लखनऊ विश्वविद्यालय
University of Lucknow

IQAC RESEARCH HIGHLIGHTS

Vol ----- Issue ----, January 2026 A Quarterly Newsletter

Our Accreditations:

The University of Lucknow has secured a prestigious position in virious university ranking systems:

- Edu Rank : 29th in India and 463th Asian University Rankings.
- Quacquarelli Symonds (QS) : 651-700th in Asian University Rankings.
- Times Higher Education (THE) : 401-500th in Asian University Rankings.

Message from the Vice Chancellor

It is a great pleasure that IQAC brings out a quarterly research highlights. Academic research is the foundation of our pursuit of knowledge and the driving force behind our mission to positively impact society. Through rigorous research, exploration, and discovery, we contribute to the global body of knowledge, address societal challenges, and prepare our students to become critical thinkers and leaders. The University of Lucknow has a rich tradition of pioneering research and it is our collective responsibility to build on this legacy and propel our institution to new heights of excellence. It is my wish that this research bulletin will help foster the creativity and scientific endeavour that leads to development and innovation.

Prof. Manuka Khanna

Message from Director, IQAC

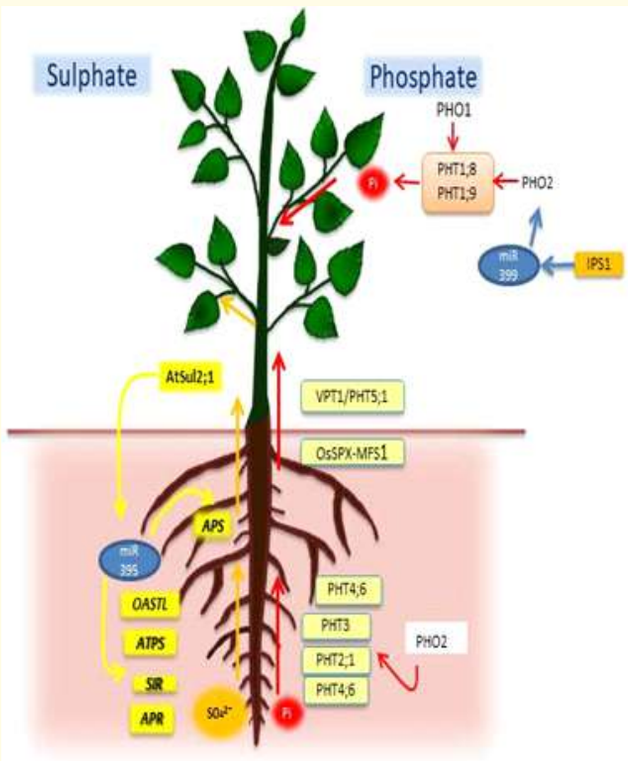
To support and promote academic research IQAC is coming with its first research highlights. IQAC continues to invest in state-of-the-art research infrastructure, provide competitive funding opportunities, ad foster interdisciplinary collaboration. In addition, we are exploring partnership with industry leaders, government agencies, and international institutions to create a dynamic ecosystem that amplifies the impact of our research efforts. IQAC would also like to emphasize the importance of mentorship and collaboration in nurturing the next generation of researchers. By fostering a culture of mentorship, we ensure that our students and early career researchers receive the guidance and support they need to succeed in their research.

Prof. Sangeeta Sahu

Sulfur and phosphorus transporters in plants: Integrating mechanisms for optimized nutrient supply

Dr. Ajey Singh, Department of Botany

Advancements in molecular techniques have significantly enhanced understanding of sulfur and phosphorus metabolism and transport in plants. These macronutrients are vital for plant growth, development, and stress responses. Plants absorb sulfur and phosphorus through their roots as inorganic sulfate (SO_4^{2-}) and phosphate ($H_2PO_4^-$, HPO_4^{2-}, or PO_4^{3-}) ions via specialized SULTR and PHT transporter families. Molecular characterization, regulatory control, and cellular localization of these transporters provide strategies to improve nutrient use efficiency in crops. Plants also possess complex signalling networks that integrate nutrient sensing, uptake, and homeostasis, with feedback mechanisms adjusting transporter activity under nutrient deficiency. This review analyses the molecular mechanisms governing distribution, function, and regulation of sulfur and phosphorus transporters, highlighting their roles in environmental stress adaptation and their connection with stress-responsive pathways. Additionally, it underscores the importance of phytohormones in coordinating sulfur and phosphorus homeostasis to enhance abiotic stress tolerance.

