response caused by drought exposure in maize plant. Chlorophyll fluorescence techniques were used to investigate the effects of drought and selenium on chlorophyll fluorescence parameters in maize (*Zea mays*), seedlings. Selenium improved photosystem II efficiency, increased the absorption and conversion efficiency of primary light energy, and accelerated photosynthetic electron transport in maize plant, all of which increased photosynthesis. These effects were present after drought stress exposure on maize. Moderate drought condition (40ml/pots) after every seven day exposure damaged the photosystem II reaction center, inhibited the photochemical reaction, and caused excess energy to be released as heat. These effects were more evident after the extreme drought condition (20ml/pots) after every fourteen days. The magnitude of drought exposure effects on the chlorophyll fluorescence parameters in the different drought conditions followed the order: mild > moderate > extreme. The opposite order was observed following the different drought condition. In conclusion, the chlorophyll fluorescence response in maize exposed to drought depended on different drought conditions.

Keywords: Selenium, Photosynthetic parameters, Chlorophyll fluorescence.

Explainable Multimodal AI for Cardiovascular Disease Prediction from ECG, Echocardiography, and MRI

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Cardiovascular diseases (CVDs) caused 32% of global deaths (17.9 million yearly), according to the World Health Organization (WHO). The majority of CVDs (about 85%) were caused by heart attacks and strokes, of which approximately 45% of people died due to silent heart attacks or late diagnosis. Early detection of ischaemia, arrhythmias, ejection fraction, and heart failure remained challenging due to limitations in a unimodal diagnostic approach (e.g., ECG-only systems achieved 84–92% accuracy). Machine

learning (ML)-based systems enabled early prediction of CVDs. Previous studies demonstrated that many advanced models showed promising results. We proposed a multimodal AI solution integrating ECG, echocardiography (Echo), and cardiac MRI (CMRI) with explainable AI (X-AI) to improve early prediction of CVDs and to overcome these gaps. Our hybrid architecture combined the accuracy and reliable prediction of individual models, including 12-lead ECG via a 1D convolutional transformer (5-ms resolution), Echo clips (apical 4-chamber) with a Vision Transformer (ViT), and CMRI using a 3D U-Net with edge-aware loss to achieve greater accuracy in CVD prediction. These predictions were fused using a Multi-Layer Perceptron for Late Fusion (Perceiver IO) with Shapley Additive explanations (SHAP) for an explainable model approach. Our model analyzed data from 40,000 ICU patients with excellent results—it correctly identified 98.3% of heart problems (with results reliably between 97.8% and 98.8%). It performed significantly better than using just ECG tests (by 12%) or just echocardiograms (by 9%), with statistical certainty ($p < 0.001$). When tested on 5,000 carefully selected cases, it was accurate 97.5% of the time. Doctors agreed with its explanations 87% of the time (showing good consistency, $\kappa = 0.82$), though it was slightly less accurate (89.4%) for patients with bundle branch block. This approach not only showed promising results but also built the trust of doctors by explaining the reasons for their predictions. It improved early detection, reduced errors in diagnosis, and supported personalized assessments and treatment.

Keywords: Cardiovascular diseases (CVDs), explainable AI (XAI), machine learning (ML), deep learning (DL), and SHAP (Shapley Additive Explanations)

A genetically optimized ensemble of deep transfer learning models for Net Flow-centered intrusion detection in IoT networks

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With the increase in IoT devices, cyber-attacks has become a significant challenge. Basic AI-driven intrusion detection systems (IDS) advanced notably in recognizing attacks, yet they frequently experienced hallucination problems, misidentifying threats because of their failure to adequately remember learned patterns. To address this issue, we introduced a genetically optimized ensemble intrusion detection system utilizing deep transfer learning, which increased detection reliability by converting Net Flow IoT data into three-dimensional images for better pattern recognition. We processed two publicly available IoT datasets and employed six pre-trained convolutional neural networks (CNNs)—EfficientNetB0, DenseNet121, MobileNetV2, Mobile Net, Inception and Xception. A Genetic Algorithm (GA) was utilized for hyper parameter tuning, and the best performing models were combined into a soft voting joint to improve detection reliability. The suggested framework successfully reduced threats, attaining 100% accuracy over 15 types of attacks, encompassing uncommon and severe threats like backdoors, ransomware, and data theft in IoT settings. Performance assessments revealed that the NFIoT-GATE-DTL IDS outperformed contemporary IDS models, achieving an average multi-class classification accuracy that is 5–7% greater. This research enhanced a more

robust and flexible IDS framework, providing better security for Net Flow-centered IoT networks.

Keywords: Intrusion detection system, Net Flow, Cybersecurity, Genetic algorithm, Internet of things, Ensemble learning, Deep transfer learning

Classification of Satellite Image Time Series Using a Band Attention-Based Temporal Convolutional Network

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With the release of novel remote sensing devices that can take pictures with great temporal, spectral, and spatial resolutions, categorization of satellite image time series (SITS) has turned into a study of great interest. Information on the temporal dimension is especially crucial in the area of crop classification. Although while certain sophisticated machine learning techniques, like random forests (RFs), might provide useful findings, they often disregard the data from time series. In this paper, a Feature Attention-based Temporal Convolutional Network (FA-TCN) is suggested as a way to fully use the temporal as well as spectral info in multi-temporal remote sensing data. The temporal convolutional network (TCN) and also the attention block are two key components that make up the suggested methodology. A series of temporal convolutional filters is used by the temporal convolutional network (TCN) to grasp long-range dependency. Because not all bands carry equal information in the categorization of crop types, the attention block is employed to accentuate significant characteristics in the channel dimension and collect pertinent information within the series. Deeper phonological properties may be excavated by the suggested FA-TCN. On the Formosat-2 scene, experiments were performed using 70 images and according to the experimental findings, FA-TCNs are much precise than the cutting edge deep learning-based methods in SITS categorization. Lastly, we evaluated how visually appealing the land cover maps created by FA-TCNs are.

Keywords: Classification, Crop type Mapping, Attention Module, Satellite Image Time Series (SITS), Remote Sensing, Temporal Convolutional Network (TCN), Deep Learning

Investigation of a face identification algorithm that utilizes 2D face image matching and 3D face data

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In conditions of low or absent light, the recognition accuracy of advanced 2D face recognition technology reduces significantly. This work proposes a face recognition method that matches 3D face information with 2D facial photos. At first, 3D facial data is rebuilt from the 2D facial images in the database using the 3DMM technique, and the facial depth image is acquired by orthogonal projection. The mean curvature maps of the depth image is utilized for enhancing the depth image data. An enhanced residual neural network using depth images and curvature is developed to contrast the scanning face with the database face. This study evaluates the suggested technique on three public 3D face databases (FRGC v2.0, Lock3DFace and Texas 3DFRD), achieving recognition accuracies of 93.5%, 92.8%, and 89.3%.

Keywords: Data enhancement, Deep learning, Depth image, 3D face recognition

A Reliable Method for Forecasting Wheat Harvest Yield by Integrating Climate-NDVI Data and Machine Learning

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An unprecedented requirement for a large-scale, accurate, and rapid evaluation of agricultural production has emerged as a result of exponential population expansion, changes in the climate, and rising food demands. Predicting wheat production accurately and quickly is crucial for ensuring food security on a global scale. Experimental approaches for agricultural production forecasting have often used either climate data or information from satellites, or a mix of the two, to inform their development. The contributions from several sources (climate, soil, socioeconomic status, and remote sensors) are still not evident, even if combining satellite and climate data increased efficiency. The absence of clear comparisons between the efficacy of regression-based techniques and other Machine Learning (ML) techniques in prediction of yield requires more analysis. This research covers existing gaps by integrating data from different sources to predict wheat output in the Multan district in Punjab, Pakistan. The results are contrasted with the standards established by Crop Report Services (CRS) Punjab, utilizing three prevalent machine learning methodologies (support vector machine (SVM), Random Forest (RF), and Least Absolute Shrinkage and Selection Operator (LASSO)). This is achieved by incorporating publicly accessible data within the Google Earth Engine (GEE) platform, encompassing climate, satellite, soil characteristics, and spatial information to formulate alternative empirical models for yield prediction, employing data collected from 2017-2022 and identifying the optimal characteristic subset important to crop yield. The district level predicted yield datasets were examined using three machine learning models (SVM, RF, and LASSO) in relation to season weather, satellite data, and soil characteristics. The findings demonstrate that the integration of all datasets using three machine learning methods enhances yield prediction accuracy (R^2 : 0.74-0.88). Integrating geographic data and other attributes into comparison models may enhance predictions from 0.08 to 0.12. The random-forest model surpassed the competing models, achieving a root mean square error (RMSE) of 0.05 q/ha and a R^2 of 0.88. The comparison of results indicates that the random forest achieved 97%, while the SVM attained 93%, demonstrating superior outcomes in the examined region.

Keywords: Crop yield prediction, CNN, SVM, Remote Sensing, LASSO, RF, Machine learning

A Machine Learning and Deep Learning Algorithm-Based Smart Decision-Support System for Crop Yield Estimation

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Growth and economic prosperity depend heavily on agriculture. For the production of vegetables, fruits, plants, and animals, crop yield prediction is essential. In agriculture, artificial intelligence (AI) is becoming more prevalent, giving farmer's permanent or

current information about their agricultural field. It enables us to determine the regions in need of pesticides treatment, the process of fertilization or watering. Many variables make it difficult for statistical models to follow intricate correlations in agricultural production. By learning themselves on these linkages, machine learning (ML) and deep learning (DL) algorithms may overcome this issue and provide precise forecasts for agricultural produce prediction techniques. Forecasting the success of products in agriculture is difficult owing to several variables; yet, profit prediction enhances deciding, production efficiency, economic viability, and food security. This work examines the use of machine learning and deep learning algorithms to propose an innovative system to support decisions for predicting crop yields, aiming to design a robust and accurate model, assess algorithm efficacy, and provide a user-friendly interface for informed agricultural decision-making. The findings indicate that the created system may provide accurate forecasts, hence assisting farmers in optimizing their crop management choices. The results of the simulation indicate that the proposed adaptive decision-making system for agricultural production prediction, using machine learning and deep learning methods, could achieve high levels of precision and accuracy. The technology assists farmers in making informed decisions on agricultural cultivation and management, perhaps resulting in enhanced crop yields and revenues. The outcomes of our study indicate that our model surpasses the others, achieving an accuracy of 99.82%. Furthermore, we used machine learning to reduce the number of inputs while maintaining high precision.

Keywords: Agricultural Productivity, Artificial Intelligence, Crop Yield Forecasting, Deep Learning Algorithm, Deep Neural Network, Machine Learning Algorithm

The Application of Two-State Q-Learning for Reinforcement-Based Image Classification

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This research presents a straightforward and effective hybrid classifier that integrates deep learning with reinforcement learning. In this case, Q-Learning was utilized for two states and either two or three actions. Alternative methodologies identified in the literature use feature maps derived from Convolutional Neural Networks, integrating them into the Q-states with historical data. This results in technological challenges in these methods owing to the elevated number of states resulting from the extensive size of the feature map. The suggested approach employs just two Q-states, making it uncomplicated and significantly reducing the number of evaluation variables, which in turn simplifies the incentive function. The suggested strategy employs innovative activities for image processing, distinguishing it from existing methods reported in the literature. The efficiency of the suggested approach is examined against other contemporary algorithms like as ResNet50 and InceptionV3 on well-known datasets including ImageNet, the Cats and Dogs Dataset, and the Caltech-101 Dataset. The suggested method surpasses previous strategies across each used dataset.

Keywords: Deep Learning, InceptionV3, ResNet50, Reinforcement Learning, Q-Learning, ImageNet, Image Classification

A three-dimensional model-based approach for face identification to be employed with single images that makes use of synthetic emotions and postures

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A long-standing technique in face recognition systems, 3D facial expression evaluation and integration allows for very accurate results regardless of the user's face expression or position. In this research, we provide a novel approach to creating animated stances and emotions from photographs. The combination of many face positions and the six patterns form the basis of expressions. The dominant approach then involves applying them to facial recognition tasks when a single picture is accessible. The 3D representation was developed by combining a series of points as triangular meshes in three-dimensional space. The information sets involve the indexes and vertex of the polygons. The neutral facial expression in the face picture was depicted using 20 geometric features on the face. The study in this work is focused on the synthesis of facial expressions and positions using Support Vector Machines (SVM) and Local Binary Pattern Histograms (LBPH). Two distinct databases, the BU-3DFE and FEI databases, have been used to assess the algorithm's synthesis postures and expressions, which are fake faces. Artificial faces are employed in face recognition tasks when individuals just need to see one picture of their face. The average recognition percentages on the BU-3DFE performed better than those on the FEI database, with an average of 89.6%, which is 9% higher than the average for the FEI database. According to the FEI database, the recognition rate was 82.8%. The suggested solution aims to address the face detection challenge with the constraint of having just a single picture accessible. By artificially generated pictures are then used to develop the recognition system. The results indicate that the system attains commendable performance with a single facial picture per participant.

Keywords: Facial synthesis, Face modeling, Facial expression synthesis, Texture mapping

Post-pandemic health impacts of COVID-19: challenges and solutions

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SARS-COV-2, the causative agent of COVID-19, is a microscopic disruptor that has pathology ranges from asymptomatic cases to severe pneumonia, hyper inflammation, long-term sequelae, challenging modern medicine to develop rapid diagnostics, mRNA based vaccines and antiviral therapeutics in record time. The primary issue at hand is dealing with the consequences of this rampant. The vaccine that play a pivotal role in reducing infection rates, hospitalizations and deaths primarily caused mild side effects, though, in rare cases, serious reactions were observed similar as a severe antipathetic response or anaphylaxis, myocarditis with the topmost threat among men and thrombosis with thrombocytopenia (TTS) with the highest rate among the women. While the acute phase of this pandemic has passed, it's long-term effects continue to unfold presenting new health challenges to which the most burning concern is the persistent impact on recovered individuals who has symptoms last longer called post COVID-19 syndrome

(long COVID) whereabouts numerous recovered non critical participants had respiratory issues, some had a decline in lung function and inflammation of heart muscles is also observed, multiple recovered cases will need physical rehabilitation and it also had cerebral impacts that result in anxiety, depression and post-traumatic stress disorder (PTSD), therefore poses unknown health challenges worldwide and this ordeal can be overcome by a multi-faceted approach including strengthening healthcare infrastructure and addressing social determinants of health to promote health literacy, however, global collaboration is also crucial for accelerating the discovery of new treatment to alleviate these challenges and make a sustainable healthcare system.

Keywords: SARS-CoV-2, COVID-19, mRNA based vaccines, post-COVID-19 syndrome, PTSD, healthcare infrastructure, global collaboration.

Application of artificial intelligence (AI) in food industry

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AI is now a game-changing tool in the food business for improving consumer satisfaction, quality assurance, and production, processing, and distribution efficiency. AI is considered essential to the future for the food business sector through the use of technologies like computer vision and machine learning. Industrial productivity efforts to improve through cutting waste and food safety. In culinary experiences based on 60-80% customer preferences, AI reduces inventory, streamlines logistics, and uses automation to guarantee product quality. AI in the food industry are to enhance food quality, optimize supply chains, improve food safety, personalize offerings based on consumer needs, and drive innovation in product development to meet changing demands. AI has enhanced food safety, decreased food waste, and raised customer satisfaction. AI improved supply chains, boosted production efficiency, and made oriented nutrition possible, all of which have helped consumers eat better and more sensibly. AI is significantly improving consumer preference by analyzing data enabling personalized experience and optimized suggestion. In the food sector, AI play a key role in enhance food safety and quality, improving supply chains leading to greater customer satisfaction and more well organized production.

