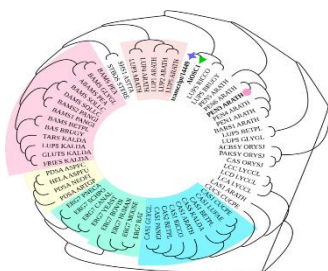


Neem Research Newsletter

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WORLD NEEM ORGANISATION (WNO)



From

The Editor's Desk.....

In this Issue of Neem Newsletter, abstracts of research articles on the effects of neem in agriculture, environment, human and animal health are presented. In the domain of agriculture, beneficial effects as well as possible safety concerns have been examined. Combined application of azadirachtin and the entomopathogenic fungus *Beauveria bassiana* ARP14 (ARP14), provided improved efficacy compared to single treatments against *Riptortus pedestris*, a major soybean pest. Nanoformulation of azadirachtin was found to circumvent its physicochemical drawbacks but also boost its insecticidal performance against cotton pests. Evaluation of the fate of botanical biopesticides in processed tomato samples revealed that azadirachtin persisted after processing, posing a potential consumer risk. The negative effects of azadirachtin on the growth and metabolism of nontarget organisms was demonstrated. Toxicity of the commercial product AzaMax® (azadirachtin) to the stingless bee *N. testaceicornis*, which are essential pollinators was evaluated. Although azadirachtin did not induce immediate lethality in *N. testaceicornis*, results suggest that it may compromise digestive physiology and genomic integrity inducing sublethal effects.

In a field experiment conducted in Egypt, integration of treated wastewater irrigation with application of humic acid and seaweed extract as biostimulants was found to simultaneously improve tree productivity, wood quality, and environmental remediation demonstrating the capacity of neem trees to remediate metals from contaminated soils. Investigation of the productivity of selected species of tropical trees of the Indian subcontinent under combined elevated CO₂, O₃, and climate stress revealed that *Azadirachta indica* exhibited greater stress tolerance. Boron-doped carbon dots prepared from a herbal mixture that contained neem were shown to be useful for fluorimetric sensing of chromium for environmental applications.

Combination of *Coronopus didymus* (watercress) with neem and quercetin was reported to be a promising targeted nutraceutical approach for managing diabetes and its associated hepatic complications. Using network pharmacology and bioinformatics approach, the therapeutic mechanisms of neem leaf extract in hepatotoxicity and liver injury through the identification of pathways and molecular targets were elucidated. A novel bioactive paste made by incorporating a neem-hypericum oil-in-water emulsion into fibrillated bacterial cellulose demonstrated excellent biocompatibility, safety, and superior wound healing efficacy in a rat model, highlighting its potential as a multifunctional biomaterial for advanced wound care applications. Current findings on the medicinal properties of the neem limonoid nimbin, with a focus on its antiviral mechanisms, biosynthetic pathways, and therapeutic prospects was evaluated in a review.

Neem-extract stabilized zinc oxide nanoparticles exhibited strong antibacterial and organ-protective effects against avian pathogenic *E. Coli* infection in broilers, making them a promising alternative to antibiotics in the treatment of poultry.

S. Nagini

Core Founding Member &
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Neem in Agriculture

[Combination of azadirachtin and entomopathogenic fungus as a better control agent against *Riptortus pedestris* \(Hemiptera: Alydidae\).](#)

Sarker S, Lim UT.J Econ Entomol. 2026 Jul 25:toag215. doi: 10.1093/jee/toag215. Online ahead of print.PMID: 42501402

Riptortus pedestris (Fabricius) (Hemiptera: Alydidae) is a major soybean pest controlled mostly with synthetic insecticides, but environmentally friendly alternatives are needed. To develop a better microbial control option using the entomopathogenic fungus *Beauveria bassiana* ARP14 (ARP14), we evaluated whether azadirachtin (AZA) enhances its effectiveness in topical bioassays on eggs and second-instar nymphs. At 10 d, the hatching rates for the AZA and the AZA + ARP14 mixture were all lower (33%) than those for the synthetic insecticide λ -cyhalothrin (83%), ARP14 (73%) or no treatment control (100%). Similarly, in the assay of second instars in the absence of food sources, the ST50 values for AZA and the AZA + ARP14 mixture were almost 1.8 times lower than that for singly applied ARP14. Also, in the presence of food sources, earlier mortality of the 2nd and 3rd instars was observed in the treatment of the AZA + ARP14 mixture compared to agents applied singly from daily observation after treatment. Mycosis was up to 3.5 times higher at 10 d when the AZA + ARP14 mixture was applied to second-instar nymphs compared to a single application of ARP14. Nevertheless, the developmental time became shorter only in the single treatment of ARP14 than in the control, whether applied to eggs or to second-instar nymphs. These results suggest that the combined application of AZA and ARP14 provides improved efficacy compared to single treatments against second instars of *R. pedestris*. Thus, the AZA + ARP14 mixture can be a potential control agent to replace synthetic chemical insecticides used against *R. pedestris*.

