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WORLD NEEM ORGANISATION (WNO)





This month's research reports on neem are predominantly pertaining to human health. Scientists have demonstrated that ZnO nanoparticles synthesized by using neem leaf extract can be utilized for cervical squamous cancer treatment. Synergistic inhibition of *Staphylococcus aureus* and *Escherichia coli* bacteria was observed when the aqueous extracts of A. indica and C. citratus were combined together. Silver nanoparticles prepared from *A. indica* leaf extracts increased antioxidant status and improved the wound-healing process in mice. In Ghana, ginger and leaves of the neem tree were regularly used by pregnant women for alleviating waist pain, malaria, and anaemia. Combined application of neem leaf extract and bacteriophage was found to be a cost-effective approach to control multidrug-resistant bacterial pathogens. Nimbin analogs were shown to stimulate glucose uptake and glycogen storage in the insulin signalling cascade and therefore of potential benefit in diabetes mellitus. Scientists successfully formulated neem leaf essential oils as a natural insecticide against mosquitoes and cockroaches. Several other papers highlighting the use of neem for sustainable environment have been published.

S. Nagini

Core Founding Member, WNO Chief Scientific Coordinator & Regional Director, South India



Neem in Agriculture

Phytochemical profiling, antioxidant activities, enzymatic activities and insecticidal potential of aqueous extracts of four plants on the larvae of Helicoverpa armigera (Lepidoptera: Noctuidae), the main pest of cotton plant in Ivory Coast.

Bini KKN, Kobenan KC, Kouakou M, Kouadio IS, Zengin G, Jekő J, Cziáky Z, Danho M, Ochou OG.

Arch Insect Biochem Physiol. 2023 Apr 26:e22017. doi: 10.1002/arch.22017. Online ahead of print.PMID: 37185885

In the context of climate change, the Ivorian cotton industry is facing with the loss of sensitivity of pests (Helicoverpa armigera) and the appearance of new so-called emerging insects. Faced with this situation, cotton producers tend to use insecticide products in high doses, in excess of the norm. However, the misuse of chemical products poses many health risks. Therefore, to limit the use of chemicals, aqueous extracts of local plants with insecticidal properties were examined in the laboratory and in the field. Four local plant species were selected [Anacardium occidentale (Anarcardier); Azadirachta indica (Neem); Hyptis suaveolens (Hyptis) and Tephrosia vogelii (Tephrosia)]. After determining the chemical profiles of the four extracts by high performance liquid chromatography (HPLC)mass spectrometry, their inhibitory activities were assessed in cholinesterase and tyrosinase. The sensitivity of Helicoverpa armigera larvae was evaluated by ingesting the aqueous extracts at several concentrations ranging from 2% to 64% in an artificial nutrient substrate. Then, the mortality rates of the larvae during 72 h were evaluated and the lethal concentrations were determined. The results of chemical analyses (HPLC) showed that the richest aqueous extract in phytochemicals with 54 elements detected was that of cashew (A. occidentale). T. vogelii, A. indica and H. suaveolens presented 44, 45, and 39 chemical compounds, respectively. In addition, the total phenolic content was higher in A. occidentale (110.67 mg gallic acid equivalents/g) followed by A. indica (42.43 mg gallic acid equivalents/g). The highest antioxidant ability was observed with the aqueous extract of cashew (A. occidentale). Anti-enzymatic activities such as acetylcholinesterase, butyrylcholinesterase and tyrosinase inhibition were most pronounced in A. occidentale $(2.35 \pm 0.02 \text{ mg galanthamine equivalent/g}, 3.77 \pm 0.01 \text{ mg galanthamine equivalent/g and}$ 71.28 \pm 0.07 mg kojic acid equivalent/g, respectively). The most toxic aqueous extract for H. armigera larvae was that of cashew with a lethal concentration $LC_{50} = 11.68\%$. Moreover, the principal component analysis performed showed that the insecticidal activity is strongly correlated with the antioxidant and enzymatic activities of the aqueous extracts. Then, the hierarchical ascending classification showed cashew as the best plant. For the sustainability of cotton production, it would be necessary to limit the use of chemical-synthetic insecticides through the use of plant extracts, especially from cashew leaves.

Plant Extracts Control In Vitro Growth of Disease-Causing Fungi in Chayote. García-Ramírez E, Contreras-Oliva A, Salinas-Ruiz J, Hernández-Ramírez G, Spinoso-Castillo JL, Colmenares Cuevas SI.