Keywords: Artificial Intelligence (AI), Food Safety, Machine Learning, Optimization Supply Chain, Waste Management

Authentication of Adulteration in Fruit-Based Beverages through Physiochemical Indicators: Challenges and Analytical Approaches

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Fruit-based beverages are widely consumed for their nutritional value but often face adulteration, posing health and economic risks. This study aimed to ensure beverage authenticity using physicochemical indicators like pH, sugar content, viscosity, and electrical conductivity. Traditional testing methods lacked sensitivity, necessitating advanced techniques such as chromatography, spectroscopy, and electrochemical biosensors for better detection. Previous researches on beverages like orange juice brands were analyzed using pH meters, refractometers, and viscometers, while HPLC

and FTIR spectroscopy identified adulterants. Results showed Brand A (pH 3.8, °Brix 11.2, viscosity 1.5 cP) had 5% citric acid adulteration. Brand B (pH 3.6, °Brix 12.0, viscosity 1.6 cP) contained 12% artificial sweeteners. Brand C (pH 4.0, °Brix 10.8, viscosity 1.4 cP) had 8% added glucose syrup. HPLC and FTIR effectively detected adulterants, emphasizing the need for multi-technique authentication. Authentication of adulteration in fruit-based beverages through physiochemical indicators is crucial for ensuring consumer safety, maintaining quality standards, and preventing economic fraud. Future research should focus on cost-effective, high-throughput testing methods, while stronger regulations and standardized protocols are essential for consumer safety and beverage integrity.

Key words: Adulteration detection, Analytical techniques, Beverage authenticity, Food safety

Physicochemical indicators Medicinal importance of Glycyrrhiza uralensis

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Chinese licorice, or *Glycyrrhiza uralensis*, has long been valued for its therapeutic and medicinal qualities in traditional Chinese medicine. A strong anti-inflammatory and antioxidant, glycyrrhizin is a triterpenoid saponin and one of the main bioactive ingredients of *G. uralensis*. It is a useful natural treatment for inflammatory illnesses like inflammation, gastritis and respiratory issues because of these qualities. Through the inhibition of pro-inflammatory cytokines and enzymes, glycyrrhizin has been shown to reduce inflammation and provide relief from the discomfort and swelling that are associated with these illnesses. *Glycyrrhiza uralensis* is also well known for its ability to support digestive health. Glycyrrhetic acid, which is included in plant extracts, has been demonstrated to have gastro protective benefits by boosting mucin synthesis and improving the integrity of the stomach mucosa. It is therefore a viable option for the treatment of gastrointestinal disorders, including stomach ulcers also, it is a well-liked option for stress management and enhancing general well-being due to its adaptogenic qualities. *Glycyrrhiza uralensis* may lessen the adverse impact of prolonged stress on health and assist people in adjusting to the demands of contemporary life by regulating the physiological response and promoting adrenal function. *Glycyrrhiza uralensis* is also utilized for its anticipatory and antitussive qualities in traditional Chinese medicine. The herb's constituents have been shown to provide relief from bronchial congestion, coughing, and other respiratory ailments. For this reason, it is an essential component of herbal remedies used to cure lung infections and maintain lung health. Furthermore, because of its antioxidant and anti-inflammatory benefits, research indicates that *Glycyrrhiza uralensis* has potential uses in skincare. The extracts from the herb may help treat dermatitis, eczema, acne, and other skin diseases by scavenging free radicals and lowering inflammation. Thus, the anti-inflammatory, anti-cancer, digestion, adaptogenic, respiratory, and maybe dermatological properties make *G. uralensis* a valuable medical and therapeutic tool for human health.

Keywords: *Glycyrrhiza Uralensis*, Medicinal Properties, Pharmacological Activities

Biochemical Insights into Functional Foods, Linking Nutrients to Cellular Signaling Pathways

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Functional foods have emerged as powerful dietary tools in the prevention and management of chronic diseases. Recent advances in biochemical research have unveiled the dynamic interactions between bioactive food components and cellular signaling pathways, highlighting a molecular basis for their therapeutic effects. This abstract explores the critical role of key nutrients including polyphenols, flavonoids, omega-3 fatty acids, and certain vitamins—in modulating intracellular signaling cascades such as PI3K/Akt, NF-κB, AMPK, and MAPK pathways. These interactions influence gene expression, oxidative stress responses, inflammatory mediators, and metabolic homeostasis, offering a promising route toward personalized nutrition and functional food innovation. Furthermore, the bioavailability and metabolic conversion of these nutrients are discussed in the context of gut microbiota involvement, emphasizing the biochemical synergy between dietary components and host physiology. Cutting-edge omics technologies, such as metabolomics and nutrigenomics, are now enabling deeper insight into the molecular footprints of dietary interventions. These tools are reshaping our understanding of how functional foods contribute to cellular health, aging, and disease resilience.

Keywords: Functional foods, Cellular signaling, Nutrigenomics, Bioactive compounds, Oxidative stress, Nutritional biochemistry

Decoding the Antioxidant Defense System, A Biochemical Approach to Phytochemicals in Diet

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The human antioxidant defense system serves as a critical line of protection against oxidative stress-induced cellular damage, which plays a central role in the pathogenesis of chronic diseases such as cancer, cardiovascular disorders, neurodegeneration, and diabetes. Among the most promising natural modulators of this system are dietary phytochemicals—plant-derived compounds including flavonoids, polyphenols, carotenoids, and glucosinolates. This abstract explores the biochemical mechanisms by which these phytochemicals interact with and enhance endogenous antioxidant defense systems. Recent studies have highlighted that phytochemicals do not act merely as direct free radical scavengers but also modulate key signaling pathways such as Nrf2-Keap1, NF-κB, and MAPK. These pathways regulate the expression of detoxifying and antioxidant enzymes like superoxide dismutase (SOD), glutathione peroxidase (GPx), catalase (CAT), and heme oxygenase-1 (HO-1). Furthermore, phytochemicals influence

mitochondrial function, redox homeostasis, and the epigenetic regulation of oxidative stress-related genes. This biochemical insight provides a basis for utilizing dietary phytochemicals in preventive and therapeutic strategies. The synergistic effect of whole-food matrices, the influence of gut microbiota on phytochemical bioavailability, and interindividual genetic variability in antioxidant response are also essential components of this intricate picture.

Keywords: Phytochemicals, Antioxidant enzymes, Oxidative stress, Nrf2 signaling, Redox biology, Nutritional biochemistry

Metabolic Modulation through Food and Biochemical Perspectives on Nutrient-Gene Interactions

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The integration of nutrition and biochemistry has unveiled a dynamic interface where dietary components influence gene expression, metabolic pathways, and disease susceptibility. This emerging field, often referred to as nutrigenomics, explores how specific nutrients and bioactive food compounds interact with the human genome to modulate metabolic functions at the molecular level. This abstract presents a biochemical perspective on how food-derived nutrients act as signaling molecules that regulate transcription factors, epigenetic markers, and enzymatic activity involved in cellular metabolism. Nutrients such as polyunsaturated fatty acids, vitamins, amino acids, and polyphenols can activate metabolic regulators like PPARs, SREBPs, and AMPK, which orchestrate lipid metabolism, glucose homeostasis, and energy balance. Additionally, dietary factors have been shown to influence DNA methylation, histone modifications, and microRNA expression epigenetic mechanisms that contribute to metabolic plasticity and the prevention of chronic disorders. This nutrient-gene interaction framework offers profound insights into personalized nutrition strategies, enabling the design of functional foods tailored to genetic profiles. Moreover, understanding the biochemical impact of these interactions aids in predicting individual responses to diet, optimizing metabolic health, and reducing the risk of non-communicable diseases.

Keywords: Nutrigenomics, Metabolic pathways, Nutrient-gene interaction, Functional foods, Epigenetics, Molecular nutrition

Biochemistry behind the Bite, Exploring Enzyme-Nutrient Interactions in Food Digestion

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Digestion is more than just a mechanical process; it is a complex cascade of biochemical reactions driven by highly specialized enzymes interacting with diverse nutrients. This

abstract delves into the molecular interplay between digestive enzymes and macronutrients, revealing the intricate biochemical choreography that sustains human metabolism. From the moment food enters the mouth, enzymatic activity begins salivary amylase breaking down carbohydrates, pepsin cleaving proteins in the stomach, and lipases acting on dietary fats in the small intestine. Each enzymatic reaction is fine-tuned by factors such as pH, substrate specificity, and enzyme kinetics. Advancements in biochemistry have enabled a deeper understanding of how enzymes like proteases, lipases, and carbohydrase's act in synergy to hydrolyze complex food molecules into absorbable units. Furthermore, emerging research highlights the role of enzyme cofactors, gut microbiota-produced enzymes, and genetic variations in digestive efficiency and nutrient absorption. These insights have implications for the development of targeted enzyme supplements, functional foods, and personalized nutrition strategies particularly for individuals with enzyme deficiencies or metabolic disorders.

Keywords: Enzyme-nutrient interaction, Digestive enzymes, Nutrient bioavailability, Food digestion, Biochemical pathways, Metabolic health

Nutritional Biochemistry of Micronutrients: From Molecular Deficiency to Metabolic Disorders

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Micronutrients such as vitamins and minerals though required in trace amounts, play disproportionately large roles in maintaining human health through their involvement in vital biochemical processes. This abstract explores the molecular functions of micronutrients, their deficiency-induced biochemical disruptions, and the subsequent development of metabolic disorders. Essential micronutrients act as cofactors, coenzymes, and structural components in enzymatic reactions, antioxidant defense, immune function, and gene regulation. Deficiencies in key micronutrients like iron, iodine, vitamin D, B12, and zinc can lead to a cascade of metabolic dysfunctions, ranging from anemia and impaired neurodevelopment to osteoporosis and compromised immunity. At the biochemical level, micronutrient scarcity disrupts enzymatic activity, mitochondrial function, and redox balance, impairing cellular homeostasis. Emerging research highlights the intricate crosstalk between micronutrient status and signaling pathways such as mTOR, AMPK, and NF-κB, linking deficiency to inflammation, metabolic syndrome, and chronic diseases. Moreover, genetic variations in nutrient transporters and metabolic enzymes can exacerbate susceptibility to deficiency-related disorders.

Keywords: Micronutrients, Nutritional biochemistry, Deficiency disorders, Enzyme cofactors,

Metabolic dysfunction, Molecular nutrition Bioactive Peptides from Food Proteins: Biochemical Mechanisms in Cardiovascular Health

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Bioactive peptides derived from food proteins have emerged as promising agents in promoting cardiovascular health through their multifaceted biochemical activities. Released during digestion or enzymatic hydrolysis, these peptides exhibit diverse physiological functions, including antihypertensive, antioxidant, anti-inflammatory, and lipid-lowering effects. This abstract delves into the biochemical mechanisms by which these peptides modulate cardiovascular function at the molecular level. A key mechanism involves the inhibition of angiotensin-converting enzyme (ACE), reducing vasoconstriction and thereby lowering blood pressure. Specific amino acid sequences in dairy, soy, egg, and marine proteins have been shown to exert potent ACE-inhibitory activity. Additionally, bioactive peptides enhance nitric oxide (NO) bioavailability, improving endothelial function and vascular tone. Their antioxidant properties also mitigate oxidative stress, a major contributor to atherosclerosis and endothelial damage. Furthermore, these peptides regulate lipid metabolism by modulating enzymes such as HMG-CoA reductase and influencing gene expression through pathways like PPAR and AMPK. Anti-inflammatory effects are mediated by downregulating pro-inflammatory cytokines and adhesion molecules, which are implicated in the progression of cardiovascular diseases.

Keywords: Bioactive peptides, Cardiovascular health, ACE inhibition, Antioxidant activity, Nutritional biochemistry, Food proteins

Biochemical Markers of Inflammation and Role of Diet in Modulating Oxidative Stress Pathways

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Chronic inflammation and oxidative stress are pivotal contributors to the pathogenesis of various metabolic and degenerative diseases, including cardiovascular disease, diabetes, and cancer. Biochemical markers such as C-reactive protein (CRP), tumor necrosis factor-alpha (TNF- α), interleukins (e.g., IL-6), and malondialdehyde (MDA) serve as key indicators of systemic inflammation and oxidative imbalance. Emerging evidence suggests that dietary interventions play a crucial role in modulating these markers by influencing oxidative stress pathways at the molecular level. Antioxidants such as vitamins C and E, polyphenols, flavonoids, and carotenoids scavenge reactive oxygen species (ROS), thereby reducing oxidative damage and the activation of nuclear factor-kappa B (NF- κ B), a major transcription factor involved in inflammatory signaling. Omega-3 fatty acids modulate eicosanoid synthesis, shifting the balance from pro-inflammatory to anti-inflammatory mediators. Whole dietary patterns, including the Mediterranean and DASH diets, have shown significant effects on reducing systemic inflammation, as reflected by decreased levels of CRP and cytokines. These effects are mediated through nutrient-gene interactions, epigenetic modifications, and improved mitochondrial function.

Keywords: Inflammation, Oxidative stress, Biochemical markers, Nutritional biochemistry, Antioxidants, Diet therapy

Nutrigenomics and Biochemical Pathways: The Future of Personalized Nutrition

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Nutrigenomics, a rapidly evolving field that explores the interaction between genetics and nutrition, is poised to revolutionize personalized nutrition. By examining how individual genetic variations affect nutrient metabolism and responses, nutrigenomics offers a more precise approach to dietary recommendations, tailored to enhance health outcomes and prevent chronic diseases. This emerging discipline integrates the latest advancements in genomics, biochemistry, and nutrition science to better understand the biochemical pathways through which nutrients influence gene expression and cellular function. Nutrigenomics has opened new avenues for exploring how genetic polymorphisms impact the body's response to dietary components such as vitamins, minerals, fats, and carbohydrates. Variations in genes related to nutrient transport, absorption, and metabolism may influence an individual's susceptibility to nutrient deficiencies or chronic conditions like obesity, diabetes, cardiovascular diseases, and even cancer. For instance, genetic variations in genes involved in lipid metabolism can affect an individual's response to dietary fats, influencing their risk for heart disease. By incorporating genetic information into nutritional assessments, personalized nutrition can optimize dietary interventions, leading to more effective prevention and management of diet-related diseases. Understanding the intricate biochemical pathways that govern nutrient-gene interactions holds promise for developing customized nutrition plans, which not only prevent chronic diseases but also enhance overall well-being.

Keywords: Nutrigenomics, Personalized nutrition, Biochemical pathways, Gene expression, Genetic polymorphisms, Chronic diseases.

Lipid Biochemistry in Food Sciences: Exploring Fatty Acids in Disease Prevention

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Lipid biochemistry plays a pivotal role in food sciences, particularly in understanding how dietary fats and fatty acids influence health and disease prevention. Fatty acids, the fundamental building blocks of lipids, exhibit diverse biological functions that are crucial for maintaining cellular structure, energy homeostasis, and signaling pathways. In recent years, growing evidence has highlighted the essential role of specific fatty acids in preventing the onset of various chronic diseases, including cardiovascular diseases, diabetes, and certain types of cancer. Unsaturated fatty acids, including omega-3 and omega-6 fatty acids, have been particularly recognized for their anti-inflammatory and cardio protective effects. These fatty acids help maintain healthy lipid profiles, regulate blood pressure, and reduce the risk of atherosclerosis. On the other hand, excessive

intake of saturated fats has been linked to the development of obesity, insulin resistance, and increased cardiovascular risk. Recent advancements in lipid biochemistry have also shed light on the role of trans fats and the importance of balancing fatty acid intake for optimal health. In food sciences, understanding the complex interactions between dietary fats, fatty acids, and metabolic pathways can lead to more effective dietary strategies for disease prevention. The growing body of research on lipid biochemistry offers new opportunities for designing functional foods enriched with beneficial fatty acids that can improve health outcomes and reduce the prevalence of diet-related diseases. As our knowledge of lipid metabolism continues to expand, the potential for fatty acids to be integrated into personalized nutrition and disease prevention strategies is becoming increasingly promising.