[Nanoformulation of Azadirachtin Improves Its Control on Cotton Pests.](#)

Tang Z, Dong J, Sun Y, Tabusibieke C, Wang Y, Lu W.Molecules. 2026 Jul 3;31(13):2347. doi: 10.3390/molecules31132347.PMID: 42451715

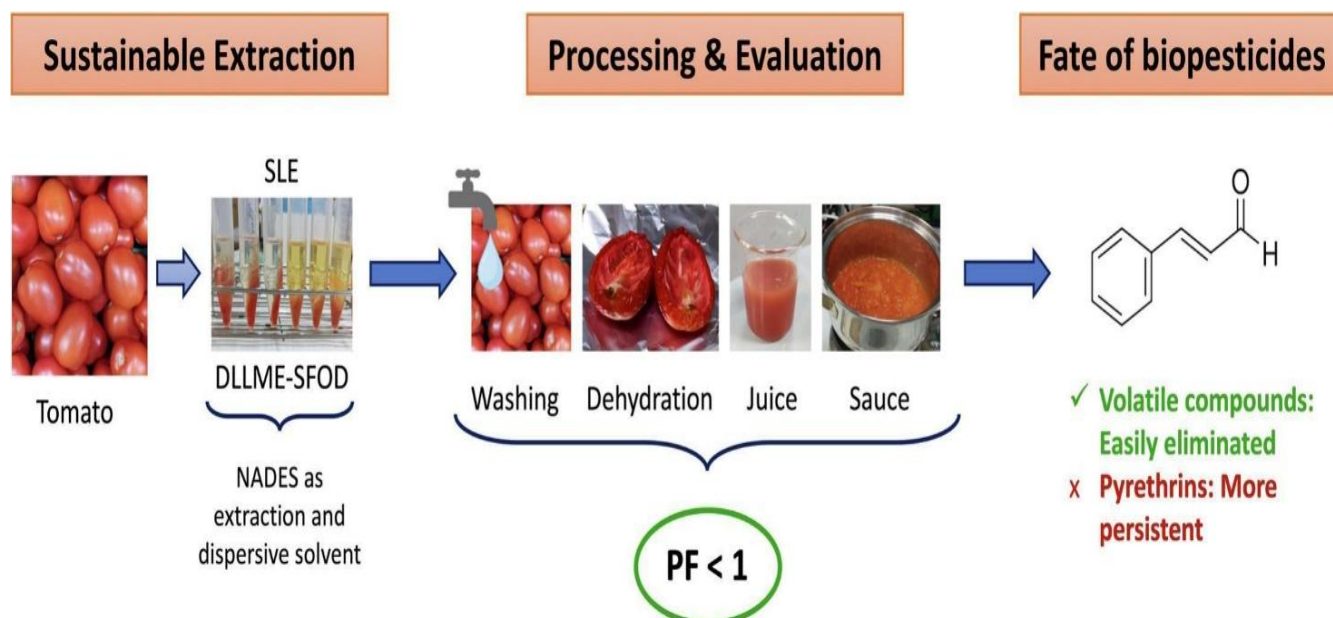
The practical efficacy of Azadirachtin (AZA)-a botanical insecticide valued for its strong antifeedant activity-is often undermined by its poor environmental stability, arising from rapid photolysis and thermal decomposition. Herein, amino-modified mesoporous silica nanoparticles (MSNs) were employed as nanocarriers to encapsulate AZA, yielding the AZA@MSNs-NH₂ nanoinsecticide. Under UV irradiation (254 nm), the degradation rate of AZA@MSNs-NH₂ was more than 35% lower than that of commercial AZA after 24 h of exposure. In biosafety tests, MSNs at 50-800 mg/L enhanced cotton seed germination and seedling growth, whereas MSNs below 200 mg/L caused no observable harm to zebrafish survival. Free AZA (0.5-10 mg/L) showed limited efficacy in bioassays against *Helicoverpa armigera* and *Apolygus lucorum*, reducing larval weight gain only marginally in the former (mortality < 5%) and performing poorly against the latter. In contrast, AZA@MSNs-NH₂ significantly boosted both growth inhibition and lethal effects against both pests, yielding > 80% growth inhibition and 62.65% corrected mortality for *H. armigera*, as well as strong lethality toward *A. lucorum*. Overall, this work confirms that nanoformulation of AZA

