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Journal Name: Journal of Environmental Chemical Engineering **IF: 7.5**

Title: Nano-biohybrid photocatalysts for sustainable wastewater treatment: Recent advances and future perspectives

Author: Kumar M.; Sahoo P.C.; Pillai S.; Raut R.; Parida K.

Details: Volume-14, Issue-5, October 2026

Abstract: Currently, the rising discharge of industrial, agricultural and domestic effluents has severely contaminated the water bodies with a wide variety of organic and inorganic pollutants such as dyes, medicines, heavy metals and persistent organic compounds. Traditional wastewater treatment processes are often characterized by low efficiency, being costly to operate, secondary contamination, and weak elimination of the refractory pollutants. In that regard, it is possible to note that nano-biohybrid photocatalysts are becoming a prospective and viable alternative to advanced wastewater treatment. The mini-review will include a detailed account of the latest breakthroughs in designing, manufacturing and applications of nano- biohybrid photocatalysts with an accent on their prospects to alleviate the existing environmental issues. In detail, the synthesis strategies of nano-biohybrid systems (including incorporation of nanoparticles with enzymes, microbial cells or biomolecules), the importance of surface engineering, heterojunction formation and defect modulation in enhancing photocatalytic performance are reviewed. The mechanistic understanding of the pollutant degradation is established, where emphasis is made on the reactive oxygen species (ROS) formation, the efficiency of charge separation, and synergistic bio-nano interactions which enable the selective and quick degradation of a broad spectrum of pollutants. Recent studies have established that nano- biohybrid photocatalysts are more effective in degrading efficiencies, broad-spectrum pollutant removal, stability in operation, reuse and less energy is required as compared to traditional photocatalysts. These systems are special in that they incorporate biological specificity and catalytic activity with high surface area, tunable electronic structure, and light absorption characteristics of nanomaterials that lead to environmentally friendly, energy efficient, and long-term wastewater treatment. Lastly, the review mentions the current obstacles like material, scale-up, cost-effectiveness, and regulatory issues, and future trends including the creation of multifunctional, self-regenerative and scalable nano-biohybrid photocatalysts.



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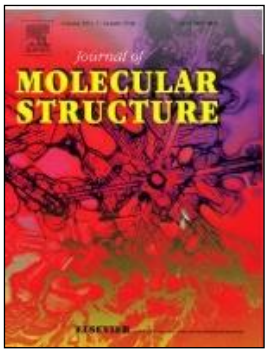
Journal Name: Journal of Molecular Structure **IF: 4.9**

Title: Tetranuclear defective dicubanes of vanadium complexes: Synthesis, characterization and their potential biological activities

Author: Singh A.R.; Rajpurohit A.S.; Khongsai L.; Singh S.A.; Chingakham B.S.; Jaccob M.; Lonibala R.

Details: Volume 1373, October 2026

Abstract: Four tetranuclear V(V) complexes 1-4 with unique $\{V_4O_8\}$ defective dicubane cores were synthesized through novel route under methanolic condition using bis(acetylacetonato) oxovanadium(IV) precursor along with 2,2′-bipyridine and substituted 2,2′-bipyridine ligands i.e. 2,2′-bipyridine in (1), 4,4′-dimethyl-2,2′-bipyridine (2), 5,5′-dimethyl-2,2′-bipyridine (3) and 4,4′-dimethoxy-2,2′-bipyridine (4). The complexes are characterized on the basis of CHN, UV-visible, IR and SC-XRD analysis data. Single-crystal X-ray diffraction analysis revealed the solid-state structures of all complexes (1-4) with distorted octahedral geometries for the four V(V) ions. The electronic nature of the complexes and their molecular surfaces were investigated using density functional theory (DFT) and Hirshfeld surface analysis. In vitro antidiabetic studies indicated that the complexes possess good antidiabetic activities against α-glucosidase and in vitro studies of anticancer activities against A549 cells, complex 3 shows better activity with IC_{50}= 2.5±1.07 µM.



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Journal Name: Scientific Reports **IF: 4.9**

Title: Structure-based virtual screening and molecular dynamics elucidate novel inhibitors of HIV-1 TAR RNA from enamine library

Author: Mundlia P.; Singh S.P.; Gartia J.; Ranawat P.; Singh G.; Barnwal R.P.