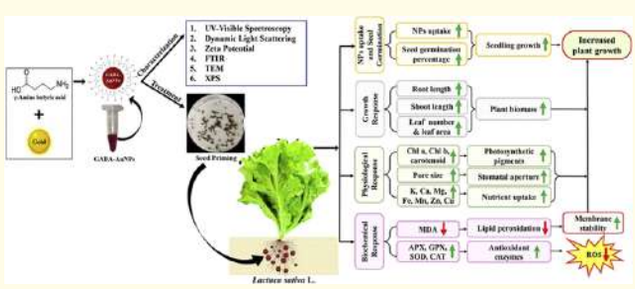


Singh, A., Khare, S., & Gupta, P. (2025). Plant Physiology and Biochemistry, 2025, 109918.
For more info:
doi.org/10.1016/j.plaphy.2025.109918

Novel GABA-Stabilized Gold Nanoparticles for Plant Systems: Synthesis, Characterization, and Unprecedented Effects on Growth, Physiological Function, and Nutrient Efficiency in Lactuca sativa L.

Prof. Mohammad Israil Ansari, Department of Botany

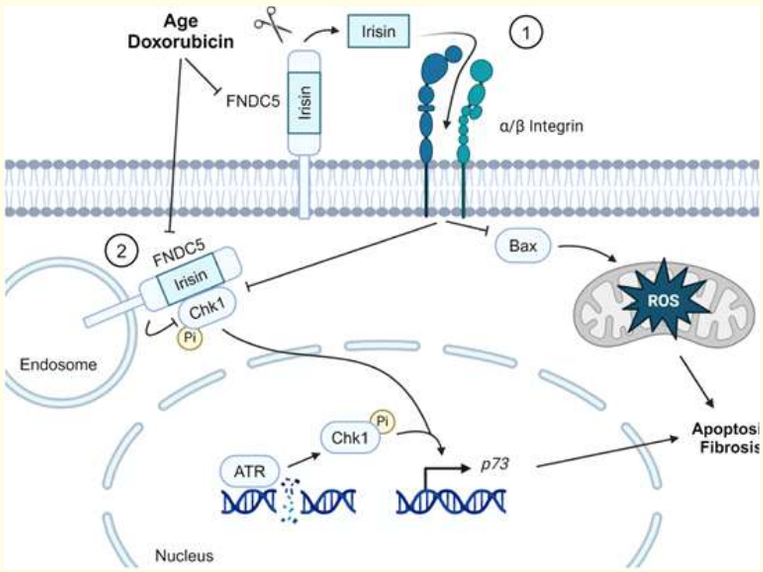
Conventional methods of nutrient supply for the growth of plants are not very suitable in the field of agriculture. To enrich the field of agricultural sciences in view of enhancing crop productivity, nutrient supply, soil health, sustainable farming practices and human welfare, an advanced technology termed as “Nanotechnology” is widely explored due their amazing potential applications. In this study, we present the synthesis, comprehensive characterization, and agricultural application of GABA-AuNPs. To investigate the chemical state and surface composition of the GABA-AuNPs, X-ray photoelectron spectroscopy (XPS) analysis was conducted. Additionally, GABA-AuNP treatment improved mineral nutrient uptake, optimized stomatal function, and reduced oxidative stress, as evidenced by a decrease in MDA content. However, higher concentrations (≥ 400 µM) exhibited diminishing returns, with potential negative effects on growth and nutrient homeostasis. These findings suggest that GABA-AuNPs offer a novel strategy for promoting plant growth, nutrient assimilation, and stress resilience, though concentration-dependent effects warrant careful consideration for practical agricultural applications.