not only circumvents its physicochemical drawbacks but also boosts its insecticidal performance against cotton pests, supporting the advancement of sustainable cotton pest control.

[Evaluation of the effects of domestic tomato processing on biopesticide residue using natural deep eutectic solvents \(NADES\) extractions.](#)

Reyes-Ávila A, Carbonell-Rozas L, Garrido Frenich A, Romero-González R. Food Chem. 2026 Jul 7;525(Pt 1):150324. doi: 10.1016/j.foodchem.2026.150324. Online ahead of print. PMID: 42424740

The present study evaluated the fate of fourteen botanical biopesticides in processed tomato samples. Various processing methods were employed, including washing, dehydration, and the preparation of juice and sauce. The extraction was performed using more sustainable techniques, aimed at minimizing the environmental impact of conventional organic solvents by substituting them with natural deep eutectic solvents (NADES). Solid-liquid extraction (SLE) and dispersive liquid-liquid microextraction with solidification of floating organic drop (DLLME-SFOD) were utilized for solid and liquid tomato samples, respectively. The NADES used was choline chloride:2,3-butanediol (ChCIBt) at a 1:4 molar ratio for both techniques, resulting in recovery values ranging from 69.2 to 106.2% for SLE, and extraction efficiencies reaching up to 46.2% for DLLME-SFOD. The impact of these processes was evaluated employing the processing factor (PF), yielding PF values of less than 1 in all cases. Compounds as pyrethrins, azadirachtin, and rotenone persisted after processing, posing a potential consumer risk.



[Non-target influence of natural insecticide neem oil on bacterial growth and metabolism.](#)

Górzyńska O, Zdarta A, Smulek W. Int Microbiol. 2026 Jul 30. doi: 10.1007/s10123-026-00870-9. PMID: 42527748

Although azadirachtin is an insecticide used in organic farming and in medicines that treat diseases caused by insects, its influence on microorganisms, which are not targeted, has never been considered. In this study, the metabolic and enzymatic activities of model

bacteria, *Escherichia coli* and *Pseudomonas fluorescens*, were investigated in the presence of neem oil at various concentrations of azadirachtin (100 ppm, 500 ppm, 900 ppm), and biodegradation was also explored. Microbial growth and cell activity studies show that neem oil azadirachtin has a negative effect compared to control samples in almost every case. The activity of superoxide dismutase, catalase, and glutathione S-transferase in the bacterial strains analyzed in response to insecticide contamination varied, according to the strain tested. However, it is possible to conclude that, in general, azadirachtin had a negative effect on enzyme activity in almost all cases studied. The Box-Benkhen experiment on the biodegradation of azadirachtin by the *Pseudomonas fluorescens* strain shows that complete degradation was not possible during the assays. The conducted analysis provided insight into the response of bacteria to the presence azadirachtin.

[Toxicity and Morphological Alterations Caused By Azadirachtin in the Stingless Bee *Nannotrigona testaceicornis* Lepeletier, 1836 \(Insecta: Hymenoptera: Apidae: Meliponini\).](#)

Santoro A, Santana TAT, Beltrame WS, da Silva de Carvalho NR, de Oliveira Garcia LE, de Oliveira FGM, Esquissato GNM, de Alencar Arnaut de Toledo V, Moreira DR, Gigliolli AAS, Takasusuki MCCR. Neotrop Entomol. 2026 Jul 30;55(1):72. doi: 10.1007/s13744-026-01421-7. PMID: 42530777