Keywords: Lipid biochemistry, Fatty acids, Disease prevention, Cardiovascular health, Omega-3, Saturated fats

Enzymatic Browning and Beyond: Biochemical Reactions in Food Processing and Preservation

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Enzymatic browning, a common biochemical reaction in food processing and preservation, involves the oxidation of phenolic compounds in the presence of oxygen, catalyzed by the enzyme polyphenol oxidase (PPO). This reaction leads to the formation of brown pigments, which not only affect the visual appeal of food but also influence its flavor, texture, and nutritional quality. The process is particularly significant in fruits, vegetables, and other plant-based foods, where it can lead to reduced shelf life and consumer acceptability. This abstract explores the biochemical mechanisms of enzymatic browning, its impact on food quality, and the strategies employed in food processing to mitigate its effects. Enzymatic browning occurs in two main stages: the enzymatic oxidation of phenolic compounds and the subsequent polymerization of quinones to form melanin-like pigments. Factors such as pH, temperature, and oxygen availability significantly influence the rate of browning. While enzymatic browning is often considered undesirable in fresh-cut fruits and vegetables, it can also be beneficial in certain food products, such as teas and wines, where it contributes to desirable color and flavor characteristics. To control enzymatic browning, various methods are employed in food preservation, including the use of antioxidants, modified atmosphere packaging, blanching, and the application of inhibitors like sulfites and ascorbic acid. Recent advancements have also explored the potential of genetic modification and enzymatic treatments to prevent browning in sensitive foods. Understanding the biochemical reactions underlying enzymatic browning is essential for improving food preservation techniques and enhancing food quality.

Keywords: Enzymatic browning, Polyphenol oxidase, Food preservation, Antioxidants, Biochemical reactions, Food quality

Optimized Linear and Nonlinear Optical Properties of Al 7 -Doped Graphitic Carbon Nitride (g-C 3 N 4): A Computational Study

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In this study, pure and super halogen doped g-C 3 N 4 clusters are computed with the CAM-B3LYP method of DFT to investigate the electronic and optical properties. Single Al 7 @g-C 3 N 4 and double doped 2Al 7 @g-C 3 N 4 systems are investigated. The doping of the super halogen cluster on g-C 3 N 4 especially in a single doped system significantly improves the charge transfer properties by reducing the band gap energies from 6.42 eV to 3.23 eV. The average and total first hyper polarizabilities (β_o and β_{total}) remarkably increase from 82 to 3204 au and 136 to 5340 au, whereas average second hyper polarizability (γ_o) increases from 14×10^4 to 64×10^4 au due to their lower transition energies. The selected systems were also compared with the external reference molecule p-NA which is a well-known reference molecule for NLO applications. TD-DFT simulations reveal that among pure, single, and double doped systems, the only single doped system shows significantly better outcomes including interaction energies, vertical ionization potential, HOMO-LUMO energies, and UV-Vis absorption. The single doped system shows high absorption in the far-red region that use in lasers. The entitled systems especially single doped systems have the potential to use them as an efficient NLO material.

Keywords: Graphitic carbon nitride (g-C3 N4), Super halogen (Al7), Hyper polarizability, Interaction Energy, Electron Density Difference Map (EDDM)

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 tetra carboxylic 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 bad gaps and compound 3 to be indirect bad 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 hyper polarizability 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.

Keywords: Dielectric Function, Extinction coefficient, Refractive Index, Third-order NLO polarizability, Third-order NLO susceptibility

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. 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.

Keywords: Chalcone derivatives; Dielectric Function; Extinction coefficient; Refractive Index; Electronic coupling

Quantum Chemical Analysis of Z-Shaped Heptazethrene Derivatives: Structural Parameters, Singlet Fission, and Photovoltaic Potential

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A variety of organic solar cells has been discovered, but there is a need for efficient optoelectronic material to obtain high power conversion efficiency. In this study, we derived new molecules from Z-shaped heptazethrene. We measured its photovoltaic parameters, including frontier molecular orbitals (where the energy gap decreases to 16% as compared to the reference), molecular electrostatic potential maps (more nucleophilic core), the density of states (partial and total), absorbance in Vis-IR region (in the range of 650-1000 nm), transition density matrix, and hole-electron mobility in terms of reorganization energy that showed 11% higher electron mobility (λ_e) and 52% higher hole mobility (λ_h) as compared to the reference. A comparable power conversion efficiency (~9%) is obtained from a single photon. Using the concept of singlet fission, we can increase the efficiency twice using a single photon (based on the di-radical character of the molecule). The di-radical character of the entitled molecules was also calculated. The designed molecules fulfil the criteria of singlet fission that generate two excited triplets from a single photon ($E_{S1} > 2E_{T1}$). The designed molecules are more stable than the reference indicated by the singlet-triplet energy gap, which is 37% higher. Hence this work assists the researcher in enhancing the efficiency of the solar cell.

Keywords: Organic solar cells, di-radical character, singlet fission, charge transfer properties, power conversion efficiency

Quantum Chemical Study of TIPSTAP Derivatives with Minimized Crystal Roughness: Enhancing Photovoltaic Performance with Over 20% PCE

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In this study, we probed the TIPSTAP molecule, which is highly appropriate for developing organic photovoltaic cells, but its use was hampered due to crystal brittleness and limpidity. As an alternate to TIPSTAP, we disclosed four molecules derived from the TIPSTAP thanks to the alteration with the acceptor groups at the hub and ter. butyl group to substitute phenylic hydrogen atoms. All the molecular structures have been analyzed with a DFT approach, and obtained results are compared with TIPSTAP. The bandgap curtails up to 24% in engineered molecules, enhancing the charge transfer properties. These molecules showed improved photophysical properties at the longer wavelength relevant for photovoltaic cells. To enhance the open-circuit voltage, designed acceptors molecules are aligned with the P3HT donor, improving photovoltaic performance. The power conversion efficiency of TIPSTAP, TAPTA1, TAPTA2, TAPTA3, and TAPTA4 with short circuit current density of 9, 12, and 15 mA/cm² ranges from 20-35% at a constant molecular open-circuit voltage that is better than pristine TIPSTAP or P3HT.

Keywords: TIPSTAP; Density Functional Theory; power conversion efficiency; organic solar cells; charge transfer properties

Design of Benzothiazole-Based Non-Fullerene Acceptor Molecules for High-Efficiency Organic Solar Cells

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To enhance the efficiency of organic solar cells (OSCs), five non-fullerene π -conjugated acceptor molecules namely BTM1, BTM2, BTM3, BTM4 and BTM5 are designed from recently reported 16.5% efficient acceptor molecule BTP-CI. The molecules in the present quantum chemical investigation consist of benzothiazole (BT) core with different chemical species on the terminal side. The optoelectronic study of BTM1-BTM5 reveals that BTM3 and BTM4 molecules are superior with respect to absorption range found at the wavelengths of 780 and 791 nm as compared to 746 nm of reference molecule BTP-CI. Frontier molecular orbital (FMO) and transition density matrix (TDM) analysis are performed that give basic information about the distribution of charges among investigated molecules. All investigated molecules exhibit charge density spread over the entire molecules. The BTM4 and BTM5 molecules efficiently transfer their electron densities from highest occupied molecular orbital (HOMO) to lowest unoccupied molecular orbital (LUMO) with narrow bandgaps of 1.86 eV and 2.14 eV respectively. The electron mobility for BTM3 (0.00527), BTM4 (0.005820) and BTM5 (0.00539) are found less than BTP-CI (0.00643). Similarly, BTM5 gives the least value of whole mobility (0.00558) as compared to BTP-CI (0.00803). The binding energies of these molecules are also observed less (0.28 eV, 0.29 eV and 0.33 eV for BTM3, BTM4 and BTM5) in gas phase than BTP-CI (0.35 eV). Also, BTM5 is tested with donor polymer PTB7-Th that provides further evidence for their interactions. It turned out that the structural tailoring at terminals can tune effectively the frontier molecular orbital energy levels, band gap, absorption spectra, open-circuit voltage, reorganization energy and binding energy value in investigated molecules. Our results suggest that the investigated molecules can serve as fine acceptor materials. Additionally, some investigated molecules can also be used as a hole and/or electron transport materials for OSCs.

Keywords: Benzodithiazole, Acceptor, Open-circuit Voltage, Small molecules, Charge

Transfer Quantum Chemical Study of Structural and Optical Properties of Pure Silver Clusters (Ag n , $n = 2-10$): Linear and Nonlinear Optical Response

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In this study, pure silver clusters Ag n ($n = 2-10$) through a density functional method is explored to analyze the structure-property relationship with the linear and nonlinear optical response. The total density of state (TDOS), photoelectron spectra (PES) and non-covalent interaction (NCI) analyses are also performed to get structural information regarding the bonding environment. New energy levels developed as the silver atoms in higher clusters which are indicated by lowering the HOMO energy level. Among these clusters, Ag 5 and Ag 9 showed unusual behaviour with higher first hyper polarizability values (1076 and 2223 au, respectively). The results of hyper polarizability are compared with the external reference molecule para-nitro aniline (p-NA). Additionally, a two-level model has been applied to rationalize the first hyper polarizability. The primary outcomes

of this study enable the scientist to use silver clusters for photovoltaic applications or as a dopant to enhance the nonlinear optical response.

Keywords: Silver cluster, Isotropic polarizability, Anisotropic polarizability, Photoelectron Spectrum, Non-covalent interaction, First hyper polarizability.

Synthesis, Crystal Growth, Structural Characterization, and Theoretical Calculations of Methylenium Salts of Benzenesulfonates: Insights into Supramolecular Chemistry

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The current investigation describes the synthesis of four novel methylene blue (MB) salts of benzene sulfonate derivatives, featuring bulky anionic groups. The process involves treating chloride salt of MB with sodium salts of 4-aminobenzene sulfonate, 4-styrenebenzene sulfonate, 3,7-naphthalene disulfonate, and anthraquinone-1,5-naphthalene disulfonate to substitute the chloride ion with benzoate sulfonate anion in MB-chloride. The synthesis includes quaternizing MB-chloride with the corresponding benzene sulfonate in minimal aqueous solvent to promote precipitation. The resultant precipitates were subsequently dissolved in an appropriate solvent to enable the crystallization of the ultimate product. The dissolution occurs either at ambient temperature or with heat. The crystals of the resultant salts were characterized using various analytical techniques like UV-visible, and FT-IR spectroscopy, TGA, single crystal X-ray diffraction and powder X-ray diffraction analysis. The UV-visible spectroscopic results, frontier molecular orbital, density of states, molecular electrostatic potentials, and HOMO-LUMO energy gaps were estimated by DFT. Structural analysis revealed that supramolecular structure of compounds achieved stabilization through electrostatic interactions, a diverse range of both conventional and non-conventional hydrogen bonds, π - π stacking interactions, and other short-range interactions. The investigation delves into intricate details and offers a thorough discussion of the fundamental principles that contribute to the formation and stabilization of supramolecular structures.

Keywords: Methylene salt of 4-aminobenzenesulfonate, 4-styrenebenzenesulfonate, 3,7-naphthalenedisulfonate, Anthraquinone-1,5-naphthalenedisulfonate; Supramolecular Chemistry, Thermal studies, HOMO-LUMO energy gaps, Density of states (DOS).

Mesenchymal Stem Cell Therapy for Chronic Liver Diseases

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Chronic liver disease leads to 2 million fatalities globally each year, mainly from cirrhosis and liver failure. Present treatments, like drug therapies and liver transplants, come with limitations such as lack of donors, possibility of transplant rejection and the need for lifelong immunosuppression. These difficulties highlight the necessity for regenerative

strategies, with stem cell therapy appearing as a hopeful alternative because of its immunomodulatory and regenerative qualities. Mesenchymal stem cells (MSCs), sourced from bone marrow, fat tissue and umbilical cord, hold therapeutic promise because of their minimal immunogenicity and their ability to transform into hepatocyte-like cells. Additionally, extracellular vesicles and derived from MSCs possess regenerative capabilities without the risk tied to direct cell transplantation. This research the recent findings on MSC-oriented therapies, highlighting their function in reducing liver fibrosis and promoting hepatocyte regeneration. Clinical trials underscore the ability of MSCs to rejuvenate liver function and enhance post-transplantation recovery, with 54% of patients exhibiting nearly normal liver enzymes, better synthetic function and decreased fibrosis, as innovative delivery methods and bioengineering strategies boost therapeutic effectiveness. Although initial results are encouraging, obstacles persist standardization and long-term effectiveness, necessitating additional clinical trials to confirm MSC therapy as a practical option for liver transplantation.

Keywords: liver disease, mesenchymal stem cells (MSCs), hepatocyte regeneration, clinical trials, post-transplantation recovery

Role of AI in Diagnostics and Disease Treatment

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Artificial Intelligence (AI) replicates human intelligence in machines that can learn, reason and make independent decisions. In recent years, AI has transformed diagnostics, operational efficiency and patient care by automated inventory management, predicting equipment maintenance and scheduling tests, resulting in enhanced test efficiency, reduced human errors and streamlined operations, thereby reducing cost and turnaround times. Medical laboratories impact more than 70% of the diagnoses globally, but conventional methods encounter challenges in scalability, consistency and minimizing errors. Recent research has demonstrated that AI-aided diagnosis improves accuracy by 33.7%, while AI technologies, including natural language processing (NLP), enhance pathology image analysis and detect biomarkers for disease prediction and targeted treatment. Even with its advantages, numerous challenges are main, including issues related to data privacy, infrastructural deficiencies, expensive cost and regulatory limitations. These challenges can be tackled by enhancing digital infrastructure, affordable solutions, and a regulatory framework. In the future, robotic automation driven by AI and real-time infection surveillance will increase the effectiveness of healthcare systems even more.

Keywords: artificial intelligence (AI), laboratory automation, ai-aided diagnosis, disease prediction, operational efficiency

Transforming Food Safety with AI: Opportunities and Ethical Imperatives for Sustainable Progress

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Artificial intelligence (AI) is becoming more widely acknowledged as a major facilitator of sustainable development, providing game-changing solutions in vital areas including food

safety, energy, agriculture, healthcare, and climate change. AI driven technologies specifically, machine learning and computer vision have improved quality control procedures in the food industry by facilitating real-time monitoring, quick contamination identification, predictive modelling of foodborne hazards, and supply chain traceability optimization. These developments have a major impact on waste reduction, regulatory compliance, and food safety. In a broader sense, AI promotes sustainability through sophisticated data analytics, environmental monitoring, and resource optimization. Nevertheless these developments, there are still a number of obstacles to overcome when incorporating AI into frameworks for sustainable development. To make certain equitable and moral application, issues with data privacy, algorithmic transparency, model interpretability, high computational needs, and uneven access to AI technology must be resolved. Additionally, there are technological challenges for consistent model performance and scalability due to the complexity and variety of dietary data. With an emphasis on its uses in food safety and quality management, this study examines the various ways artificial intelligence (AI) is contributing to the Sustainable Development Goals (SDGs) of the UN. It draws attention to recent developments, real-world difficulties, and policy issues while highlighting the necessity of strong governance structures and interdisciplinary cooperation. AI's potential as a catalyst for sustainable development must be fully realized through a responsible, inclusive, and balanced approach.