Details: Volume-16, Issue-1, December 2026

Abstract: The HIV-1 trans-activation response (TAR) RNA is a key regulatory element necessary for viral replication, presenting a high-value target for anti-HIV therapeutics. Recent advances in RNA-targeted drug discovery have leveraged large, diverse compound libraries, such as the Enamine collection, using structure-based virtual screening to uncover novel modulators of RNA structure and function. In this study, we employed an integrative in silico approach combining high-throughput virtual screening of the Enamine library against the central bulge region of HIV-1 TAR RNA with molecular dynamics (MD) simulations to assess binding stability and conformational adaptability of lead molecules. Virtual screening pinpointed multiple candidate ligands predicted to disrupt the critical Tat-TAR interaction interface, with subsequent MD simulations over 500-nanosecond timescales revealing ligand-induced stabilization of druggable RNA conformations and dynamic remodelling of key binding pockets. Notably, some top-scoring compounds featured strong and persistent contacts within the U23-C25 bulge and the adjacent major groove, recapitulating pharmacologically relevant mechanistic disruption. These findings reinforce the synergy of structure-based screening and MD for identifying and validating RNA-targeted small molecules and provide promising new scaffolds for further experimental testing as selective HIV-1 replication inhibitors.



URL: https://www.nature.com/articles/s41598-026-50156-3

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Journal Name: Cellular Signalling **IF: 4.7**

Title: NECTIN-4 orchestrates macrophage-mediated tumor plasticity in oral squamous cell carcinoma

Author: Acharya S.S.; Paul S.; Viswanathan S.; Bajoria A.A.; Patnaik S.

Details: Volume-149, January 2027

Abstract: Tumor associated macrophages (TAM) are key regulator of the tumor microenvironment (TME), however, the upstream factors that contribute to the polarization and functional reprogramming in oral squamous cell carcinoma (OSCC) remain largely unclear. This study evaluates the role of Nectin-4 in modulating tumor-immune interactions and its impact on OSCC progression. Detailed transcriptomic data from The Cancer Genome Atlas (TCGA)-OSCC dataset revealed that high NECTIN-4 expression was associated with enrichment of pathways involved in epithelial mesenchymal transition (EMT), angiogenesis, and stemness, and was inversely correlated with inflammatory signaling and immune infiltration.Additionally, single-cell transcriptomic analyses demonstrated an increase in macrophages, solely focused on the stroma, in Nectin-4 high tumors. Consistently, SCC-9 cells exhibited high levels of Nectin-4 and Nectin-4 enriched conditioned media (CM) derived from SCC-9 cells induced polarization of THP-1 monocytes toward a TAMs-like phenotype, characterized by increased CD163 expression and elevated secretion of immunomodulatory cytokines such as CCL-2. Co-culture of TAMs with SCC-9 cells promoted tumor aggressiveness, as evidenced by increased expression of EMT markers (E-cadherin, N-cadherin, vimentin) and stem cell markers (CD133, OCT4), invasion and cytoskeletal remodeling. These TAMs also enhanced angiogenesis in cancer cells by increasing the expression of VEGF-A, angiopoietin-1 (Ang-1), and TGF-β, along with in ovo neovascularization and promoting endothelial tube formation. Overall, the study identifies Nectin-4 as a key mediator of tumor-immune crosstalk in OSCC, driving macrophage enrichment, immune suppression and pro-tumorigenic signaling. Therefore, targeting Nectin-4 signaling could be a new approach to restore anti-tumor immunity and inhibit OSCC progression.



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Journal Name: Plant Signaling and Behavior **IF: 4.1**

Title: Laying the blueprint of abiotic stress tolerance: an analysis on the complexities of the stress matrix

Author: Samanta I.; Saha B.; Tarafdar S.; Roy P.C.; Bulle M.; Giri M.K.; Chowdhary G.

Details: Volume-21, Issue-1, 2026

Abstract: Extreme weather conditions driven by climate change have resulted in higher average temperatures, more frequent intense heat waves, increased drought conditions, improper soil conditions, as well as increased pest and disease incidence, posing a unique challenge to plants. Until now, several studies have been performed to reveal how plants can acclimatize or cope with these unfavorable conditions. These studies have majorly focused on how plants respond to an individual stress at a particular point in time. But in nature, no stress occurs in isolation; rather, they act mostly in combination. This condition is referred to as “multifactorial stress combination” or, more precisely, it is termed as “stress matrix”. The damages and corresponding responses from individual stresses and stress combinations may entirely be different, leading to complex downstream signaling. Through this review, we have made an attempt to decipher the physiological and molecular responses of different plant species to multiple stress combinations. It is further emphasized that more focus needs to be drawn towards the development of plants that are tolerant to multiple or co-occurring stress factors, keeping in mind the adversities of the consistently challenging environmental conditions.