Nannotrigona testaceicornis are essential pollinators for biodiversity maintenance and agricultural production. However, during foraging in agroecosystems, they may be exposed to residues of bioinsecticides used for pest management. Thus, this study evaluated the toxicity of the commercial product AzaMax® (azadirachtin) to the stingless bee *N. testaceicornis*. Adult worker bees were exposed to this bioinsecticide by contact and ingestion at concentrations recommended for strawberry crops, and mortality was assessed after 24, 48, and 72 h. Morphological alterations of the midgut and changes in chromatin structure in brain cells were evaluated in the surviving stingless bees. Exposure resulted in low mortality, precluding the estimation of the LC₅₀, but revealed significant sublethal effects, such as disorganization of the midgut epithelium, loss of digestive cells, reduction of regenerative cells, and disappearance of the peritrophic membrane. An increase in chromatin condensation was detected at different exposure times and concentrations, suggesting disruption of gene regulatory processes. These findings indicate that although azadirachtin does not induce immediate lethality in *N. testaceicornis*, it may compromise digestive physiology and genomic integrity, potentially affecting individual performance and long-term colony maintenance. The results highlight the importance of considering sublethal parameters in bioinsecticide risk assessments, as they may reveal hidden and ecologically relevant impacts that are not detected by mortality alone. By incorporating both lethal and sublethal endpoints, this research contributes to the development of safer agricultural practices and supports the conservation of stingless bees, which are key pollinators in tropical ecosystems.

Neem For Sustainable Environment

[Enhancement of neem growth and wood quality via humic acid and seaweed extract application under treated wastewater irrigation in arid environments.](#)

Salaheldin S, Selim MA, Soliman WS, Gahory AA. Sci Rep. 2026 Jul 15;16(1):22282. doi: 10.1038/s41598-026-61599-z. PMID: 42457809

Wastewater-irrigated forestry is an important strategy for sustainable water resource management, biomass production, and ecosystem restoration in arid and semi-arid regions. A field experiment was conducted from September 2023 to June 2025 in Balana, Nasr El-Nuba District, Aswan Governorate, Egypt, to investigate the effectiveness of humic acid (HA) and seaweed extract (SWE) as biostimulants on the growth performance, physiological responses, heavy metal accumulation, and wood properties of *Azadirachta indica* irrigated with treated wastewater. The study followed a completely randomized block design with five treatments: control, HA at 1 and 2 mL L⁻¹, and SWE at 1 and 2 g L⁻¹. Measurements were recorded at 9 and 21 months after planting. Biostimulant application significantly enhanced vegetative growth, chlorophyll content, and wood quality compared with untreated plants. Seaweed extract at 2 g L⁻¹ produced the greatest improvements in stem length by 7.7 and 11.3%, stem diameter by 35.4 and 10.7%, and chlorophyll content by 13.6 and 14.75 compared to control at 9 and 21 months, respectively. Also, it increased wood density by 10%, and reduced moisture by 9%. Whereas humic acid at 2 mL L⁻¹ resulted in higher cellulose, hemicellulose, and holocellulose contents by 4, 6.4 and 10.2%, while reducing lignin and ash by 12.1 and 9.5% compared to control. Heavy metals (Pb, Cd, Cu, Fe, and Zn) accumulated in all plant organs, with accumulation patterns varying according to the element and biostimulant treatment. Most metals were preferentially retained in the roots, whereas Fe accumulated predominantly in the leaves, indicating different uptake and sequestration strategies. Despite continuous irrigation with treated wastewater, soil heavy metal concentrations declined over the experimental period, demonstrating the capacity of neem trees to remediate metals from contaminated soils. These findings demonstrate that integrating treated wastewater irrigation with biostimulant application can simultaneously improve tree productivity, wood quality, and environmental remediation. Seaweed extract at 2 g L⁻¹ is recommended for maximizing tree growth and wood physical properties, while humic acid at 2 mL L⁻¹ is preferable for improving wood chemical quality, highlighting the potential of this integrated approach for sustainable woody plantations in water-limited regions.