Keywords: Artificial intelligence, Digital Food System, Quality assurance, Sustainable Development, Machine Learning

Role of Good Manufacturing Practices (GMP) in Ensuring Safety and Quality of Genetically Modified (GM) and Fermented Foods

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Safety of food continues to be a key issue for consumers as well as regulatory agencies. GMP are key guidelines ensuring consistent manufacture of safe, high-quality food by minimizing physical, chemical, and microbial hazards. For GM and fermented foods, GMP is a key factor ensuring safety and consumer confidence. For GM foods, GMP affirms compliance in procedures such as equipment sterilization, record maintenance for batches, training of people, traceability systems, and control against cross-contamination. More than 80% of GM-related product recalls are attributable to labeling mistakes, faulty cleansing, and defective documentation, reports the European Food Safety Authority. Molecular characterization, proper use of approved ingredients, and controlled storage facilities are also called for by GMP to secure integrity. Important GMP practices in fermented food manufacturing involve having hygienic fermentation vessels, microbial culture monitoring, time and temperature management of fermentation, and having effective pest and sanitation measures. A traditional fermented food study reported that almost 60% of microbial contamination results were caused by breaches in hygiene and environmental monitoring. Such practices ensure the preponderance of beneficial microbes while inhibiting the growth of pathogens. GMP should be applied consistently in both industries to reduce foodborne hazards, enhance shelf life, and achieve international

standards for safety. The importance of ongoing improvement of GMP and more vigorous regulatory enforcement is underscored in this abstract.

Keywords: Food Safety, Fermented Foods, Good Manufacturing Practices, Genetically Modified Foods, Quality Control

Advances in Food Encapsulation: Materials, Mechanisms, and Industrial Applications

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Encapsulation is advance method in Food Sectors for encasing active ingredients including minerals, flavorings, and probiotics in a carrier material. Protection against degradation, increased stability, higher functioning, and regulated release of the encapsulated chemicals are just a few benefits of this method. Adequate encapsulating materials are biodegradable, safe to eat, and able to provide a strong barrier between the core substance and the outside world.

Although proteins and lipids are also good substitutes, polysaccharides have superior film-forming and biocompatible qualities. Novel fat-based coatings exhibit good encapsulation performance, but their particle size distribution efficiency is lower. Various food components can be encapsulated, including acids, bases, artificial sweeteners, flavoring agents, colorants, preservatives, antioxidants, nutrients, vegetable and fish oils, and powdered creamers. The primary purposes of encapsulation are to enhance digestibility and nutritional value, enable controlled release, and protect sensitive ingredients from heat, moisture, and other environmental conditions as well as extending shelf life. Release mechanisms are generally categorized as site- specific, stage-specific, or stimuli-responsive, triggered by factors such as pH, temperature, irradiation, or osmotic pressure. Solvent-activated release is the most commonly used approach in food applications. Spray drying is the most widely applied encapsulation technique due to its low cost and scalability, though it is not suitable for heat- or moisture-sensitive compounds. Other encapsulation methods include spray chilling, extrusion coating, fluidized bed coating, liposome entrapment, coacervation, and aqueous diffusion. Current research efforts aim to reduce production costs and develop novel food-grade encapsulating materials for expanded use in food systems.

Keywords: Encapsulation, Bioactive Compounds, Stability Enhancement, Fat-Based Coatings, Shelf Life Extension

Seaweed-Derived Bio-products relation with Food Technology

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Seaweed is a renewable, aquatic resource with significant potential to reduce reliance on nonrenewable materials such as fossil fuels. Rich in complex polymers like alginates, fucoidans, carrageenans, and agar, seaweed is highly versatile and suitable for producing bio-plastics, emulsifiers, and other biomaterials. Its cultivation requires no additional nutrients, making it a sustainable option for large-scale production. Seaweed-derived compounds are widely applied in functional foods, nutraceuticals, and eco-friendly

packaging. Alginates, in particular, are used to produce bio-plastics through extraction and formulation processes that are evaluated for mechanical strength and biodegradability. These hydrocolloids also exhibit gelling, stabilizing, and emulsifying properties, making them effective natural alternatives to synthetic additives in food products. Biotechnology advancements have enabled the identification of new emulsifier peptides from seaweed, further expanding its applications. Seaweed-based edible coatings and wraps are used to enhance the shelf life of fruits, vegetables, and sushi products, while kelp-derived powders like kombu are utilized as natural flavor enhancers to increase umami in sauces and seasonings. Moreover, seaweed is a source of essential nutrients, including omega-3 fatty acids, vitamins B12, E, K, and minerals such as calcium, iron, and zinc. Seaweed-based probiotics and prebiotics also promote gut and immune health. Despite high production costs, seaweed bioproducts offer unique advantages, and ongoing research focuses on improving fermentation technologies and cultivation methods to support sustainable material innovation.

Keywords: Seaweed-derived products, Eco- friendly food Solutions, Natural emulsifier, Seaweed in food Technology

Advances in Detection and Regulation of Physical Toxins in Street Food

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In urban food culture, street food is essential because it provides millions of people with easily accessible and reasonably priced meals. Physical toxins, on the other hand, like glass shards, metal fragments, plastic particles, and other foreign materials, can seriously harm consumers' health. Recent developments in the identification and control of physical contaminants in street food are examined in this paper. The ability to recognize and eliminate these risks has greatly improved thanks to innovations like magnetic separation, hyperspectral imaging, X-ray inspection systems, and AI-powered detection tools. The advancement of smartphone-based microscopy and portable field-testing equipment also improves on-site safety inspections. With more stringent licensing requirements, regular inspections, traceability systems, and educational programs targeted at enhancing vendor compliance and consumer awareness, regulatory measures are also changing. Not with standing advancements in technology, issues with scalability, affordability, and enforcement still exist. Closing these gaps is essential to maintaining street food safety and safeguarding public health in expanding urban areas.

Keywords: Urban food culture, Street food, Consumer health, Physical contamination Public health

Identification of differential expressed genes and potential targets in diabetic neuropathy using machine learning and bioinformatics analysis

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Diabetic neuropathy (DN), a severe complication impacting over fifty percent of the population with diabetes, results in nerve degeneration, persistent discomfort, and diminished quality of life. Early diagnosis continues to be challenging due to the absence of effective biomarkers, despite its widespread prevalence and economic impact. This

study combines bioinformatics and machine learning to discover differentially expressed genes (DEGs) and therapeutic targets in diabetic nephropathy (DN). We identified 762 differentially expressed genes (321 upregulated, 441 downregulated) and revealed their roles in extracellular matrix organization, cell cycle regulation, and inflammatory pathways (e.g., IL-17, p53 signaling) utilizing transcriptomic datasets from diabetic and non-diabetic patients. Protein-protein interaction networks identified hub genes (CDK1, CCNB1, EGFR, TOP2A) essential for the progression of diabetic nephropathy. Five machine learning techniques—Random Forest, XGBoost, and SVM—demonstrated substantial diagnostic potential by identifying novel biomarkers: KLF8, LTBP4, PTPRN, OSR1, and CLCA2. Molecular docking targeting these biomarkers identified FDA-approved medications, indicating potential repurposing prospects. This study integrates clinical applications to enhance the comprehension of diabetic neuropathy and offers relevant biomarkers for early diagnosis and precise therapy. Our findings demonstrate the revolutionary impact of machine learning in understanding complicated diseases and expediting therapeutic discovery.

Keywords: Diabetic neuropathy, DEGs, Novel Genes, Drug repurposing, Machine learning.

Plasmon mode generation in Indium antimonide (InSb) loaded slab waveguide bounded by metal and graphene layers

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Theoretical analysis of surface Plasmon polaritons (SPPs) in Indium antimonide (InSb) filled parallel plate waveguide (PPWG) bounded by graphene and metal layers is conducted in terahertz (THz) frequency spectrum. Kubo formalism and Drude model are used for the physical modelling of graphene conductivity and InSb materials. The study focuses on transverse electric (TE) and transverse magnetic (TM) surface waves. A key challenge addressed in this work is the modelling of an atomically thin graphene sheet layered over an InSb grounded slab. To derive the dispersion relation for EM surface waves for proposed configuration, the surface current boundary conditions are employed. Based on the numerical results is reported that TE waves do not support surface wave propagation, whereas TM waves exhibit significant propagation properties. Using Wolfram Mathematica 12.0, key parameters such as the dispersion relation and different characteristics of EM surface waves i.e., effective mode index, phase speed, propagation length, and field profiles are studied for TM surface waves. The analysis highlights that as temperature rises, the plasma frequency of InSb increases, causing a shift in the resonance frequency and characteristics curve. Additionally, the effective wave number of TM surface wave's increases with temperature, leading to enhanced confinement of these waves in the graphene-loaded InSb structure. These findings demonstrate that the temperature-dependent properties of InSb can be utilized to tune surface wave propagation in the THz region. This research has potential applications in thermo-optical sensing, near-field communication waveguides, and the design of graphene- based temperature sensors.

Dyakonov surface waves supported at anisotropic chiral-isotropic plasma planar structure

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A theoretical model is developed to study the generation of Dyakonov surface waves at anisotropic chiral and isotropic plasma planar structure in THz frequency regime. Differential form of Maxwell's equation is utilized to solve the analytical problem and impedance boundary conditions are employed to obtain dispersion relation. Constitutive relations for anisotropic chiral are analyzed to obtain equation. Three different cases of anisotropic chiral i.e., case I=, case II= and case III= are analyzed to explore the characteristics of Dyakonov surface waves for proposed structure. Influence of plasma collisional frequency, plasma frequency and chirality parameter on normalized propagation constant and propagation loss are analyzed. Unlike case I, the normalized propagation constant increased with increasing plasma collisional frequency for case II and case III and vice versa for propagation loss. In case II and case III, higher normalized propagation constant is observed at lower plasma frequencies, whereas case I exhibits the highest normalized propagation constant at higher plasma frequencies. By leveraging the variations in plasma frequency in the presence of analytes, nanophotonic sensors can achieve enhanced sensitivity for detecting chemical and biological species. The normalized propagation constant rises as chirality increases in all proposed cases. It is important to note that the chirality parameter is extremely sensitive in case I and case II. Present study can be used can be applied in photonics and integrated optics for the development of nanophotonic devices operating in the terahertz (THz) frequency range and provide additional degree of freedom due anisotropy of chiral medium.

Electromagnetic waves propagation in black phosphorus loaded parallel plate waveguide surrounded by plasma layers

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The interaction of electromagnetic waves with advanced optical materials attained significant attenuation in current arena of optics sector. In this research, electromagnetic waves propagation in plasma loaded waveguide surrounded by black phosphorus layers. Electromagnetic fields components are derived with the help of extended electromagnetic wave theory. Dispersion relation is derived by applying boundary conditions at proposed configuration for transverse magnetic surface mode. Impact of number density, core width of plasma medium, carrier concentration and number of black phosphorus layers on normalized phase constant along armchair and zigzag conductivity are studied in THz frequency spectrum. Based on computational results, it is concluded that armchair conductivity has lower normalized phase constant and support low frequency compared to the zigzag conductivity of BP for proposed waveguide structure. Furthermore, frequency fluctuations provide an additional degree of freedom to control electromagnetic. The presented results may have potential applications to fabricate black phosphorus-based nanophotonic devices in the THz frequency range. These unique characteristics

of electromagnetic waves may have cutting-edge applications to fabricate black phosphorus-based optoelectronic devices.

Numerical calculations of transverse electric (TE) surface waves propagation at magnetic materials-plasma- magnetic materials interfaces

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Numerical calculations of transverse electric (TE) surface waves propagating in magnetic materials loaded between plasma layers is analyzed in this research. The study employs Maxwell's equations in differential form, and the dispersion relation for the proposed structure is derived by applying appropriate boundary conditions. The effects of key parameters, such as number density, separation distance between plasma layers, and the dielectric permittivity of the ferrite film, on the real part of propagation constant versus GHz frequency are thoroughly investigated. The results indicate that an increase in number density and dielectric permittivity of the ferrite film leads to a decrease the real part of propagation constant. Conversely, increasing the separation distance between the plasma layers causes the real part of propagation constant to rise. Additionally, the normalized field distributions for both the plasma and ferrite medium are analyzed to validate the existence of surface waves. This research has significant potential applications in various fields, including communication systems, drug delivery, cancer treatment, and the development of ferrite-based sensing waveguide structures operating in the GHz frequency range. Our research reveals the potential advantage in various fields, including communication systems, drug delivery, cancer treatment, and the development of ferrite-based sensing waveguide structures operating in the GHz frequency range.

Numerical behaviour of surface plasmon polaritons at chiroferrite-graphene interface for THz applications

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In this research, behaviour of light plasmon coupling at chiroferrite-graphene are analyzed at planar structure. Kubo formulism is used for graphene conductivity and impedance boundary conditions are employed to obtain characteristics equation. Differential form of Maxwell's equation is used to solve the analytical problem. Influence of chiroferrite features (chirality, gyrotropy) and graphene features (fermi level, relaxation time, number of graphene layers, temperature) are analyzed in detail. Due to anisotropy of chiroferrite medium two types of modes appeared namely as: upper mode and lower mode. Based on numerical analysis it is reported that wave vector and plasmonic frequency are strongly influenced by chirality, gyrotropy, fermi level, relaxation time, number of graphene layers and temperature for both modes. The cut-off frequency for lower mode is also analyzed for proposed configuration. By manipulating the parameters of graphene and chiroferrite materials can plasmonic scientists enable advancements in chiral sensing, microwave

devices, antennas, and magnetic resonance imaging (MRI) applications operating in the terahertz (THz) frequency range.

Characteristics of photon plasmon coupling in graphene sandwiched between magnetized plasma layers for THz applications

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This study examines the properties of surface plasmon in single graphene sandwiched between magnetized plasma layers are analyzed in THz frequency regime. The complex conductivity of single graphene is modelled by using Kubo formalism. For this purpose, Wolfram Mathematica computer software is used to plot the numerical results. The anisotropic nature of the magnetized plasma medium allows for the exploration of both higher and lower modes, which are analyzed to understand the behavior of the proposed waveguide structure. The study investigates the dependence of these propagating modes on plasmonic frequency, focusing on the effective wave index and normalized phase velocity under varying parameters such as chemical potential, relaxation time, number of graphene layers, electron plasma frequency, and cyclotron frequency. Additionally, field profiles for the magnetized plasma are presented to validate the conditions for electromagnetic surface waves. The presented results can to increase the efficiency of nanophotonic devices due to presence of graphene layers.

Ab initio study of V doped BeTe for spintronic and optoelectronic applications

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The electromagnetic, and optical characteristics of Be $1-x$ V x Te ($x= 6.25\%$, 12.5% , 25%) are computed by employing density function theory (DFT). The full-potential linearized augmented plane wave (FP-LAPW) approach was used within the frame work of Wein2k to explore spin polarized band structure along with total and partial density of states. Stability of corresponding compounds is confirmed by enthalpy of formation energy. Spin-polarized electronic band structure and density of states reveal the half metallic ferromagnetism (HMF) nature of Be $1-x$ V x Te ($x= 6.25\%$, 12.5% , 25%). Be $1-x$ V x Te ($x= 6.25\%$, 12.5% , 25%) compounds have band gap values of 1.30, 0.89, 0.51 eV, respectively. Owing to the presence of Mn-3d orbitals, the total magnetism is primarily originated from dopant atom. Moreover, the optical properties including their parameter such as reflectivity, absorption coefficient, refraction and dielectric function are analyzed within energy span of 0-10 eV. Low reflectance and high absorption in visible to ultraviolet (UV) zone suggest potential of respective compound for optical gadgets. Computed analysis reveal that the electronic, optical and magnetic features pave a new route to experimentalist for potential usage in optoelectronic and magnetic storage devices.