Pushpanjali Yadav, Mohammad Amir, Abdul Raheem, Shaheen Anjum Khan, Manisha Sharma, Mohammad Israil Ansari, 2025, Biocatalysis and Agricultural Biotechnology, 67, 103644
DOI: https://doi.org/10.1016/j.bcab.2025.103644

FNDC5/irisin mitigates the cardiotoxic impacts of cancer chemotherapeutics by modulating ROS-dependent and -independent mechanisms

Dr. Pranesh Kumar, Department of Pharmacology, Institute of Pharmaceutical Sciences

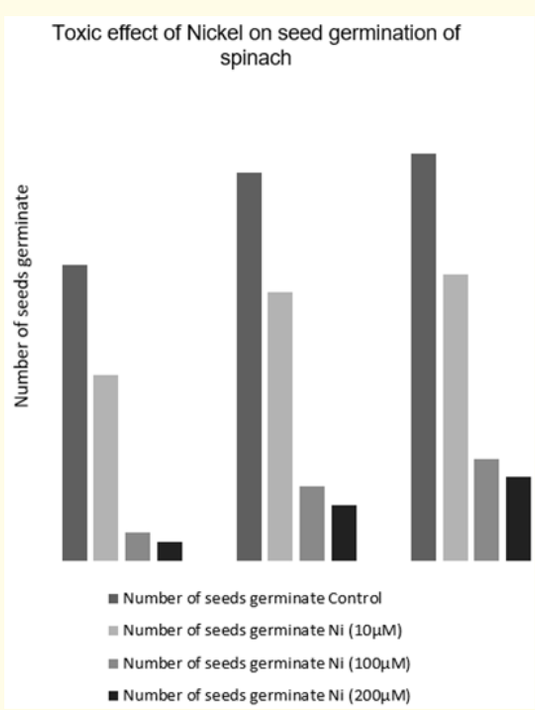


Cardiotoxicity remains a major limiting factor in the clinical implementation of anthracycline chemotherapy. Though the etiology of doxorubicin-dependent heart damage has yet to be fully elucidated, the ability to trigger oxidative stress has been heavily implicated. Here, we demonstrate that fibronectin type III domain-containing protein 5 (FNDC5), the precursor protein for myokine irisin, is depleted in the hearts of human cancer patients or mice exposed to chemotherapeutics. FNDC5 overexpression in murine heart was cardioprotective, introduction of FNDC5-targeted shRNA into the myocardium was sufficient to trigger Bax upregulation, ATR/Chk1 activation. Though our data point to the potential clinical utility of FNDC5/irisin-targeted agents in the treatment of chemotherapy-induced cardiotoxicity, we also found significant down regulation in FNDC5 expression in the hearts of aged mice that attenuated the cardioprotective impacts of FNDC5 overexpression following doxorubicin exposure. Together our data underscore the importance of FNDC5/irisin in maintenance of cardiac health over the lifespan.

Manish Kumar et al. Redox Biology, 80, 2025,103527.
For more info:
https://doi.org/10.1016/j.redox.2025.103527

Impact of excess nickel on the seed germination, their growth and other physiological characteristics of spinach