[Carbon sequestration and stress resilience potential of select dominant tropical tree species of Indian subcontinent under combined elevated CO₂, O₃, and climate stress.](#)

Akil Prasath RV, Mohanraj R, Jayakumaran R, Balaramdas KR. J Environ Manage. 2026 Jul 25;414:130558. doi: 10.1016/j.jenvman.2026.130558. PMID: 42501642

During the last two decades, a number of research outcomes have vetted possible plant responses to elevated CO₂ (eCO₂) and other climate stressors in temperate trees and agricultural crops. However, such climate change repercussions (elevated CO₂, O₃,

temperature, and drought) on tropical trees, especially on dominant trees of the Indian subcontinent, remain largely unexplored. This study investigates the productivity of selected species (*Pongamia pinnata*, *Ficus benghalensis*, *Azadirachta indica*, and *Syzygium cumini*) under three experimental settings, 1) Combined Stress Condition (SC) - Carbon dioxide (CO₂): 700 ppm, ozone (O₃): 70 ppb, temperature: 1.5 to 2°C, and drought: 20% under Open Top Chamber days; 2) Chamber Condition (CC) - species were tested in the OTC without stress treatments; 3) Ambient Conditions (AC) - species were maintained under Ambient Conditions (AC). Under all the above three conditions, the following key parameters, viz., photosynthetic rate, stomatal conductance, transpiration, carbon stock, chlorophyll content, proline, phenol, and soil organic carbon, were monitored throughout the experimental period (90 days) at specific intervals. Results of the experimental study revealed that the mean photosynthesis rate of the selected saplings in SC was found to be low when compared to AC and CC. Furthermore, under SC, the carbon stock of selected saplings decreased significantly in the four species but at different magnitudes during the post stress stage: 59% in *Pongamia pinnata*; 39% in *Ficus benghalensis*; 13% in *Azadirachta indica*, and 1% in *Syzygium cumini*. Notably, *Syzygium cumini* and *Azadirachta indica* demonstrated comparatively greater stress tolerance. These findings explicitly demonstrate the climate resilience potential of *Syzygium cumini*, and this could be attributed to the enhanced phenol synthesis and Mono Dehydro Ascorbate radical production. In the wake of climate extremes, potential use of these tree species may strengthen sustainable forestry.

[Boron-Doped Carbon Dots Derived From Herbal Mixture for Selective Fluorimetric Sensing of Cr⁶⁺ and Their Environmental Applications.](#)

Sushma, Yadav N, Kumari S, Thakur S, Debnath J, Swart HC, Prakash J, Ghosh KS. Luminescence. 2026 Jul;41(7):e70562. doi: 10.1002/bio.70562.PMID: 42432459

Carbon dots prepared from natural resources are presently being used as chemosensors of different metal ions. In the present work, highly fluorescent and photostable boron-doped carbon dots (BCDs) with an average size of 10.7 nm were prepared from a powder mixture of *Azadirachta indica*, *Momordica charantia*, and *Syzygium cumini* in the presence of boric acid using a hydrothermal process. BCDs were characterized using HRTEM, XRD, XPS, Fourier transform infrared spectra (FTIR), UV-Vis, and fluorescence techniques. Maximum emission intensity of BCDs was recorded at 420 nm on excitation at 330 nm. The quantum yield of BCDs was ~12%. BCDs selectively detected Cr⁶⁺ ions through a visual color change from colorless to yellow. Selective quenching of BCDs' emission by Cr⁶⁺ was identified as an efficient analytical tool based on complexation between BCDs and Cr⁶⁺. BCDs were able to detect Cr⁶⁺ within the linear range of 0-500 µM, and the limit of detection was 0.29 µM. Rapid, label-free, and selective detection of Cr⁶⁺ by BCDs was further used for quantitative analysis of toxic Cr⁶⁺ in real water samples.



Neem for Human Health

[Antidiabetic Effect of *Coronopus Didymus*, *Azadirachta Indica* and Their Active Compound Quercetin Against STZ-NA Induced Diabetes Mice Models.](#)

Ali W, Ali M, Sehar M, Shahid S, Shiue YL, Mustafa G, Akhtar B, Sharif A. Appl Biochem Biotechnol. 2026 Jul 24. doi: 10.1007/s12010-026-05851-2. PMID: 42496827