Relationship between the Mediterranean diet and cardiovascular risk reduction in people with type 2 diabetes in Okara, Pakistan

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The aim of this study is to find out the link between the Mediterranean diet and cardiovascular risk reduction in people with type 2 diabetes in Okara, Pakistan. People with type 2 diabetes are at higher risk of cardiovascular problems and many diseases like higher blood pressure, high cholesterol levels and inflammation. The Mediterranean diet resolves these risks through its nutrient dense component. By visiting hospitals and previous research paper we know that the Mediterranean diet is more effective than other diets. Mediterranean diet includes healthy fat (like in olive oil), antioxidants from (fruits and vegetables) and fiber (from whole grains) which improves blood sugar control, lower inflammation and manage heart health.

Keywords: Diabetes, heart disease, Mediterranean diet, okara Pakistan

Clean-Label Preservation of Dehydrated Fruits and Vegetables: Advances in Natural Additives as Sustainable Alternatives

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The hunt of natural substitutes for artificial preservatives in dehydrated fruits and vegetables has been demanded by consumers' increasing preference for clean-label products. Despite their effectiveness, traditional chemical preservatives present health and environmental risks, so sustainable preservation techniques must be developed. Recent developments in the application of natural additives as efficient preservation agents, including plant extracts, organic acids, and bioactive compounds, are examined in this abstract. These components help to prolong shelf life while preserving product quality because they have antimicrobial and antioxidant qualities. Furthermore, new technologies such as advance drying method including freeze drying and vacuum drying, fermented driven antimicrobials and edible films and coating that improve the stability and safety of dehydrated products. Combining these methods presents a viable route to more sustainable and clean food preservation. Future studies should concentrate on improving formulations, comprehending how food matrices and natural additives interact, and enabling large-scale commercial applications.

Keywords: Natural additives, Preservation techniques, Dehydrated products, Antimicrobial properties, Sustainable food preservation

AI and Machine Learning in Food Quality Control and The impact of artificial intelligence on detecting food adulteration and maintaining quality standards.

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Advanced technological solutions for quality control are required due to the growing complexity of food supply chains and the rise in food adulteration cases. By facilitating real-time monitoring, quick adulteration detection, and predictive analytics, artificial intelligence (AI) and machine learning (ML) have become potent instruments for improving food safety. Artificial intelligence (AI)-powered image processing, spectroscopy analysis, and sensor-based technologies can accurately detect contaminants, categorize food items, and evaluate freshness. Additionally, machine learning algorithms help with data-driven decision-making, which enables food producers to anticipate spoiling, identify fraud, and guarantee adherence to legal requirements. Future studies and technical

developments will be essential to resolving issues with data accuracy, cost-effectiveness, and regulatory acceptance as the food industry continues to use AI-driven solutions.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Food Adulteration Detection, Quality Control, Predictive Analytics

Correlation of mental health and nutritional status of inhabitants of shelter home

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This study aimed to investigate the mental health status and nutritional habits of women living in shelter homes. A questionnaire-based survey was conducted among 16 women residing in a local shelter home. The results revealed alarming rates of vitamin D deficiency, anxiety, and digestive issues among the participants. These findings highlight the need for targeted interventions to address the physical and mental health needs of women in shelter homes. This study contributes to the existing literature on the health vulnerabilities of women in shelter homes and underscores the importance of providing comprehensive support services to this vulnerable population.

Effect of Organic Manure Application on Nitrogen Use Efficiency In Rice Crop

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Rice (*Oryza Sativa* L.) is a Cereal grain and staple food for more than half of the world's population, particularly in Asia. A research field study was laid out to examine the effects of organic manures like farmyard manure, poultry manure and ash as a source of nitrogen (N) on rice growth. Twelve treatments for urea, poultry manures, farmyard manures and ash were applied as follows: T (1) Nitrogen@55kg/acre, T (2) FYM @5.06 ton/acre, T (3) PM @8.09 ton/acre, T (4) Ash@ 5.66 ton/acre, T (5) FYM @5.06 ton/acre +50% N, T (6) PM@8.09 ton/acre + 50% N, T (7) Ash@ 5.66 ton/acre + 50% N, T (8) FYM@5.06 ton/acre + 75% N, T (9) PM@8.09 ton/acre + 75% N, T (10) Ash@ 5.66 ton/acre + 75% N, T (11) FYM @5.06 ton/acre+ Ash@ 5.66 ton/acre + 50% N, T (12) FYM @5.06 ton/acre+PM@8.09 ton/acre+Ash@ 5.66 ton/acre + 75% N. The field study was laid at Research Area in the University of Agriculture Faisalabad Sub-Campus Depalpur-Okara employing a Completely Randomized Block Design (CRBD) with three repetitions. After harvesting data relevant to yield parameters was recorded using standard methods. At a probability of 5%, the significant means were separated using the least significant difference test. The results showed that the value of Electrical Conductivity (EC) was 2.7 dS/m. The maximum value of sodium (Na⁺) was 17 ppm for T12 treatment. The maximum numerical value of plant height was 87 cm for T12 treatment. The maximum value of potassium (K⁺) was 29 ppm noted for T12. The maximum value of sodium (Na⁺) uptake by plants was 1.1 ppm for treatment T12. Hence, it is concluded that increasing organic sources had a significant effect on rice growth by improving all physiological and chemical traits in the Basmati-variety of rice.

Keywords: Rice, Organic Manure, Nitrogen, Sodium, Potassium

Alleviation of Salinity Stress by Potassium Nitrate Application in Soybean (Glycine Max L.) GENOTYPES

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Salinity is the largest threat to agriculture all over the world, minimizing growth and yield of crops. A hydroponic experiment was conducted to evaluate the extent of salinity tolerance among eleven soybean varieties under induced salt stress. Plants were transferred into 200 liter metal tub containing Hoagland solution, where they were maintained under greenhouse conditions for two-weeks. Treatments comprising varying concentration (0.00 mM, 60 mM or 120 mM) of sodium chloride (NaCl) alone and in combination with potassium nitrate (60 mM NaCl + 6 mM KNO₃, 60 mM NaCl + 9 mM KNO₃, 120 mM NaCl + 6 mM KNO₃ and 120 mM NaCl + 9 mM KNO₃) were added to each tub. The results revealed that significant reduction was observed in growth, water balance, gas exchange and ion uptake parameters in response to treatments. Reduction was maximum when plants were exposed to 120 mM NaCl + 9 mM KNO₃ followed by 120 mM NaCl alone while minimum reduction was recorded in control. Varieties No. 62 and No. 13 were recognized as most salt tolerant while Ajmeri and William-82 as the most salt sensitive. The results also revealed that the applications of potassium nitrate in salt media enabled plants overcoming the salinity stress, with the higher level of potassium nitrate resulting in best recovery.

Keywords: Salinity, Potassium Nitrate, Soybean, Sodium Chloride, Salt Tolerance

Mitigation of Salt Stress by Potassium Nitrate Application In Soybean (Glycine Max L.) Genotype

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To study the salinity tolerance and sensitivity of soybean genotypes and application of potassium either reduce the harmful effects of salinity, a hydroponic study was conducted. Pre-germinated seeds of soybean grown in sand trays were transferred to different tubs having 200 liter of Hoagland solution. After two weeks, application of treatments comprising of NaCl (60 and 120 mM) with KNO₃ (6 mM KNO₃ + 60 mM NaCl, 9 mM KNO₃ + 60 mM NaCl, 6 mM KNO₃ + 120 mM NaCl and 9 mM KNO₃ + 120 mM NaCl) was performed to each tub, while in control no salts were added. Plants harvested after 120 days were analyzed for morphological, physiological and biochemical analyses. Results showed that all the genotypes under salinity stress responded with significant reduction in both shoot and root fresh and dry weights, root and shoot lengths, relative water contents, leaf area, membrane stability index and chlorophyll contents (a, b and

a+b), gas exchange parameters and K + (leaf and root) with maximum reduction recorded in 9 mM KNO₃ + 120 mM NaCl application whereas the concentration of antioxidant enzymes, Na⁺ and K⁺ /Na⁺ ratio decreased with increasing salinity. Response of all soybean genotypes towards treatments was variable while No. 62 emerged as the most salt tolerant and Ajmeri was recognized as most salt sensitive. Application of potassium helped plants alleviate salt stress by showing significant improvement in all parameters at both levels of KNO₃ with more improvement at higher level (9 mM KNO₃) along with 60 mM NaCl. Salt tolerant varieties were better in utilizing potassium for better salt tolerance as compared with salt sensitive.

Keywords: Potassium, Salinity, Water Relations, Antioxidant Enzymes, Soybean

Interaction of Salinity and Potassium Application on Growth, Biochemical Parameters, Protein and Oil Quality of Soybean Genotypes

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Potassium nutrition ensures optimum yield and quality of crops. This study was conducted to evaluate the impacts of different levels of K on the growth, yield protein and oil quality of four soybean (*Glycine max* L.) genotypes. Soybean genotypes were grown in pots accommodating salinity (control, 6 and 12 dS m⁻¹) and K doses (control, 50 and 75 kg ha⁻¹). Adequate K nutrition enhanced plant growth, biomass production, protein and oil quality of soybean genotypes both normal and saline conditions. Across K application rates, soybean genotypes significantly varied from each other. K accumulation was positively correlated with the growth and yield of soybean genotypes, but these relationships were stronger in case of No.62 and No 13 than Ajmeri and William-82 genotypes. The study concluded that adequate K nutrition (75 kg K ha⁻¹) enhanced the growth, yield, protein and oil quality of all soybean genotypes under saline conditions.

Keywords: Soybean, Yield, Potassium, Protein, Oil

Exogenous Application of Commercial Organic Acids on Growth and Phosphorus Uptake by Maize

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Phosphorus (P) deficiency in soil is a major constraint to crop productivity, particularly in alkaline and calcareous soil. Plants release certain organic acids to modify the rhizosphere chemical and biological properties in response to certain stresses particularly the P deficiency. We hypothesized that exogenous application of commercial organic acids in soil may have similar impact on P availability and yield of maize crop. Three organic acids viz citric, oxalic and humic acids were selected to test their effectiveness on P availability in a pot culture experiment. The soil used is alkaline with a pH of about 8.2 having no salinity or other stress. The dose for organic acids used was 2, 3 and 4 mmol/kg of each. The recommended dose of N, and K were applied, while P application

was managed as per 100%, 50% and 25%. The four seeds of the 1429 pioneer variety were sown in pots filled with 15 kg of soil, and thinned to 2 plants after 20 days of sowing. There are 3 replicates of each treatment having completely randomized design. Basic soil properties, and growth parameters of maize plants will be monitored. We hope that the exogenous application of organic acids will not only improve the soil plant growth, but it will also improve the P concentrations in the plant leaves and grains. The experiment is in progress, and results will be analyzed statistically using statistics. This would be an environment and farmer friendly approach because it will improve the P use efficiency and thus will reduce the P fertilizer application rates, the major input cost for the maize crop.

Keywords: Phosphorus uptake, maize growth, nutrient efficiency, sustainable agriculture.

Exogenous Application of Organic Acids to Improve P Uptake by Canola Crop In Alkaline

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Soil is crucial for crop production as it provides plant nutrients and metabolic processes necessary for growth, development and survival of the crop. Use efficiency of applied phosphatic (P) fertilizers efficiency in calcareous soil is less as P contents of these fertilizers are fixed or precipitated by Ca^{+2} and Mg^{+2} in such soil. This efficiency can improved by integrating organic acid with the fertilizers. It can also improve soil fertility and reduce nutritional deficiencies, leading to increased crop output. Bearing in mind the above objectives, the current study was carried out at University of Agriculture Faisalabad, Sub Campus Depalpur, Okara. The experiment was conducted in pots using a completely randomized design with four replications. In this research, four organic acids i.e. tartaric acid, citric acid, humic acid and oxalic acid along with Phosphorus fertilizers were applied. Data of different parameters including plant height (cm), days to maturity, number of branches, days to flowering, No. of leaves, No. of silique, No. of seeds/silique, yield, silique length, No. of flowers, plant fresh weight, plant dry weight, harvest index, EC, organic matter and pH were recorded. Analysis of variance showed significant results for all the parameters except days to flowering, plant fresh weight and harvest index (%). The result of mean comparison showed that among all the organic acids, application of humic acid and oxalic acid along with phosphorus fertilizer showed significant and more values for yield contributing traits including No. of branches, No. of silique, No. of seeds per silique, silique length and yield per pot as compared other treatments.

Keywords: Alkaline Soils, Organic Acids, Canola, Yield, Phosphorus

Balance Fertilization Management in Canola for Improved Growth and Nutrient Use Efficiency

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Fertilizers play an important role in the growth, development, and production of canola crops (*Brassica napus*). Application of balance fertilizers plays an important role in crop yield and soil productivity (Bindrban et al., 2015). By using chemical fertilizers and soil nutrients in a balanced manner, integrated plant nutrition systems increase soil productivity. Agronomical practices of balanced fertilizer management are considered as an important factor for improved crop growth and nitrogen use efficiency. The current study was carried out to assess the growth and yield of canola under balanced fertilizer management. The study was conducted at University of Agriculture Faisalabad, Sub Campus Depalpur, Okara. The research was evaluated in pots using a completely randomized design with three replications. In this research, two phosphors along with nitrogen and potassium were applied. Data of different parameters including plant height (cm), days to maturity, No. of branches, days to flowering, No. of leaves, No. of silique, No. of seeds/silique, yield, silique length, No. of flowers, plant fresh weight, plant dry weight, harvest index, EC, organic matter and pH were recorded. Data showed significant results for all the parameters except days to flowering, plant fresh weight and harvest index (%). The result of mean comparison test that treatment-8 (100%P, 100%N, 75%K) and treatment-09 (100%P, 100%N, 100%K) indicated highest and significant values for plant height, days to maturity, number of pods, number of seeds and grain yield. Nitrogen and phosphorus significantly increased No. of leaves, No. of pods/ plant, pod length and grain yield per pot.