Girish Chandra Pathak, Department of Botany



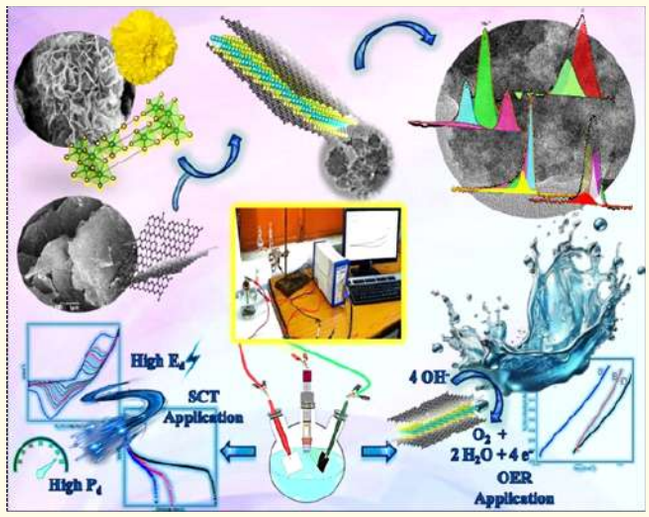
From the beginning Industrial Revolution, heavy metal concentration changed dramatically in the environment and it, led to metal toxicity. Contamination of soil and groundwater by heavy metals becomes a serious threat to the environment and human health. In trace amounts, certain heavy metals are required for the normal growth and development of plants, and in excess amounts, they cause toxicity to plants, humans and animals. In this study, we conduct a test on spinach (Spinacia oleracea L.) to find out the toxic effect of nickel on seed germination, root and shoot growth and antioxidant enzymes. A Set of four solution culture experiments was done with different concentrations of Ni (control, 10, 100 and 200 µM). Nickel toxicity leads to a reduction in germination (no. of seeds), shoot and root length, as compared to seeds germinated in low nickel (control). It also reveals the antioxidative defense mechanisms of plants, first increasing enzyme (catalase) activity at 10 µM Ni but later getting inhibited on increasing the Ni concentration 100, 200 µM. The increase in Ni toxicity it leads to the breakdown of the antioxidative defense mechanisms of plants.

G.C. Pathak, Singh Nilu & Dwivedi R. International Journal of Plant and Environment, 2025, 11 (2): 395-400
For more info: doi: org/10.18811/ijpen.v11i02.20

Exploring layered nanocomposite of MoS2 and rGO as a highly efficient supercapattery and OER electrocatalyst

Narendra Kumar Singh, Department of Chemistry

Herein, a low-temperature hydrothermally synthesized MoS2@rGO nanocomposite electrode materials have been studied for supercapattery and oxygen evolution reaction (OER) applications. Pristine MoS2 and rGO have also been studied for comparison with MoS2@rGO. PXRD, FTIR, Raman spectroscopy, XPS, SEM-EDS, HRTEM, SAED and BET were employed for physical properties. The electrochemical performance was evaluated using a three-electrode system in 1 M KOH. MoS2@rGO (1:2.4) exhibited superior electrochemical properties compared with its pristine constituents, with the highest specific capacitance of 4503.8 Fg−1 at a high current density of 5 A g−1. It delivered an energy density of 72.16 W h kg−1 and a power density of 849.5 W kg−1 at 5 A g−1. It also achieved a high specific power of 1734.8 W kg−1 at a current density of 10 A g−1. Tafel anodic polarization revealed a current density of 638.4 mA cm−2 at an applied potential of 700 mV with Tafel slope of 92 mV dec−1.