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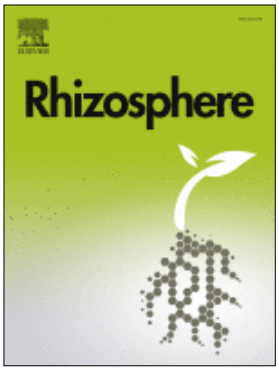
Journal Name: Rhizosphere **IF: 3.9**

Title: Engineering resilient agroecosystems via nano-biofertilizer interfaces: Physicochemical mechanisms of microbial stabilization and rhizosphere soil health

Author: Kumar C.; Kumar N.; Kumar R.; Adhya T.K.; Singh R.K.

Details: Volume-40, December 2026

Abstract: Nano-biofertilizer hybrid platforms that include microbial consortia, biopolymer scaffolds, and engineered nanomaterials (ENMs) are proposed as a solution to the problems associated with conventional agrochemicals. However, there is now a substantial efficacy gap that makes their translation from controlled laboratory settings to complex soil ecosystems challenging. This paper offers a critical synthesis of the physicochemical and biophysical principles governing the nano-biotic interface in the rhizosphere, rather than relying on extensive empirical surveys, to examine the basis of this translational failure. We first critically evaluate extended Derjaguin–Landau–Verwey–Overbeek (eDLVO) theory, which explicitly combines critical hydration forces and soil colloid heterogeneity, to describe the thermodynamic and kinetic drivers of biomolecular corona (BMC) generation within complex soil organic matter. Secondly, we reassess the mass transfer kinetics of formulations contained in biopolymers. This review describes anomalous transport behaviour seen in dynamic soil environments from theoretical zero-order ideals by critically analysing geometrical assumptions in kinetic release models (e.g., Korsmeyer–Peppas cylindrical diffusion exponents). Third, we analyse the evidence on ENM-microbe interactions that are currently available, making a careful distinction between theoretical models of the amplification of quorum sensing (such as N-acyl homoserine lactones) in competitive soil microbiomes and physiological responses that have been demonstrated. Finally, to comply with ecotoxicological constraints, we prioritise research and highlight specific quantitative benchmarks (such as EC50 values). By highlighting inconsistencies in the literature and putting physical chemistry under realistic soil restrictions, this study emphasizes the stringent structure-property relationships required to produce reliable, field-ready nano-biofertilizers.



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Journal Name: Journal of Material Cycles and Waste Management **IF: 3.8**

Title: Species-specific vermicomposting of dairy processing sludge: optimized pre-composting, comparative earthworm performance, and life cycle assessment

Author: Mohapatra J.; Kumar R.; Nayak J.; Banerjee S.; Karmakar B.; Mishra A.; Khan M.A.; Chakrabortty S.; Tripathy S.K.; Jeon B.-H.

Details: Volume-28, Issue-5, September 2026

Abstract: In this study, vermistabilization of dairy processing sludge (DPS) was performed by mixing with cattle dung (CD) in 1:1 ratio and subjecting it to varying pre-composting periods of 7 days to 35 days for the three earthworm species, Eisenia fetida (E.F), Eudrilus eugeniae (E.E), and Perionyx excavatus (P.E). Pre-composting times of 3 weeks (DPS21E.F), 2 weeks (DPS14E.E), and 3 weeks (DPS21P.E) gave optimal results for all three earthworms' growth, reproduction, and composting efficiency in terms of total Kjeldahl nitrogen, total available phosphorus, and total potassium for the three species. E.F was found to have the most effective soil-builder capacity, which contributed to a higher seed germination index, 193% for Vigna radiata (mung bean), 197% for Raphanus sativus (radish), and 193% for Cucurbita pepo (pumpkin). LCA showed that vermicompost treatments resulted in climate change impacts of approximately 265, 272, and 276 kg CO2-eq for E.F, E.E, and P.E, respectively, compared to approximately 415 kg CO2-eq for synthetic urea. Terrestrial acidification impacts ranged from approximately 10.86–10.90 kg SO2-eq for vermicompost treatments, whereas the urea system exhibited the highest impact at approximately 11.03 kg SO2-eq, with additional contributions from natural gas–based fertilizer production.