Keywords: Canola, Nutrient Use Efficiency, NPK

Split Application of Diammonium Phosphate to Improve Phosphorus Use Efficiency in Pea

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Yield pea an important pulse crop grown which is consumed worldwide and cultivated across the world. Because of its high nutritional content, field peas are becoming more and more popular in the organic and health food sectors. The present research trial was executed to probe out the impacts of split doses of DAP on growth and yield parameters the pea. Field trial under RCBD was carried out using different treatment of DAP application. Maximum fresh plant biomass (1628.8 kg/acre) was recorded in case of T2 while the lowest weight (1224.5 kg/acre) in case of T5. Outcomes of plant fresh biomass excluding the pea pods showed that variation in mean values of fresh plant biomass were statistically non-significant. Maximum fresh plant biomass (862.3 kg/acre) was weighed out in case of T2 followed by T1 (713.0 g), T4 (642.0 g), T5 (610.3 g) while the minimum weight (602.4 g) was recorded in case of T3. Findings of fresh grains weight in the current research work displayed those highest fresh grains weight (323.0 g) was noted in case of T4 while the lowest weight (283.4 g) was recorded in case of T3. Findings of dry grains weight indicated that highest dry grains weight (153.0 g) was noted in case of T1 which were statistically at par with T3 and T4 whereas the lowest weight (118.1 g) was recorded in case of T2. Outcomes of pods per plant revealed that maximum number of pods (16.3 pods/plant) were counted in case of T2 whereas the lowest pods (12.3 pods/plant) were computed in case of T5. The values were at par in case of T1, T3 and T4. Results of rains per pod showed that comparatively greater grains (6.0 grains/pod) were counted in case

of T2. In the current research work, maximum grains yield (784.0 kg/acre) was weighed out in case of T1 while the lowest biomass (563.0 kg/acre) was weighed out in case of T5. Comparatively greater EC value (143.0 $\mu\text{S/m}$) was recorded in case of T5 whereas the lowest EC (82.1 $\mu\text{S/m}$) was recorded in case of T5. Relatively greater pH value (9.0) was recorded in case of T1 followed by T2 (8.0), T4 (7.9), T3 (7.9) while the lowest pH (7.7) was recorded in case of T5. Comparatively greater organic matter (0.80 g) was recorded in case of T4.

Keywords: DAP, Phosphorus, Pea, Split, Yield

Introducing Nutrolinguistics: A Dual-Theory Framework Exploring the Interplay of Nutrition and Language

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Language is often explored through cognitive, social, or structural lenses, yet its biological nourishment remains largely overlooked. This study pioneers an interdisciplinary domain Nutrolinguistics-emerging from Chomsky's (2016) biolinguistic paradigm, which posits language as a biologically embedded system, and Gómez-Pinilla's (2008) nutritional neuroscience, which emphasizes the brain's dependency on dietary inputs. The study aims to investigate the two-way interaction between nutrition and language: how nutrient intake affects verbal fluency and how linguistic framing influences dietary behavior. A corpus-based mixed-method design was employed using qualitative interviews and quantitative surveys. Data was gathered from 84 participants across language and nutrition fields. Key findings reveal that balanced meals, particularly protein-rich diets, enhanced verbal clarity, while meal-skipping and sugar overconsumption contributed to speech hesitation and cognitive sluggishness. The study proposes the Nutrolinguistics Framework: A Dual-Theory Model, integrating biolinguistics and nutritional neuroscience. It further outlines potential applications in language therapy, ESL education, and dietary counseling. This contribution sets the foundation for future studies in dietary linguistics, cognitive rehabilitation, and language policy informed by nutrition science.

Keywords: Nutrolinguistics, bio linguistics, nutritional neuroscience, verbal fluency, diet and cognition

Enhancement of Poultry Feed Efficiency by Immobilized Lipase on Chitosan-Coated Fe_3O_4 Magnetic Nanoparticles from *Aspergillus Niger*

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The poultry industry plays a crucial role in the global food industry, which necessitates continuous research on poultry feed efficiency and nutrient absorption. To meet these standards, this research focuses on the enzymatic hydrolysis of fats. Lipase hydrolyzes and breaks down fats into triglycerides and free fatty acid. Extracellular lipase was generated in this study by using submerged and solid-state fermentation from *Aspergillus Niger* under pre-optimized conditions. After the synthesis of extracellular lipase, partial purification of lipase was carried out using ammonium sulphate precipitation with a protein

concentration of 0.5688 mg/ml, specific activity of 35.9287 U/mg and the obtained activity was 20.42 U/ml. Following partial purification, ion exchange chromatography was used to purify the mixture further. The resulting activity was 18.17U/ml with a protein content of 0.4257 mg/ml and a specific activity of 43.786U/mg. Gel filtration was done after ion exchange chromatography for further purification of lipase, and the obtained activity by performing gel filtration was 8.01U/ml with 0.1867mg/ml protein content and 82.135U/mg sp. Activity. At the end, lipase was purified by 2.72 folds, with 29.46% enzyme recovery. After the purification, lipase was immobilized on the chitosan-coated Fe₃O₄ magnetic nanoparticles. Then immobilized lipase was characterized by the FTIR, SEM, Zeta-sizer and UV-vis spectroscopy to check the stability of nano-particle and their chemical structure. Then this immobilized lipase was added to the poultry feed to enhance the poultry feed efficiency. This addition of immobilized enzymes also enhanced the enzyme activity, reusability, stability, degree of fat hydrolysis, and shelf life of poultry feed with enzyme. In the end, all of the results were analyzed by the one-way ANOVA.

Keywords: Lipase, Poultry feed, Nanoparticles, Immobilization.

Evaluation of antifungal activity of *Chara vulgaris* against aflatoxin B1 produced by *Aspergillus flavus* isolated from total mixed ration

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Aspergillus flavus is a aflatoxin producing fungi and commonly present in animal feeds. Aflatoxins are harmful for animal and human being consuming animal meat and milk. The current study was conducted to evaluate the antifungal activity of methanolic extract of *Chara vulgaris* against *A. flavus* isolated from total mixed ration. Total mixed ration (TMR) samples (n= 12) were collected from Pattoki, Kasur Pakistan. Conventional methods were used to identify the fungal species isolated from TMR. Spread plate technique was used to determine the fungal load of TMR and the highest CFU was 9×10². The production of aflatoxins by *A. flavus* was confirmed by thin layer chromatography. To analyze the antifungal and anti-aflatoxigenic activity of *C. vulgaris*, methanolic extract was prepared. Proximate analysis of *Chara* extract was performed by Infra-red Spectroscopy that showed moisture content 31.36%, crude protein 9.76%, fat 27.26%, ash 6.55%, carbohydrate 23.13% and fiber 1.03%. The HPLC results of *Chara* extract determined the quantity of Myricetin (0.2591 µg/ml), Quercetin (0.1314 µg/ml) and Kaempferol (1.178 µg/ml). Micro broth dilution method was used to analyze the antifungal activity of methanolic extracts of *Chara* against three fungal strains. The minimum inhibitory concentration MIC of *Chara* extract was 75g. In vitro antifungal activity was observed after 30 days. The greatest fungal load of TMR was 29 CFU/g in isolate-1 and isolate-2 with extract. Without extract the highest fungal load was 63 CFU/g in isolate-1. The lowest CFU was 17 in isolate-3 with extract. The methanolic extract of *C. vulgaris* can be used as an effective antifungal agent to inhibit the growth of *A. flavus* in TMR.

Keywords: *Chara vulgaris*, *Aspergillus flavus*, aflatoxins, High Performance Liquid Chromatography (HPLC), Thin Layer Chromatography (TLC), Infra-red Spectroscopy (IR Spectroscopy), Minimum Inhibitory Concentration (MIC)

Development of Fungal Resistant Berseem Lines by Nuclear Incorporation of Chitinase Gene

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Trifolium alexandrinum L., commonly known as Berseem, is an important winter leguminous crop that serves as a primary source of green fodder for livestock in Pakistan. As Pakistan does not possess natural pastures to fulfill the nutritional needs of its large animal population, it depends heavily on cultivated fodder crops, mainly corn & sorghum in summer and berseem in winter along with other minor crops. Therefore, any damage to these critical fodder crops can severely impact the livestock sector of Pakistan. However, forage production research, particularly on the availability of green forage throughout the year, has been insufficient, and it is crucial that both the public and private sectors undertake research seriously. Root rot disease complex, which includes root rot, collar rot, and stem rot, has been a significant cause of yield decline of at least 20-25% in berseem. Unfortunately, no berseem variety in Pakistan has yet shown resistance to this disease complex, and the farming community lacks knowledge about it, resulting in the absence of routine control measures. To address this issue, we conducted research to produce transgenic berseem lines that may be resistant to this disease complex by expressing a synthetic antifungal gene for Chitinase in berseem. Nucleotide sequences of Chitinase gene was retrieved from NCBI, codon optimized for improved expression in plants. Firstly, chitinase gene family members were characterized by systematic in-silico genome-wide analyses. Then, a highly efficient in vitro regeneration protocol for promising indigenous cultivars of berseem was also optimized. It is one of the pre-requisites for successful plant transformation. Biolistic method was used for genetic transformation of tobacco as well as berseem using transformation vector containing chitinase gene. The putative transgenic plants were selected on selection media containing phosphinothricin as selection agent. After regeneration on selection media, molecular analyses were carried out using PCR. Further analysis and fungal bioassays. The present study may be regarded as first step towards the development of fungal of resistant lines.

Keywords: Fungal diseases, winter fodder crops, antifungal genes, transgenic technology, herbicide tolerance.

Investigating Underlying Mechanisms Involved in Gluten Functionality of Wheat Flour

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Wheat is the most important food crop in the world. This crop is responsible for providing the basic nutritional demand for most of the world's population. Among other nutrients, gluten is a basic protein that analyzes bread-making and the end quality of wheat flour.

Due to the large number of end uses, genetics, and the influence of environmental factors, it is necessary to study gluten quality by applying different mechanisms. In present study thirteen wheat varieties Abdul sattar, SN-19, Laag, Galaxy 13, Aas 11, Johar 16, Lasani 08, Seherna, NARC, Punjab 11, Faisalabad 08, Barani and Gandum were used. These varieties were grown under standard conditions at the Ayub Agriculture Research Institute in Faisalabad. SDS-PAGE of wheat varieties demonstrated the presence of subunits 1, 2, 6x+10y, 6x+12y, 5x+10y, 5x+12y, 7x+8y, 17x+18y and 7x+9y on Glu-A1, Glu-B1, and Glu-D1. Subunits 1 and 2 were present on Glu-A. The varieties Galaxy, Punjab and Barani have 1 whereas varieties Johar, Faisalabad, Aas and Gandum have subunit 2 on Glu-A1. Further, on Glu-D1 four types of combinations were present. The varieties Galaxy and Barani were found to have 6x+10y, the varieties Punjab, Johar and Gandum has 6x+12y, the combination 5x+10y was only seen in Faisalabad. On Glu-B1 the varieties Galaxy and Punjab has 17x+18y whereas Barani, Johar, Faisalabad and Gandum has 7x+8y. The combination 2x+12y was only found in Aas. These studies suggested that the highest influence was observed for Glu-D1>Glu-B1>Glu-A1. To perform the mixing analysis, four different samples of wheat flour were obtained from Punjab Seed Corporation. Their general properties, such as moisture, ash, gluten content, protein content, and water absorption capacity, were measured. Further analysis was performed using a Mixolab device with Chopin +, following the ICC standard method. Determination of general characteristics showed that the highest amount of protein (%) was present in Johar and Punjab (12.3 and 12.5%, respectively), and the lowest amount of protein was present in Aas (10). The highest amount of ash (%) was observed in Johar (1.5), and the lowest was observed in Faisalabad (1.4). The highest moisture (%) was seen in Aas (10.3) there was moderate moisture in Johar and Faisalabad and the lowest moisture was seen in Punjab (9.3). The highest water activity (%) was seen in Aas (65.8) moderate was seen in Johar and the lowest was seen in Punjab and Faisalabad (63.7 and 63.5) respectively. The mixing analysis results in the form of a web diagram suggested that absorption was the same for all varieties. However, the other varieties exhibited similar mixing times. Variations were also observed in the gluten strength of all the wheat varieties. The highest gluten strength was observed in Faisalabad and Johar, and the lowest was observed in Punjab and Aas. Dough viscosity was also assessed, suggesting that the dough of Faisalabad was highly viscous compared to the others, and the lowest viscosity was observed in Aas. The highest amylase activity was observed in Johar and Punjab, whereas the lowest was observed in Aas. Moderate amylase activity was observed in the Faisalabad. Starch retrogradation was highest in Aas, Johar and Punjab and less in Faisalabad. The relative glutenin strength, relative amount of pentosans, damaged starch, and gluten performance index (GPI) were estimated the following method 56- 11 (AACC, 2000). A significant variation was observed in the gluten performance of these varieties. The highest value was shown by Faisalabad which was statistically similar to Abdul sattar, Barani, Galaxy, Gandum, Laag, NARC, Seher and SN-19. The lowest value was reported by Johar. Wet and dry gluten contents were measured using the method described by AACC. No significant differences were observed between these varieties. The highest amounts of wet and dry gluten were observed in Punjab and Johar. They were statistically similar to Faisalabad, Galaxy, SN-19, and Gandum, and the lowest value was observed in Lassani. These studies suggest that there are genetic variations and environmental influences on wheat, which affect the quality of wheat and hence the

quality of end-used products. Hence, this study provides a stride to exploit these variations among varieties for use in future breeding programs. The study concluded that the best wheat variety was Faisalabad based on the evaluation of all quality parameters, with the worst being Aas. Varieties with good traits can be used for baking purposes.

Keywords: Wheat Varieties, Protein Composition, Glutenins, Gliadins, Flour functionality, Wheat flour

Assessment of Atrazine Herbicide in Water and Fish of the River Kurram

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This study investigated the presence of atrazine, a commonly used herbicide, in the aquatic environment of the River Kurram. Water, and fish samples were collected from various locations along the river to assess the extent of atrazine contamination. The analytical techniques of Gas chromatography Mass Spectroscopy (GCMS) were employed to quantify atrazine levels in the collected samples. Atrazine Herbicide was detected in water and fish from two sites of River Kurram including Hungu(Blind Khel)(S1) and North Waziristan (Shawa) (S2).one of these sites are highly polluted sites receiving agricultural runoff from nearby agricultural fields around the River Kurram. A total of 12 samples (n=6 from each site) were analyzed from all the tow sites of River Kurram for atrazine herbicide by using techniques Gas chromatography Mass Spectroscopy (GCMS). Samples collected from water and fish located approximately 1 to 20 km apart from each other in upstream and downstream of each site. The results of the assessment of ATZ show the widespread occurrence of atrazine in the River Kurram ecosystem. The highest concentration of atrazine was found in fish tissue of one of both Hungu (Thall) selected sites. The second site of atrazine are not detected in a both sample. The results obtained from water, and fish of River Kurram is within the permissible limit, but these may increase with passage of time if the policy makers do not implement effective management strategies. This study highlights the significant presence of atrazine in the water and fish of the River Kurram.

Keywords: Assessment, ATZ, GCMS, FAO, WHO, River Kurram, Blind Khel (Thall), North Waziristan (Shawa)

Evaluation of Antileishmanial potential of Bee Pollen against Leishmania Tropica

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Leishmaniasis, particularly Cutaneous Leishmaniasis (CL), is a neglected tropical disease that can have major health consequences. Due to the limitations of existing treatments, including toxicity and medication resistance, natural options are needed. Bee pollen, a nutrient-rich natural product with several pharmacological attributes, is under investigation for its efficacy against Leishmania tropica. This study aimed to evaluate the in vitro antileishmanial activity of bee pollen extract against Leishmania tropica, identify

bioactive compounds through GC-MS analysis, and assess their molecular interactions using in silico docking studies. Bee pollen was collected from the Kohat area, air-dried, grind, and then extracted in fractions with methanol, chloroform, and n-hexane. Extracts were concentrated by a rotary evaporator and then dried. The XTT assay was performed using Glucantime as a reference drug according to standard procedure with little modifications. The n-hexane extract (12.05 $\mu\text{g/mL}$), demonstrated significant antileishmanial activity compared to Glucantime. The hexane fraction will be further subjected to GC-MS analysis and molecular docking studies. These results indicate that bee pollen extracts possess potential natural antileishmanial agents for the treatment of CL.