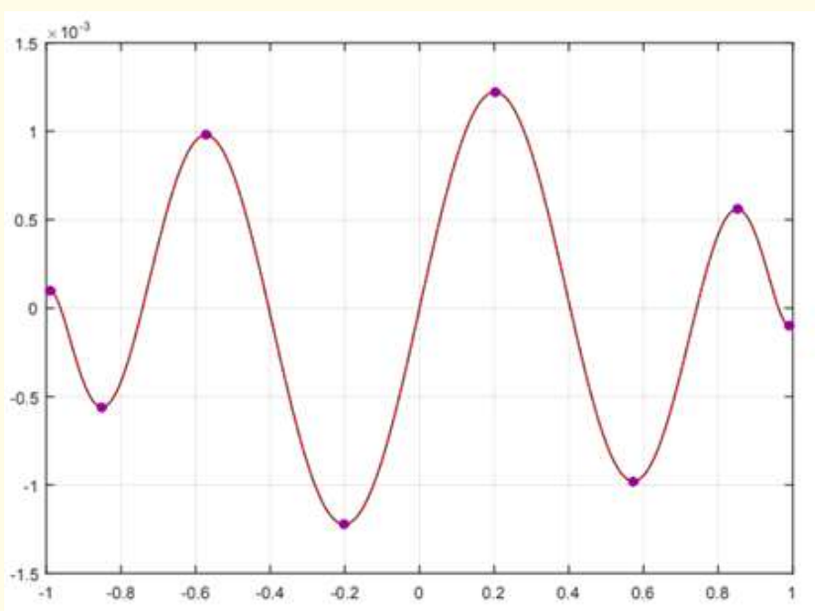


Uzma Afreen, Ushna Afreen and Narendra Kumar Singh*, Journal of Materials Chemistry A, 13, 2025, 10945–10966
For more info: doi:org/10.1039/d4ta09036e

On rational Hermite- Fejér interpolation

Kiran Manral, Swarnima Bahadur, Department of Mathematics and Astronomy

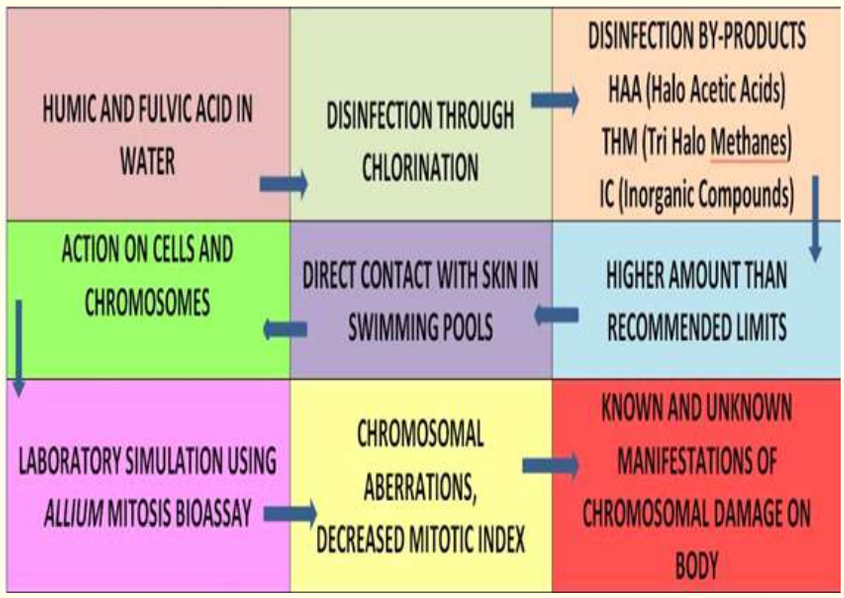
This article focuses on the study of Hermite-Fejér interpolation in a rational function space. They constructed the rational functions with poles {−1,1} satisfying the conditions of the Hermite-Fejér interpolation on the nodes of the orthogonal Jacobi polynomial. The objective is to determine the quantitative estimate of the corresponding interpolatory function. Further, some numerical simulations are performed to demonstrate the effectiveness of the theory of the research work. Notably, several examples are presented to visually demonstrate the effectiveness of the interpolator in approximating functions, thus validating the theoretical results. These findings deepen our understanding of rational interpolation, particularly in terms of the interpolant's behavior near the poles, and suggest that this method could serve as a viable alternative to polynomial interpolation, especially for functions with poles at {−1, 1}.