URL: https://link.springer.com/article/10.1007/s10163-026-02704-2

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Journal Name: Biochimie **IF: 3.4**

Title: Sedentariness disrupts, while exercise restores, thermogenic and metabolic plasticity in inguinal adipose tissue of mice

Author: Sahu B.; Senapati U.; Pani P.; Pani S.; Swalsingh G.; Pati B.; Tikoo O.; Giri S.; Kar B.P.; Trivedi R.; Bahadi C.K.; Nikhil K.; Kumar D.; Bal N.C.

Details: Volume-249, October 2026

Abstract: Inguinal WAT (IngWAT) quickly adapts its metabolism to body energy status variations, including uncoupling protein 1 (UCP1) expression. However, its long-term metabolic response to long-term sedentary and exercise training has not been fully characterized. This study investigated IngWAT's long-term response to sedentary (SED, restricted cage) vs. exercise (EXER, treadmill running with a defined protocol) conditions in mice. EXER mice showed increased expression of Sarcoendoplasmic Reticulum Calcium ATPase (SERCA)2b and UCP1, along with a reduction in adipocyte size, indicating activation of thermogenesis. Fascinatingly, exercise elevated the expression of CIDEA in tiny adipocytes and promoted a beiging effect in mice. Elevated OXPHOS complex proteins expression and NMR-based metabolite profiling in IngWAT revealed that exercise profoundly reprogrammed energy metabolism by strengthening phosphocreatine-creatine buffering, regulating TCA cycle metabolite cycling (citrate and succinate), and increasing ketone body formation (3-hydroxybutyrate and acetone). Elevated glycerol level, a higher glycerol-lactate ratio, and reduced carnitine in IngWAT of EXER mice reflected improved fatty acid uptake and β-oxidation, in contrast to the metabolic inefficiency observed during sedentariness. Moreover, increased vascularization was accomplished by upregulated expression of vascular endothelial growth factor 1a (VEGF1a), angiopoietins (ANG)1&2, supports elevated metabolic state in exercise. Conversely, SED mice showed larger adipocytes with uniform CIDEA expression, but a downregulation of thermogenic proteins. Interestingly, a significant downregulation of mitochondrial complex III was also observed, which indicates altered mitochondrial physiology in SED mice. Data presented here suggest that IngWAT is metabolically flexible and can undergo both structural and metabolic adaptations in accordance with physical activity level.



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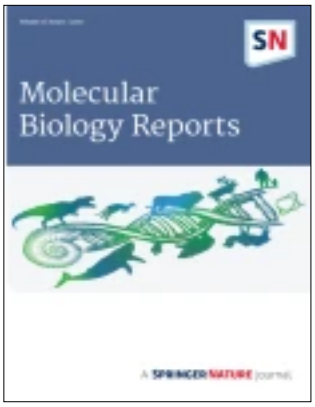
Journal Name: Molecular Biology Reports **IF: 3.2**

Title: Recent advancements in exosomal content analysis: the future of liquid biopsy

Author: Das Mohapatra H.; Banerjee S.; Dash L.; Ramnani D.; Jati P.P.; Priyadarshini P.B.; Suar M.; Sarangi C.K.; Paul S.; Dutta A.

Details: Volume-53, Issue-1, December 2026

Abstract: Exosomes are widely acknowledged as an essential agent that carries biomarkers for specific diseases, representing the molecular status of their parent cells and providing extremely useful diagnostic insights. They can be isolated from different body fluids and contain a range of cargo molecules, including proteins, lipids, metabolites, and nucleic acids. Recent advancements in technology have greatly accelerated exosome research. Proteomics provides protein signatures linked to many pathological conditions, enabling quick and clinically scalable diagnostic tools, whereas high-throughput RNA-sequencing can be used to perform detailed transcriptome profiling. Exosomal biomarkers are showing promising clinical results in early detection of neurological diseases, infectious and cardiovascular disorders, oncology, and other medical conditions, hence accelerating therapeutic monitoring. Despite these advances, several challenges continue to hinder clinical translation including the lack of standardized isolation protocol, variability in exosome yield and purity, biological heterogeneity, and limited large-scale clinical validation. Addressing these limitations will be critical for the successful integration of exosome-based liquid biopsy into routine clinical practice. Overall, exosomes having significant potential as diagnostic tool, represent a transformative horizon in biomedical liquid biopsy research to redefine the landscape of less-invasive diagnostics and tailored clinical applications.



URL: https://link.springer.com/article/10.1007/s11033-026-12661-6