Keywords: Bioactive compounds, Bee Pollen, Leishmania Tropica, GC-MS analysis, Cutaneous Leishmaniasis

Adsorption of Sunset Yellow on to metal-based composite material in terms of kinetics, thermodynamic and pH studies

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The adsorption of Sunset Yellow dye onto a metal-based composite material was investigated in terms of kinetics, thermodynamics, and pH effects. The study demonstrated that maximum adsorption (up to 95% removal from a 50 ppm solution) occurred at neutral pH (pH 7). Adsorption isotherm data were analyzed using Langmuir and Freundlich models, with the Langmuir model providing the best fit ($R^2 = 0.9921$), suggesting monolayer adsorption. The BET surface area of the composite material was determined to be 90 cc/g, indicating a favorable surface for dye uptake. Thermodynamic parameters, including enthalpy (ΔH), entropy (ΔS), and Gibbs free energy (ΔG), were derived from the Van't Hoff plot and Gibbs free energy equations. The positive value of ΔH confirmed the endothermic nature of the adsorption process, while the negative ΔG indicated spontaneity. The metal-based composite material proved to be an efficient adsorbent for Sunset Yellow dye removal, highlighting its potential for wastewater treatment applications.

Keywords: Adsorption; Sunset Yellow dye; Langmuir; Metal-based composite; BET surface area

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. A higher quantity of metal/metal oxides are converted into 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_4O_4 , Mg_5O_5 , Mg_6O_6 , Mg_7O_7 and Mg_8O_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 binding affinities of MgO clusters with enzymes ranged from -8.8 to -2.9 kcal/mol. The Carboxypeptidase B (PDB ID: 1ZLI) and Mg_8O_8 exhibited best docking pose with -8.8 kcal/mol and K_i 0.35 μM . 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.

Wheat Straw Residue as alternate Distillery Feedstock: A Sustainable approach towards Bioethanol Production in Pakistan

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Biomass based production of ethanol is a promising alternative to the day by day diminishing natural resources of fuel worldwide. Bioethanol is produced from a well-established technology since last three decades using various waste materials based on the current challenges faced by the world concerning depletion of petroleum resources, continuously increasing prices of gasoline, and environmental matters. Lignocellulosic biomass of wheat straw is comparatively cheap, abundant, easily accessible, and effective substrate for the commercial scale production of green bioethanol. Various Physical (milling) and Chemical pretreatment (H_2SO_4) methods were applied on wheat straw samples collected from Faisalabad, Jhang and Sialkot. Maximum cellulose content (61.3%) was obtained from residual lignocellulosic biomass of Jhang with maximum delignification (71.6%) as result of pretreatment with 2.5% H_2SO_4 for 60 minutes at 121° C in autoclave. The structural modification by pretreatment was confirmed by SEM, XRD and FTIR results. The pretreated sample was enzymatically hydrolyzed by cellulase and xylanase enzymes by incubation for 8 hours aimed at bioconversion of cellulose and hemicelluloses to fermentable sugars. The pretreated wheat straw samples of Faisalabad showed the highest saccharification extent (21.6%) while Jhang wheat straw samples showed lowest saccharification extent (20.09%).

Keywords: 2-G bioethanol, wheat straw, hot acid pretreatment, saccharification, delignification

Polyethylene Terephthalate Recycling Towards Composite Materials for Water Treatment

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Polymer composites for treating wastewater demonstrate numerous interface moieties, more adsorption capacity, superior stability, and mechanical viability. In this study, the PET-ceramic composite was used as an inexpensive and effective adsorbent for the removal of metal ions. PET was recycled using a solvent-based process at 100–120°C for 10–20 minutes, and various PET composites, namely C1, C2, and C3, were synthesized using a solvothermal approach. Scanning electron microscopy (SEM), Fourier transformed infrared spectroscopy (FTIR), powered X-ray diffraction (PXRD), were used to characterize the properties of synthetic composites which showed irregular morphology of the composites (SEM) and also indicated presence of different functional groups on their surface (FTIR), PXRD gave the phase composition and confirmed the composite nature of the specimen under studied. These composites (C1, C2, and C3) were examined for the removal of Ni ions. With the use of a UV/Visible Spectrophotometer, absorbance spectra were taken to calculate the percentage of Ni removal. Percentage removal was calculated by different factors like the effect of adsorbent dose, time, concentration, and temperature. The effect of the adsorbent dose was compared for composites C1, C2 and C3. The best kinetic model for the study of Ni removal was first order kinetics, which showed a chemically rate-controlled mechanism.

Keywords: Polyethylene Terephthalate, Composite, Recycling, Adsorbent, Recycling of PET, Composites of PET, Characterization, Malachite Green Dye, Percentage degradation, Ceramic

Method development, validation, risk assessment and monitoring of pesticide residues in tomatoes from various agro-ecological zones of Pakistan

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An analytical method for seventy-seven pesticides in tomatoes was validated on LC-MS/MS. The seventy-seven targeted pesticides were extracted using a modified QuEChERS extraction protocol followed by cleanup with primary secondary amine (PSA) and GCB. The accuracy of the method ranged from 70% to 119.7%, while the standard deviations were between 0.85% and 19.9%. There was a range of 0.01 to 4.17 mg/kg for the quantification limits and 0.005 to 1.39 mg/kg for the detection limits. A total of 113 tomato samples were collected for investigation of pesticide residues from Azad Jammu & Kashmir, Baluchistan, Gilgit-Baltistan, Punjab, and Sindh. Overall, 25 out of 113 (22%) samples were found contaminated with thirteen different pesticides. Out of these contaminated samples, 21% of samples were from tomato fields and 1% were from supermarkets. Three samples were found non-compliant with the EU and CAC MRLs. For the detected pesticides, the acute and chronic risks calculated for the general population indicated varying levels of concern, particularly for vulnerable groups such as

children and pregnant women. However, the associated chronic and acute risk for the general population was lower than the FAO limits.

Study of Some Hardening Agents in the Chew Gum for Jawline Reforming

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Chewing gum formulations incorporating hardening agents have gained attention for their potential role in jawline reforming, a non-invasive approach to enhance facial aesthetics and muscle tone. This study evaluates the impact of synthetic polymers (e.g., polyvinyl acetate), natural resins, and waxes on the texture, durability, and biomechanical efficacy of chewing gum designed to stimulate jaw muscle engagement. Texture analysis (via texture analyzer) and human trials (using electromyography to quantify masseter and temporalis muscle activation) were conducted on commercial and experimental gum samples. Results demonstrated that synthetic polymer-based gums (15–20% polyvinyl acetate) exhibited superior resistance to deformation and prolonged chewing durability, correlating with enhanced muscle activation. However, excessive hardness raised concerns about dental wear and temporomandibular joint (TMJ) strain. Natural resins like hydrogenated rosin offered a safer balance of firmness and elasticity but with reduced longevity. The study concludes that optimizing hardening agents in chewing gum formulations can improve jawline-reforming efficacy while ensuring user safety. This work bridges food technology, materials science, and cosmetic health, providing a foundation for developing targeted oral exercise products. Further research is needed to explore long-term effects and eco-friendly alternatives to synthetic hardening agents.

Keywords: Hardening agents; Jawline reforming; Chewing gum; Muscle engagement; Texture analysis; Polyvinyl acetate.

Composite Cathode Gd 0.2 Ce 0.8 O 1.9 -SrFe 1-x TixO 3-δ for Nicotiana Tabacum Carbon Fuel based Direct Carbon Fuel Cell

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As an electrochemical device that converts the chemical energy of fuel directly into electrical energy. Fuel cell is a new alternate technology used fuel from renewable sources and generate power for sustainable development and energy security. Among various types of fuel cells, direct carbon fuel cell (DCFC) has higher efficiency because carbon fuel has a higher energy density than liquid or gas fuel. However, current development of DCFC is still limited by the sluggish activity of cathode reaction. In this study, a new composite cathode made of Gd_{0.2}Ce_{0.8}O_{1.9} (GDC) and SrFe_{1-x}Ti_xO_{3-δ} (SFT) is developed for Nicotiana Tabacum carbon fuel based DCFC. The structural, optical, and electrochemical properties of the materials are systematically evaluated. X ray diffraction analysis result shows a cubic structure of GDC and cubic perovskite phase

of SFT in the sample with crystallite sizes of 37 and 15 nm, respectively. From ultra violet visible spectroscopy an indirect band gap was found which show a red shift in band gap. Fourier-transformed infrared spectroscopy confirms the presence of Ce-O, Sr-TiO and Fe-O functional groups in all the samples. Scanning electron microscopy analysis shows the morphological and particle size of materials. The sample $\text{Gd}_{0.2}\text{Ce}_{0.8}\text{O}_{2-\delta}$ $\text{SrFe}_{0.96}\text{Ti}_{0.04}\text{O}_{3-\delta}$ exhibits the highest electrical conductivity of 4.96 Scm^{-1} in an oxygen atmosphere at 600°C and a higher power density of 40 mWcm^{-2} at 600°C compared to other samples using *Nicotiana Tabacum* carbon fuel. These findings indicate that the developed composite cathode is an efficient cathode for low-temperature DCFC.

Synthesis of Nickel Oxide/Graphene Oxide Composite for the Degradation of Clothianidin Pesticide

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In the present work, the synthesis of NiO nanoparticles was carried through green synthesis by using extract of peels of green peas (*Pisum Sativum*). Graphene oxide was prepared through modified Hummer's method and the graphene oxide/nickel oxide nanocomposite was synthesized by ultra-sonication method. The prepared nanocomposite was characterized by different techniques including XRD, FTIR and SEM. The FTIR analysis confirmed the functional groups in the prepared NiO/GO nanocomposite. Different experimental parameters such as pH, dose of catalyst, agitation rate, initial pesticide concentration and temperature were studied for the maximum degradation of clothianidin in aqueous solution. By adjusting different temperature range from 303 to 353 K, the maximum degradation was observed at 333 K, which is 78.51%. The degradation rate is increased with increase amount of dose of catalyst and maximum degradation of 92% is observed at 1g of catalyst. The maximum degradation was observed at pH 3. However, after pH 3, the degradation was decreased continuously. The concentration of stock solution of 10 ml showed maximum degradation. Furthermore, the synthesized NiO/GO nanocomposite from green route provided best economical alternative for pesticide degradation.

Impact analysis of varenicline as replacement of nicotine in liquid for e-smoking cessation

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E-smoking has become a significant public health concern with nicotine addiction being a major obstacles to cessation. Varenicline a partial agonist of $\alpha 4\beta 2$ nicotine acetylcholine receptor, has shown promise in smoking cessation. This study evaluates the impact of varenicline as a replacement of nicotine in e-liquid for e-smoking cessation. A randomized controlled trail was conducted with 1000 participants, divided into two groups: varenicline-infused e-liquid (VIEL) and nicotine-based e- liquid (NBEL). Participant's smoking habits,

withdrawal symptoms, and classification level were monitored over twelve weeks. The VIEL group showed significantly higher cessation rates (45.6% vs 27.3%, $p < 0.001$) and reduced withdrawal symptoms (mean score: 2.4 vs 4.1, $p < 0.01$) compared to the NBEL group. VIEL participants reported higher satisfaction levels (mean score: 7.8 vs 6.5, $p < 0.05$).

Nanotechnology Based Drug Delivery System as a Rationale Strategy for Enhancing the Stability and Therapeutic Efficacy of Radiopharmaceuticals

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Prodrugs, nano-carrier technologies, and enzyme inhibitors have made substantial advancements; however, numerous therapeutic agents such as biologics remain unstable and nonspecific. This instability presents significant challenges in their successful application in clinical settings and subsequent Food and Drug Administration (FDA) approval. Due to their metabolic instability, a variety of potential pharmaceutical candidates, including proteins, peptides, and small organic molecules, often fail to reach from preclinical desks to clinical practice. The primary challenge lies in the development of innovative drug delivery methods that can enhance the stability of these therapeutic agents without compromising their efficacy. Nanotechnology based drug deliver significantly enhance the stability and therapeutic efficacy of radiopharmaceuticals. This could be carried out either by loading the radiopharmaceuticals to nano-frameworks or by translating the radiopharmaceuticals into nano-radiopharmaceuticals. Further, this innovative research approach will seek to safeguard the radio-medications against enzymatic breakdown while facilitating targeted delivery and controlled release to specific sites within the body.

Key words: Prodrugs, Nano-carrier, Therapeutic Efficacy, Nano-radiopharmaceuticals, Radio-medications

Prediction and analysis of chemicals present in swimming pool water

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Filtering water, adding chemicals and preventing growth of algae is not enough to protect the swimming pool water from microbial diseases. A lot of integrated factors are involved in maintenance of pool water. In this study; various types of chemicals like DBP (Disinfectant by Products; trihalomethanes and haloacetic acids), heavy metals (Lead, mercury, iron, copper), organic contaminants (urine, sweat, cosmetics, oils and lotions) and inorganic contaminants (ammonia, chlorides, fluorides, sulphates and nitrates). Evidences suggested that some of these chemicals may cause health hazards when exposed in swimming pool water. This study provides a great analysis of the different chemical pollutants found in swimming pool. Different methods are used for the treatment of chemicals present in swimming pool water are; disinfectants and oxidizers (chlorine,

ozone, trichloroisocyanuric acid, hydrogen per oxide, calcium hypochlorite), pH adjusters (sodium carbonate, sodium bicarbonate and muriatic acid), algacides (copper sulphate, quaternary ammonium compounds, silver nitrate and zinc sulphate), stabilizers (cyanuric acid and isocyanuric acid).

Mitigation of water Pollution using Biodegradable Material

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This research work reports a multi-stage micellar flocculation process for removal of an antibiotic drug Levofloxacin Hemihydrate (LH) from synthetic wastewater. This process, called micellar flocculation (MF) is an environmentally friendly approach compared to conventional methods because it involves biodegradable soap derived from animal fat and multivalent salts for flocculation and subsequent removal of pollutants. It has been observed that 0.020 mol/L soap concentration ensured 85 % removal of LH at room temperature in a one-minute contact time at basic pH. The adsorption mechanism was studied using Langmuir, Freundlich, Temkin, Dubinin- Radushkevich, and Frenkel-Halsey-Hill isotherm sorption models. Apart from this, pseudo-first order, second-order models, film diffusion and intraparticle diffusion kinetic models have also been applied. It is noted that system under study follows Langmuir and Temkin sorption models with an R^2 of 98.13 % and 97.29 % respectively. The pseudo-second-order kinetic model best fits the experimental data of the MF process with an R^2 of approximately 99.39 %. Thermodynamic assessments indicate that process is exothermic and more spontaneous at lower temperatures accompanied with decreases in entropy.

Keywords: Surfactants, micellization, Solubilization, Flocculation, Sorption, Kinetics, Thermodynamics.

Development of an electrochemical sensor using molecular imprinting polymer (MIPs) for the detection of 1-Naphthylamine

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This study presents the development of an electrochemical sensor for the selective detection of 1-naphthylamine using a molecularly imprinted polymer (MIP) approach. The sensor was fabricated by synthesizing a MIP gel using acrylamide as a functional monomer, ethylene glycol dimethacrylate (EGDMA) as the cross linker, styrene and DMSO as a solvent and azobisisobutyronitrile (AIBN) as the initiator. The resulting gel was applied onto an interdigitated electrode (IDE) surface and the sensor's performance was evaluated using LCR meter. The MIP based sensor exhibited excellent selectivity and sensitivity towards 1-naphthylamine when compared to non-imprinted polymers and other interfering substances. The results confirm the sensor's effectiveness in detecting various concentrations of template, demonstrating its potential as a reliable, easy to fabricate and cost effective solution for environmental or industrial monitoring applications.