Kiran Manral, Swarnima Bahadur, Filomat, 39:23 (2025), 8229–8244.
For more info: doi:org/10.2298/FIL2523229M

Risk assessment of a Disinfection By-Product (DBP) on mitotic chromosomes using Allium root-tip bioassay

Monika Yadav, Amit Kumar Singh, Department of Botany



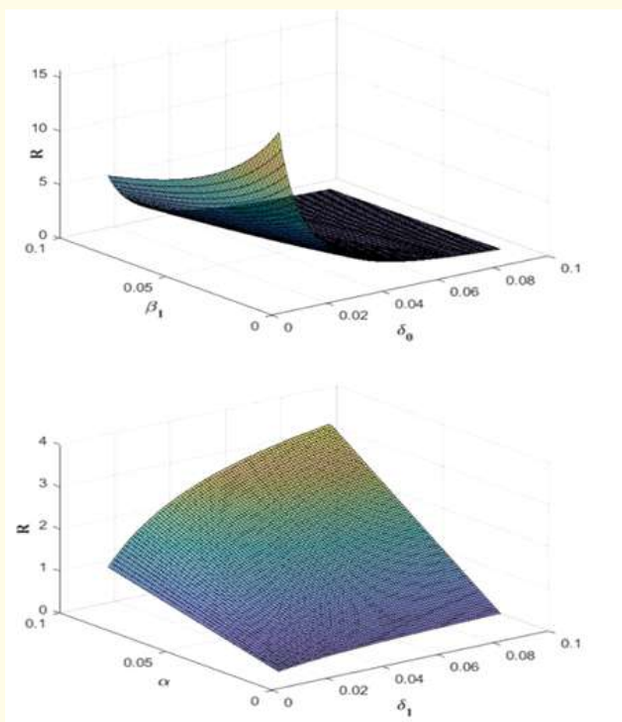
This study evaluates the cytotoxic and genotoxic effects of Trichloroacetic Acid (TCAA), a commonly occurring Disinfection By-Product (DBP) in chlorinated swimming pool waters, using the Allium cepa L. root-tip mitotic bioassay. Allium cepa L. bulbs were exposed to varying concentrations of TCAA to assess mitotic index reduction and chromosomal abnormalities. The cells of the roots grown in exposure of Trichloroacetic acid (TCAA) were then cytologically analysed. Results showed mitotic abnormalities like micronuclei, bridge formation, fragmentation, stickiness etc. with total abnormalities reaching up to 26.81%. A dose-dependent reduction in mitotic index (up to 41.68%) and an increase in abnormalities such as micronuclei, bridges and fragmentation was observed.

Yadav M., Singh V., & Singh A.K. Archives of Agriculture and Environmental Science, 2025, 10(2), 257-261(2025).
DOI: https://doi.org/10.26832/24566632.2025.1002010

Optimal control treatment and vaccination effect on SEIR epidemic model with nonlinear incidence

Dr. Rachana Pathak, Mathematics, Faculty of Engineering and Technology

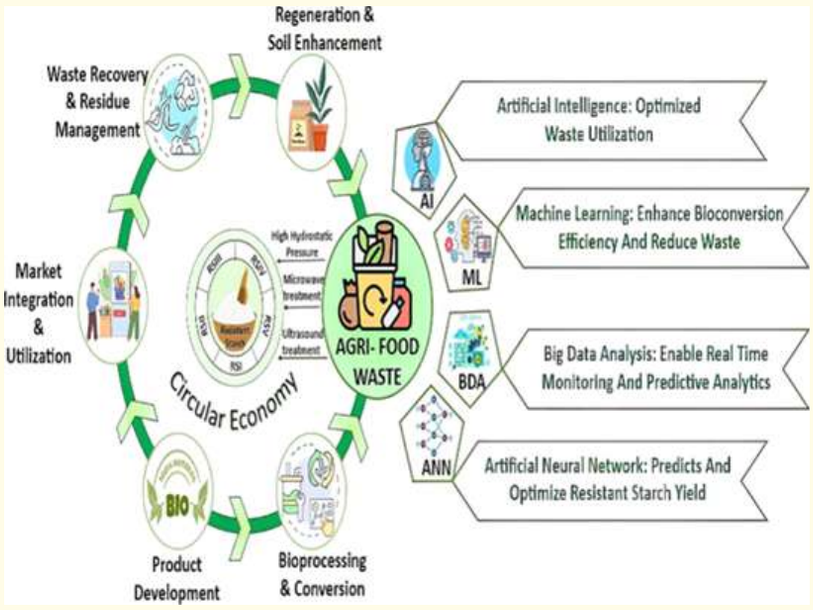
The control of infectious diseases could be very vital these days. In this research, we proposed an SEIR epidemic version with nonlinear incidence. We examine the model for the existence of a completely unique positive and bounded solution. To evaluate the contagiousness of the diseases and to check the proposed version for local and global stability at the disease free and endemic equilibrium points. We decide the reproduction number R0. We additionally investigate the influence of model parameters on reproduction number R0 through appearing sensitive analysis. The primary goal of this study is carried out extraordinary diseases manipulate strategies to decide the most useful one. The numerical findings monitor that the proposed optimum control method for control of SEIR is more effective in reducing the variety of infected population.