Coronopus didymus (Brassicaceae) is a medicinal herb valued for its anti-inflammatory and hyperlipidemic properties; however, its antidiabetic potential remains entirely unexplored. Furthermore, despite the known therapeutic benefits of *Azadirachta indica* and the bioflavonoid quercetin, their evaluation in combination with *C. didymus* has never been investigated. To address this knowledge gap, this study pioneers the evaluation of *C. didymus*, *A. indica*, and quercetin-individually and as a novel combined formulation for the management of type 2 diabetes mellitus (T2DM). We employed an integrated approach utilizing in silico network pharmacology and molecular docking (targeting NOS3, AKT1, and PPARG), in vitro bioassays (antioxidant, α -amylase inhibition, hemolytic, and anticancer), and in vivo evaluation in streptozotocin-nicotinamide (STZ-NA)-induced diabetic mice. Network screening identified 100 overlapping targets between the quercetin and T2DM, prioritizing 15 key hub targets via protein-protein interaction and KEGG pathway enrichment analyses. Molecular docking confirmed strong binding affinities of the lead compounds to NOS3, AKT1, and PPARG. In vitro assays validated robust antioxidant, α -amylase inhibitory, and anticancer activities, while maintaining a safe hemolytic profile. In vivo trials demonstrated that while individual treatments effectively lowered blood glucose, the combined formulation exhibited superior hepatoprotective efficacy, profoundly reducing serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels ($p < 0.0001$) toward baseline control levels compared to individual plant extracts, alongside enhancing serum antioxidants and ameliorating histopathological damage in hepatic and intestinal tissues. In conclusion, this study bridges a critical gap in ethnopharmacology by identifying the antidiabetic potential of *C. didymus* and demonstrating that its combination with *A. indica* and quercetin offers a potent, distinct hepatoprotective advantage, highlighting its potential as a targeted nutraceutical approach for managing T2DM and its associated hepatic complications.

[Network pharmacology and in silico analysis of *Azadirachta indica* phytoconstituents reveal potential hepatoprotective targets and mechanisms.](#)

Kumari M, Srivastava A, Subhashini, Sharma S, Sah SB, Sanjeev K. Sci Rep. 2026 Jul 7. doi: 10.1038/s41598-026-52547-y. Online ahead of print. PMID: 42414355

Network pharmacology and bioinformatics approaches may provide valuable insights into pharmacological effects by enabling a system-level understanding of how drugs interact with biological networks rather than single targets. The study aimed to elucidate the therapeutic mechanisms of *Azadirachta indica* leaf extract (AILE) in hepatotoxicity and hepato-injury (HT/HI) through the identification of pathways and molecular targets via network