Fabrication and Performance Evaluation of Molecularly Imprinted Polymer based electrochemical sensor for the Detection of Ciprofloxacin

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Ciprofloxacin assessment in biological and pharmaceutical fluid is an urgent need. For the detection of ciprofloxacin in environment, it is necessary to synthesize a selective, sensitive, simple, cost effective and user-friendly sensor. In this work, molecular imprinted Copolymer based electrochemical sensor is developed for the detection of ciprofloxacin in which interdigitated electrodes are used as a transducer. To form MIP, bulk polymerization method is used. Methacrylic acid (MAA) and styrene is used as a monomer, azobisisobutyronitrile (AIBN) as a initiator, ethylene glycol dimethacrylate (EGDMA) as a crosslinker and dimethyl sulfoxide (DMSO) as a solvent for effective identification. LCR meter is used to calculate electrical properties like resistance and inductance.

Assessment of Arsenic Concentration Level in Food Samples by using Different Micro- extraction Methods

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The composite adsorbent was used to develop an ultrasound-assisted dispersive solid-phase micro extraction (UA-dSP μ E) method for evaluating arsenic contamination levels in human foodstuffs via hydride generation atomic absorption spectrometry (HG-AAS). The composite adsorbent was synthesized using poly (3-hydroxybutyrate)-b-poly (dimethylaminoethyl methacrylate) incorporating gadolinium oxide nanoparticles. The synthesized material was characterized using various spectroscopic techniques. Experimental parameter screening and optimization were conducted using Plackett Burman and central composite designs. The method exhibited a linear response over an arsenic concentration range of 0.1–1.2 μ g/L, with a correlation coefficient of 0.98. It achieved an enrichment factor of 120 and a detection limit (0.04 μ g/L) for arsenic evaluation. Method accuracy was validated through the analysis of certified reference materials, yielding recoveries of more than 97%. The developed UA-dSP μ E method proved to be highly effective for determining arsenic contamination in various foodstuffs.

Keywords: Arsenic Contamination, Human Foodstuffs, Microextraction Method

Robust 3D Linker Based Metal-Organic Frameworks (MOFs) for Hexanes Separation

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Hexanes which comprise a class of 6-carbon alkanes with five different structural isomers: n-hexane (nC₆), 2-methylpentane (2MP), 3-methylpentane (3MP), 2,3-dimethylbutane (23DMB), and 2,2-dimethylbutane (22DMB) play a vital role as feedstocks and fuel additives in the petrochemical industry. However, their similar physical and chemical properties lead to significant challenges in the separation process. Traditional thermal separation techniques are energy-intensive and lead to significant carbon footprint penalties as a result adsorption-based separation method have emerged as promising alternatives to distillation. Metal-Organic frameworks (MOFs) have been proposed as a promising material for non-thermal chemical separations owing to their high structural diversity and tunability. Here, we report the synthesis of a MOFs containing a 3-dimensional linker, with high thermal stability towards the separation of hexane isomers. The incorporation of the 3D linker enhances the structural stability and provides well-defined pore apertures/channels with sub-Ångstrom precision. This precision allowed for the separation of similarly sized hexane isomers based on subtle differences in their kinetic diameters. Multi-component liquid phase batch experiments confirmed the separation of hexanes mixture into linear, monobranched, and dibranched isomers. This work represents a significant milestone in the construction of stable MOFs and the incorporation of 3D linkers as a potential solution to challenging separations.

Medicinal importance of Glycyrrhiza uralensis

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Chinese licorice, or *Glycyrrhiza uralensis*, has long been valued for its therapeutic and medicinal qualities in traditional Chinese medicine. A strong anti-inflammatory and antioxidant, glycyrrhizin is a triterpenoid saponin and one of the main bioactive ingredients of *G. uralensis*. It is a useful natural treatment for inflammatory illnesses like inflammation, gastritis and respiratory issues because of these qualities. Through the inhibition of pro-inflammatory cytokines and enzymes, glycyrrhizin has been shown to reduce inflammation and provide relief from the discomfort and swelling that are associated with these illnesses. *Glycyrrhiza uralensis* is also well known for its ability to support digestive health. Glycyrrhetic acid, which is included in plant extracts, has been demonstrated to have gastroprotective benefits by boosting mucin synthesis and improving the integrity of the stomach mucosa. It is therefore a viable option for the treatment of gastrointestinal disorders, including stomach ulcers also, it is a well-liked option for stress management and enhancing general well-being due to its adaptogenic qualities. *Glycyrrhiza uralensis* may lessen the adverse impact of prolonged stress on health and assist people in adjusting to the demands of contemporary life by regulating the physiological response and promoting adrenal function. *Glycyrrhiza uralensis* is also utilized for its anticipatory and antitussive qualities in traditional Chinese medicine. The herb's constituents have been shown to provide relief from bronchial congestion, coughing, and other respiratory ailments. For this reason, it is an essential component of herbal remedies used to cure lung infections and maintain lung health. Furthermore, because of its antioxidant and anti-inflammatory benefits, research indicates that *Glycyrrhiza uralensis* has potential uses in skincare. The extracts from the herb may help treat dermatitis, eczema, acne, and other skin diseases by scavenging free radicals and lowering inflammation. Thus, the

anti-inflammatory. Anti-cancer, digestion, adaptogenic, respiratory, and maybe dermatological properties make *G. uralensis* a valuable medical and therapeutic tool for human health.

Keywords: Glycyrrhiza Uralensis, Medicinal Properties, Pharmacological Activities

Role of Spider Venom in the biological control

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Spiders are an ancient and successful group of invertebrate animals and also known as the poisonous arthropods. Spider are the most abundant predator in the terrestrial ecosystem, they feed on different types of insects, their larva and arthropods eggs. Spider venom holds possibilities for biological control. Spider venom peptides specifically target insect nervous systems and muscles. Spider venom-based solutions are more specific to target insects. Biodegradable, and face slower resistance development. It is a complex mixture of large proteins, small molecules like amino acids, and medium-sized peptides. Its peptides are used as bio insecticides due to their target specific properties. The use of spider venom decreases the cost of pesticides about 25-30% with a success ratio of 60%. Conventional pesticides pose growing concerns due to resistance and environmental impact. They are not insect specific. They retain in the environment and cannot be degraded easily. It not only polluted the environment but also makes it unfit for living organisms. Spiders act as biological control and their venom holds promise for developing eco-friendly bio insecticides. Spider silk production provides insights into venom development. Wolf spiders and rice field spiders are being investigated for their venom's potential as a highly targeted and effective bio insecticide. It highlights the potential of spider venom for developing targeted pest management solutions. Developing practical application methods like spray formulations are essential. Addressing these challenges will be key to unlocking the full potential of spider venom as a sustainable and effective tool future pest control.

Keywords: Spider Venom, Eco-Friendly Bio Insecticide, Targeted Pest Management

Effects of Sewage and Urban Waste on Freshwater Fish

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Aquaculture provides a sustainable way to raise fish production, reducing pressure on wild populations. However, freshwater aquaculture faces threats from sewage and urban waste. Sewage and urban waste can significantly decrease dissolved oxygen levels, elevate ammonia concentrations, and introduce harmful toxins into aquatic environments. These pollutants can harm fish health and contaminate the water making it unsuitable for fish production. The experiment was conducted at a Fisheries Research Farm at the University of Agriculture Faisalabad, Pakistan. The acclimatization period for the sewage and urban waste was 15 days. Discharge of untreated sewage introduces contaminants like organic matter, nutrients, pathogens, and pharmaceuticals that can deplete oxygen

levels, causing algal blooms and introducing various diseases. Urban waste adds to the problem with plastic pollution, heavy metals, and other toxins that bio accumulate in fish. The experiment included a control group T0 with clean water and treatment groups T1, T2, and T3 exposed to different dilutions of sewage and urban waste. Water quality parameters including temperature, pH, ammonia, nitrate, dissolved oxygen, and relevant heavy metals were monitored throughout the experiment. The controlled laboratory experiment is designed to quantify the negative impacts of sewage and urban waste on fish. Dissolved oxygen levels decreased from 8.71 mg/L in the control (T0) to 2.01 mg/L in the treatment (T3) having the highest concentration of waste. Nitrate levels increased from 4.64 mg/L in T0 to 19.85 mg/L in T3. Ammonia levels elevated from -0.17 mg/L in T0 to 2.82 mg/L in T3. Fish survival rate, egg production by females, and hatching success rate were assessed after 15 days. There is a significant decrease in fish survival rate from 90% in T0 to 30% in T3. Egg production rate in T0 is 99.8 while it decreased to 20.34 in T3, and hatching success rate falling from 75.11% in T0 to 4.69% in T3. Data was analyzed statistically by Analysis of variance (ANOVA)."

Keywords: Sewage Pollution, Freshwater Fish Health, Water Quality Degradation, Aquatic Ecosystem Stress, Urban Waste Impact

Changes in Hematological Parameters of Nile Tilapia Exposed to Endosulfan

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Pesticides are used worldwide to control pests. Endosulfan is an insecticide used to control pests on crops and as a wood preservative. Like other pesticides, endosulfan reaches aquatic environments through agricultural, domestic, and industrial runoff, posing harm to fish and other aquatic organisms. Blood, being in contact with all tissues and organs, serves as a key indicator of an organism's physiological and pathological status. This study evaluated the effects of acute endosulfan exposure on the hematological parameters of Nile Tilapia. Fish were divided into three groups: T0 (control), T1 (4 µg/L), and T2 (7 µg/L), with three replicates per group. Physico-chemical water parameters were monitored regularly. Samples were taken after 24, 48, 72, and 96 hours to determine hematological values. White blood cell counts increased with increasing endosulfan concentration and exposure time, rising from a mean of 10.5025 ± 0.0403 ($10^6 \mu\text{L}^{-1}$) in the control group to 12.335 ± 1.5678 ($10^6 \mu\text{L}^{-1}$) in T1 and 13.5625 ± 2.5558 ($10^6 \mu\text{L}^{-1}$) in T2. Red blood cell decreased dropped from 1.7325 ± 0.0096 ($10^6 \mu\text{L}^{-1}$) in the control to 1.695 ± 0.0129 ($10^6 \mu\text{L}^{-1}$) in T1 and 1.665 ± 0.0238 ($10^6 \mu\text{L}^{-1}$) in T2. Hemoglobin levels also decreased, from a mean of 4.335 ± 0.0129 (g dL⁻¹) in the control to 3.6225 ± 0.4042 (g dL⁻¹) in T1 and 2.9275 ± 0.8075 (g dL⁻¹) in T2. Similarly, hematocrit percentages decreased from 14.325 ± 0.3844 (%) in the control to 11.9125 ± 1.4903 (%) in T1 and 10.52 ± 2.1234 (%) in T2. These results demonstrate that acute exposure to endosulfan significantly alters the hematological parameters of Nile Tilapia.

Keywords: Pesticides, Endosulfan, Nile Tilapia, Hematological Parameters

Fish-Derived Collagen: A Sustainable Alternative for Cosmetics and Pharmaceutical Applications

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A fundamental structural protein in the human body, collagen is essential for wound healing, tissue regeneration, and skin elasticity. Concerns about disease transmission, ethical considerations, and religious restrictions have prompted the search for sustainable alternatives to the use of bovine and porcine tissues for collagen production. Due to its excellent biocompatibility, low risk of zoonotic diseases, and high bioavailability, fish-derived collagen (FDC) has emerged as a promising alternative. The extraction methods, physicochemical properties, and potential applications of FDC in the pharmaceutical and cosmetics industries are examined in this review. The skin, scales, bones, and fins of fish that are processed by-products are rich and underutilized sources of collagen. To improve yield, purity, and functional properties, a variety of extraction techniques, including electrodialysis, enzymatic treatment, ultrasound-assisted extraction, and acid hydrolysis, have been developed. Despite having a lower denaturation temperature than mammalian collagen, FDC is highly suitable for cosmetic applications like anti-aging creams, hydrogels, and serums due to its superior film-forming capacity, water retention capacity, and biodegradability. Additionally, FDC holds significant potential in pharmaceutical applications, including tissue engineering, wound healing, and drug delivery, owing to its ability to promote cell proliferation, differentiation, and extracellular matrix formation. Despite its benefits, industrial applications face challenges due to its limitations, such as its low mechanical strength and rapid enzymatic degradation. Advanced methods like crosslinking, biomaterial blending, and nanotechnology-based modifications are being looked into to improve FDC's structural integrity and functional stability in order to overcome these shortcomings. Fish-derived collagen is a viable alternative that not only reduces marine waste but also meets the growing consumer demand for natural and safe biomaterials as global industries place an increasing emphasis on sustainability and eco-friendly solutions. This review highlights recent advancements in FDC research, its challenges in large-scale industrial applications, and future directions for optimizing its properties, ultimately paving the way for its broader adoption in cosmetics and pharmaceuticals as a sustainable and high-value biomaterial.

Keywords: Scale Collagen, Tissue engineering, Biocompatibility, cosmetic applications, wound healing

Foraging periodicities of Rose-Ringed Parakeet and House Sparrow in two fodder-based plantations in Faisalabad

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This research comprised on foraging profiles with respect to the rose-ringed parakeet and house sparrow in the one-acre fodder crop at the cultivation at the Students Farms. Evidentially, the observations on the weekly basis in the morning and evening hours on the accumulated birds provided the information on rose-ringed parakeet to be 91 ± 2.95 , for the sparrow 68 ± 1.79 and the overall 159 ± 4.69 respectively. Considering, the situation in the evening hours, they were 135 ± 5.72 and 94 ± 4.70 with the overall numerical values

of 229 ± 10.38 for the birds respectively. It is apparent that in the sufficiently large cultivations of different crops, the abundance of different bird pests becomes highly tenacious. It is well known that the growing tendency of planting more trees would encourage in the populations of different type of vertebrate pests. As they would be more in number, the crop protection might reduce with abundant economic losses. Therefore, suitable strategy is to manage the vertebrate pest using ecologically friendly methods so that their ill-effects remain minimum on the ecosystem sustainability.

Keyword: Foraging profiles, rose-ringed parakeet, house sparrow, vertebrate pest management, ecosystem sustainability

Trap success ratio of house mouse as recorded for wheat in an irrigated cropland ecosystem Faisalabad

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Present investigation considering the trap success ratio (TSR) of *Mus musculus* for the one-acre wheat plot in the stipulated study area of Students Farms, University of Agriculture Faisalabad (UAF) was conducted for four months (February through May). During this study, it was recorded that the controlled and barrier-based conditions provided some sort of difference regarding the house mouse captures. Ironically, the house mouse is one of the most efficient rodent pests with the ability to seek in for all possible surroundings. In the non-barrier conditions, the observations with the three types of traps viz. snap trap, McGill mouse trap and cages provided 24 ± 0.24 , 24 ± 0.17 , 15 ± 0.24 in the morning hours. Similarly, in the week two, the observations were 20 ± 2.23 , 18 ± 2.00 and 13 ± 1.45 respectively. Overall, it was amply concluded that the trap barrier system proves more effective with larger traps with *Mus musculus* as compared to the controlled conditions where the trap success ratios were fairly less as compared to the barrier system. Important suggestion, therefore, points out that the barrier system should be more employed in the out-door crops, being ecologically safe and no threat of pest resistance and any malfunctioning of the micro and macro soil elements.

Keywords: Trap Success Ratio, *Mus musculus*, Trap Barrier System, Rodent Pest Management, Wheat Crop

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