Anikat, K.B., Pathak, R., Mishra, P. and Verma, V., Nonlinear Studies, 32(1), 113-128, 2025
For more info:
https://nonlinearstudies.com/index.php/nonlinear/article/view/3696

Transforming agri-food waste into value: Sustainable approaches for next-generation resistant starch production

Dr. Pradeep Kumar, Department of Botany



Agri-food waste—organic materials discarded from farming, post-harvest handling, processing, distribution, and consumption—creates significant environmental and economic challenges due to poor resource utilization and disposal issues. Transforming these residues into value-added products, particularly resistant starch (RS), offers a sustainable solution. RS, a non-digestible carbohydrate with prebiotic benefits, supports gut health, regulates blood sugar, and promotes satiety. Recent research has focused on extracting RS from agricultural by-products such as potato peels, rice bran, banana peels, and chestnut starch. Techniques like enzymatic hydrolysis, ultrasound-assisted extraction, and thermal processing have proven effective while preserving RS functionality. Advances in artificial intelligence (AI), big data, and machine learning are further improving waste valorization. AI-driven technologies enhance the classification, separation, and processing of food waste, while IoT-based smart systems support efficient resource recovery. As these innovations evolve, large-scale implementation is expected to reduce food waste, strengthen the circular economy, and supply functional ingredients for the food industry.

Pradeep Kumar et al., Bioresour Technol. 437:133090.
For more info: doi:org/10.1016/j.biortech.2025.133090

Elucidating the Secondary Metabolite Biosynthesis Networks in Underutilized Tree Bean (Parkia timoriana) Through Integrated Metabolomic and Transcriptomic Approaches

Shafquat Fakhrah and Alka Kumari, Department of Botany

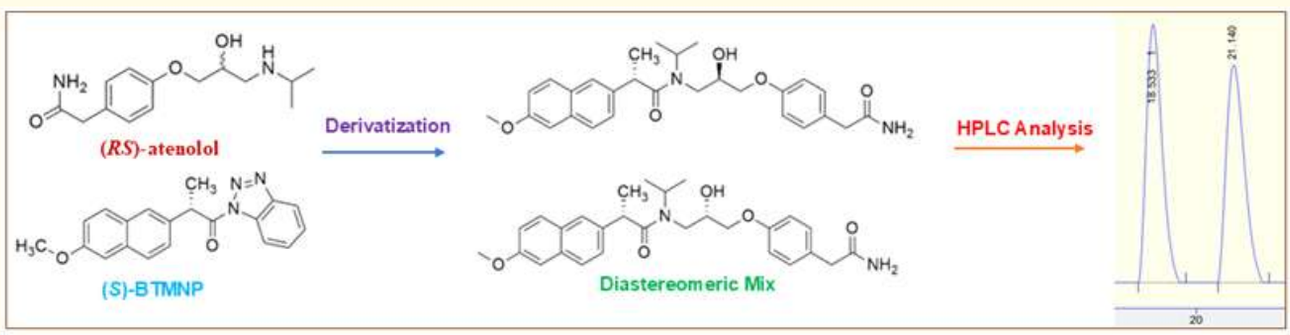
The tree bean (Parkia timoriana (DC). Merr) is an underutilized legume and is abundantly found in Southeast Asia. It is valued for its nutritious pods and cultivated for food and timber. Despite of the presence of several nutrients, the regulatory networks involved in secondary metabolite biosynthesis in the tree bean remain largely unexplored. Recent studies have highlighted that consumption of its pods provides numerous health benefits, including antioxidant, α-glucosidase inhibitory, antibacterial, antidiabetic, and insecticidal activities. To elucidate the biosynthesis of specific metabolites in this plant, a comparative metabolite and transcriptomic analysis of the leaf and root tissues of P. timoriana was carried out. The study revealed that P. timoriana leaf and root tissues contain varying levels of phenolics, flavonoids, and terpenoids. 1H nuclear magnetic resonance (1H NMR) analysis identified 16 significant metabolites in the leaf and root tissues, including sugars, amino acids, and organic acids.