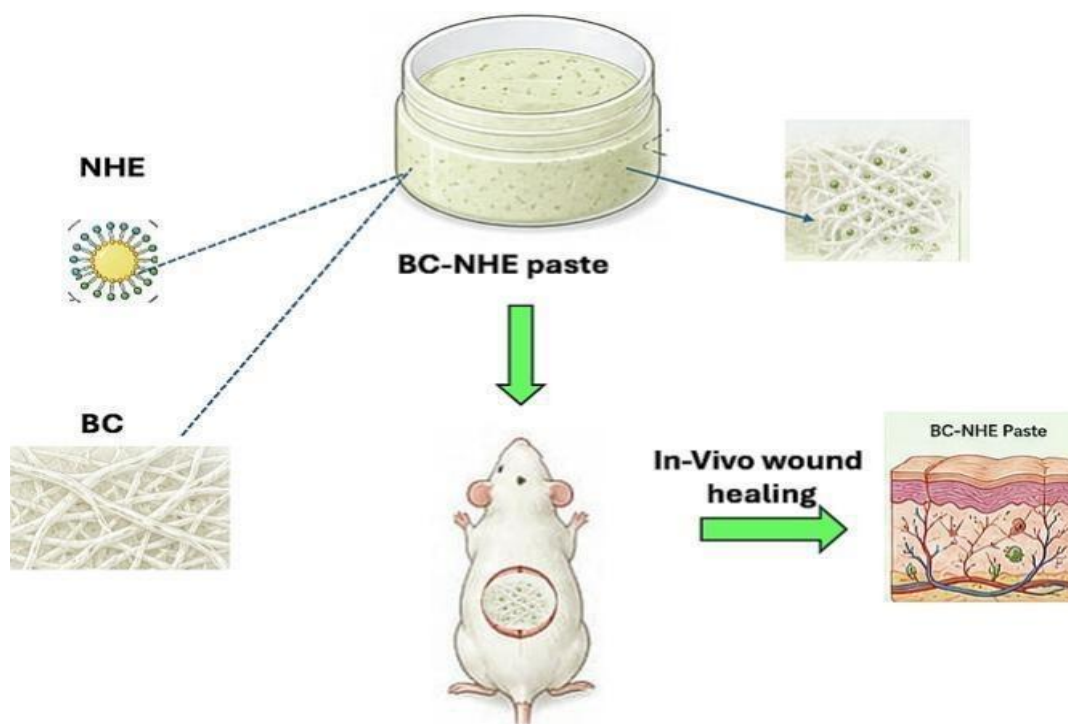
pharmacology. Phytochemical profiling of AILE was performed by Gas Chromatography-Mass Spectrometry (GC-MS). SMILES structures of identified phytochemicals were retrieved from PubChem, and ADMET properties were assessed. Five non-hepatotoxic compounds with high absorption were prioritized. Their potential targets and hepatotoxicity-related genes were predicted using SwissTargetPrediction and GeneCards, followed by drug-target network construction in Cytoscape. Hub genes were identified through protein-protein interaction (PPI) analysis (STRING) and enrichment studies (ShinyGO, KEGG). Gene regulatory networks were built using TRRUST and miRNet 2.0, and molecular docking was performed to evaluate target-protein binding affinities. In the results, ADMET profiling identified five candidate phytochemicals: Butane, 1,1-diethoxy-3-methyl (B), 1,1,3-triethoxybutane (T), Propane, 1,1,3-triethoxy (P), Gamma-Sitosterol (G), and Caryophyllene (C), with favorable absorption. A total of 478 potential compound targets (BTPGC) were predicted, while 1243 HT/HI-related genes were identified, of which 73 overlapped as potential therapeutic targets. PPI analysis generated a network of 73 nodes and 582 edges. GO enrichment revealed involvement in lipid response, oxidative response, programmed cell death, and apoptosis. CytoHubba highlighted six hub genes (TNF, CASP3, ESR1, MAPK3, EGFR, and HSP90AA1). TRRUST identified 15 transcription factors, while miRNet predicted four regulatory miRNAs (miR-155-5p, miR-122-5p, miR-328, and miR-16). This integrative computational network pharmacology analysis provides novel insights into the pathogenesis of liver diseases (HT/HI) and identifies potential therapeutic targets, exploring biomarkers for future experimental validation and clinical translation.

[Bacterial cellulose wound healing paste: in-vivo biocompatibility, toxicity, and therapeutic evaluation.](#)

Kunjalukkal Padmanabhan S, George Thomas N, Benitta A, Ampadi AN, Di Corato R, Stoppa M, Demitri C, Licciulli A. *Int J Pharm.* 2026 Jul 28;702:127247. doi: 10.1016/j.ijpharm.2026.127247. Online ahead of print. PMID: 42521059

Bacterial cellulose (BC) has emerged as a promising biomaterial for wound healing due to its high purity, biocompatibility, and good water-retention properties. In this study, a novel bioactive paste made by incorporating a neem-hypericum oil-in-water emulsion into fibrillated bacterial cellulose (BC-NHE), was tested for its in-vitro biocompatibility, in-vivo acute toxicity and wound healing in rat animal model. In vitro cytocompatibility studies using L929 fibroblast cells demonstrated high cell viability (>85%) across all tested concentrations, indicating low cytotoxicity. Acute toxicity assessment in Sprague-Dawley rats, conducted according to ISO 10993-11 guidelines, revealed no systemic toxicity, behavioral abnormalities and abnormal histopathological alterations in major organs. The wound healing capabilities of BC-NHE were evaluated using a full-thickness excisional wound in rat model and compared with a commercial collagen dressing. The BC-NHE-treated group exhibited significantly accelerated wound contraction (~98% closure by day 21), enhanced re-epithelialization, increased collagen deposition, and improved tissue organization relative to both positive and negative controls. Histological analysis confirmed advanced healing with reduced inflammation and well-structured dermal regeneration. Overall, the developed BC-NHE paste demonstrates excellent biocompatibility, safety, and superior wound healing

efficacy, highlighting its potential as a multifunctional biomaterial for advanced wound care applications.