L-dihydroxyphenylalanine (L-DOPA), an amino acid derivative and precursor to dopamine, was detected for the first time in the seeds. Additionally, the presence of pinitol in P. timoriana was also confirmed. De novo RNA-sequence analysis identified differentially expressed genes (DEGs) in both the tissues. Gene ontology (GO) and Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway analysis identified pathways associated with shikimate pathway, such as phenylpropanoid and flavonoid biosynthesis. MapMan pathway analysis revealed a high number of transcripts related to phenylalanine, tryptophan, tyrosine, and condensed tannin biosynthesis. The research conducted identified secondary metabolites in P. timoriana, and their probable biosynthetic pathway which can be used for medicinal and nutritional purposes.

Enantioselective Analysis and Separation of Two β-Blockers via Derivatization Approach

Dr. Vinod, Department of Chemistry

Enantiomeric analysis of chiral drugs is very significant, as their enantiomers display different pharmacological or toxicological behavior towards living systems. Among these drugs, β-blockers are available as racemates, where their enantiomers display different pharmacological effects. Herein, we report enantioselective separation of two β-blockers, namely, atenolol and sotalol, using a derivatization approach. The analytes were derivatized with "(S)-1-[1H-benzo(d)(1,2,3)triazol-1-yl]-2-[6-methoxynaphthalen-2-yl-propan-1-one]" {(S)-BTMNP} in a straightforward derivatization step. The resulting diastereomers were separated on a reverse-phase HPLC C18 column with a mobile phase composed of acetonitrile and TEAP buffer (75:25, v/v, pH = 3.5) and detection at 230 nm. This method achieved successful enantiomer separation for both drugs within 20 min, yielding resolution values greater than 3.8. The detection limits were determined to be 6.4 and 4.6 ng mL-1 for atenolol and sotalol, respectively, which indicated sensitivity and effectiveness of the method for the analysis of two β-blockers from their dosage formulations.



Vinod, et al. Chirality, 2025; 37: e70010
For more info: https://doi.org/10.1002/chir.70010

Nonlinear frequency and dynamic response of PLA polymeric imperfect FG sandwich plates under hygrothermal conditions

Praveen Kumar Rai, Department of Mechanical Engineering

This paper investigates the nonlinear free vibration behavior of porous functionally graded (PFG) sandwich plates under hygrothermal conditions. The material properties of the PFG plates are assumed to change continuously across the thickness governed by the volume fraction of composition. An enhanced rule of mixtures including the distribution of porosity throughout the cross - section was utilized for material modeling. The foundation medium is modeled as nonlinear, homogeneous, and isotropic, which is then solved by using Galerkin's model. The study employs first order shear deformation theory (FSDT) in the kinematic relations, and the equations of motion are derived using Hamilton's principle. An analytical solution is developed for the PFG sandwich plates, assuming supported boundary conditions. The study thoroughly examines the fundamental natural frequency of PFG plates, considering the impacts of the hygrothermal environment, porosity volume percentage, and span-to depth ratio.

Praveen Kumar Rai et al. Coupled systems mechanics 14, no. 1 (2025): 1-19.
https://doi.org/10.12989/csm.2025.14.1.001

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