[Biosynthesis of Nimbin and the Metabolic Pathway: A Focus on its Antiviral Properties.](#)

DAS G, Nayak S, Gouda S, Nath R, Lalnunmawii E, Talukdar AD, Shin HS, Patra JK. Curr Med Chem. 2026 Jul 22. doi: 10.2174/0109298673456390260702045033. Online ahead of print. PMID: 42515886

Introduction/objective: Nimbin, a triterpenoid limonoid from *Azadirachta indica* (Neem), is traditionally known for its diverse pharmacological potential, including antimicrobial and anti-inflammatory properties. However, it has recently gained wider scientific attention for its ability to protect the host cell from viral entry, suppress viral replication, and modulate immune responses against viral infections, such as Herpes simplex virus, Dengue virus, and SARS-CoV-2.

Methods: This review compiles and evaluates current findings on nimbin's medicinal properties, with a focus on its antiviral mechanisms, biosynthetic pathways, and therapeutic prospects.

Results and discussion: Nimbin achieves this by targeting key viral proteins such as spike glycoproteins and NS2B-NS3 proteases, as well as host receptors like ACE2, thereby disrupting the viral life cycle. It is also reported to interfere with the replication process of viruses by inhibition of protease enzymes and proteins essential for polyprotein processing and modulation pathways critical for viral genome replication. Apart from the antiviral activity, it also exhibits anticancer, antioxidant, antifungal, and insecticidal properties. The Mevalonate or Methylerythritol phosphate pathway, or a combination of both are key process involved in the biosynthesis of nimbin, occurring in either a localized form in plastids or distributed across the cytoplasm, endoplasmic reticulum, and peroxisomes. Advances in the synthesis of water-soluble, non-toxic 'Carbon dots' containing active nimbin biomolecules, and nanoencapsulation for better drug delivery processes will likely enhance

the biomedical traits of nimbin and its derivatives to serve as a multifaceted candidate for antiviral therapy and sources of drugs.

Conclusion: Although promising, further pharmacokinetic profiling, toxicological assessment, and clinical validation are essential to translate nimbin into an effective phytopharmaceutical agent. To improve the therapeutic efficacy and bioavailability of drugs, future studies should investigate novel nanoformulations and tailored drug delivery techniques.

Neem in Veterinary Science

[Synthesis, characterization, and therapeutic evaluation of neem-extract stabilized zinc oxide nanoparticles against avian pathogenic *Escherichia coli* in broilers.](#)

Khan MZ, Taimoor M, Noor H, Mahfooz A, Ashar A, Saleem MI, Saleemi MK, Tariq MS, Naeem AD. Nanotechnology. 2026 Jul 15;37(28). doi: 10.1088/1361-6528/ae8602. PMID: 42454440

Colibacillosis is a significant problem in poultry production and a major contributor to antimicrobial resistance because of widespread antibiotic administration. This study evaluated the therapeutic effect of the neem-extract stabilized zinc oxide nanoparticles as an alternative treatment of colibacillosis in broiler chickens. One hundred one-day-old Cobb broiler chicks were randomly assigned to five groups ($n = 20$). The negative control group was not challenged, but all the other groups were intraperitoneally challenged with avian pathogenic *Escherichia coli* (3×10^8 CFU/0.25 ml) at the age of 10 d. Group G3 was treated with colistin sulphate (1 g/5L drinking water), Groups G4 and G5 were orally treated with 50 mg kg⁻¹ and 70 mg kg⁻¹ of neem-extract stabilized ZnO-NPs, respectively, over a period of five days. The agar-well diffusion assay was used to determine the antibacterial activity; furthermore, growth performance, mortality, serum biochemistry, and histopathology were evaluated. ZnO-NPs had excellent *in vitro* antibacterial properties against avian pathogenic *E. coli* with inhibition zones comparable to colistin sulphate. Body weight gain and mortality were significantly better in the treated groups than in the untreated infected group ($p < 0.001$). Biomarkers of the liver and kidney were also normalized after the treatment, showing better hepatic and renal functioning. There was histopathological evidence of significant liver and kidney tissue recovery and a decrease in congestion and leukocytic infiltration, especially in the 70 mg kg⁻¹ ZnO-NP group. The ZnO nanoparticles stabilized with neem extracts exhibited strong antibacterial and organ-protective effects against avian pathogenic *E. Coli* infection in broilers, and were found as effective as colistin sulphate, making them a promising alternative to antibiotics in the treatment of poultry.