Plants (Basel). 2023 Apr 27;12(9):1800. doi: 10.3390/plants12091800.PMID: 37176858

The use of agrochemicals has caused environmental problems and toxicity to humans, so natural alternatives for disease control during harvest and postharvest have been evaluated. The aim of this study was to evaluate cinnamon essential oil, neem oil, and black sapote fruit extract for in vitro inhibition of fungi isolated from chayote fruit. The extracts were applied at 300, 350, and 400 ppm in Petri dishes and the mycelial growth of *Fusarium oxysporum, Fusarium solani, Goetrichum* sp., and *Phytophthora capsici* was evaluated for 7 days, and the percentage of mycelial growth inhibition per day was calculated. Cinnamon oil showed a fungicidal effect at all concentrations. Neem oil at 400 ppm showed a 42.3% reduction in the growth of *F. solani* and 27.8% reduction in the growth of *F. oxysporum,* while at 350 ppm it inhibited the mycelial growth of *Phytophthora capsici* by 53.3% and of *Goetrichum* sp. by 20.9%; finally, the black sapote extract at 400 ppm inhibited 21.9-28.6% of the growth of all fungi. The growth of postharvest fungi on chayote fruit could be prevented or reduced by applying the plant extracts evaluated at adequate concentrations.

Neem for Human Health

Comparative In Vitro Anticancer Study of Cisplatin Drug with Green Synthesized ZnO Nanoparticles on Cervical Squamous Carcinoma (SiHa) Cell Lines. Rani N, Rawat K, Saini M, Yadav S, Syeda S, Saini K, Shrivastava A. ACS Omega. 2023 Apr 12;8(16):14509-14519. doi: 10.1021/acsomega.2c08302. eCollection 2023 Apr 25.PMID: 37125098

In this article, we aimed to develop a unique treatment approach to cure cervical cancer without harming healthy normal cells and overcome the limitations of currently available therapies/treatments. Recently, chemotherapeutics based on metal oxides have gained attention as a promising approach for treating cancer. Herein, ZnO nanoparticles were synthesized with the leaf extract of Azadirachta indica. These green synthesized ZnO nanoparticles were used for a cytotoxic study on the cervical squamous carcinoma cell line SiHa and murine macrophage cell line RAW 264.7. Moreover, a hemolytic assay was performed to check the biocompatibility of ZnO nanoparticles. The biosynthesized ZnO nanoparticles were labeled as L1, L2, L5, and L10 nanoparticles. Various assays like crystal violet, MTT assay, and AO/PI dual staining method were performed to assess the anticancer potential of ZnO. The concentration of ZnO nanoparticles was taken in the range of 100-250 µg/mL in the *in vitro* anticancer study on SiHa cancer cell lines. The findings of the MTT assay revealed that biosynthesized ZnO nanoparticles exhibited significant cytotoxicity against SiHa cancer cell lines dose-dependently at two incubation times (24 and 48 h). Also, a decrease in cell viability was observed with an increased concentration of ZnO. The IC₅₀ values obtained were 141 μ g/mL for L1, 132 μ g/mL for L2, 127 μ g/mL for L5, and 115

µg/mL for L10 nanoparticles. In addition, cisplatin drug (10 µg/mL) was also used to compare the anticancer activity with the biosynthesized L1, L2, L5, and L10 nanoparticles. The results of the crystal violet assay and AO/PI dual staining method revealed that morphological changes like cell shrinkage, poor cell adhesion, and induction of apoptosis occurred in the SiHa cancer cell lines. Furthermore, the stability of the ZnO nanoparticles at physiological pH has been assessed by recording the UV-visible spectrum at various pH values. Hence, the overall findings suggested that biosynthesized ZnO nanoparticles can be utilized for squamous cancer treatment in addition to the current cervical treatment strategies/techniques.



Dataset on biochemical inhibiting activities of selected phytochemicals in *Azadirachta indica L* as potential NS2B-NS3 proteases inhibitors.

Oyebamiji AK, Akintelu SA, Akande IO, Aworinde HO, Adepegba OA, Akintayo ET, Akintayo CO, Semire B, Babalola JO.

Data Brief. 2023 Apr 18;48:109162. doi: 10.1016/j.dib.2023.109162. PMID: 37168603

The anti-NS2B-NS3 proteases activities of Azadirachta indica L. were investigated via the data obtained from selected bioactive compounds from Azadirachta indica L. The work was investigated using *in silico* approach and the series of computational software were used to execute the task. The software used were Spartan 14, material studio, Padel, Pymol, Autodock tool, Autodock vina and discovery studio. The obtained descriptors from 2D and 3D of the optimized compounds were screened and they were used to develop QSAR model using material studio software. Also, biological interaction between the selected bioactive compounds from Azadirachta indica L. and NS2B-NS3 proteases (PDB ID: 2fom) were accomplished using docking method and the calculated binding affinity as well as the residues involved in the interaction were reported. More so, the ADMET features for [(5S,6R,7S,8R,9S,10R,11S,12R,13S,17R)-17-(2,5-dihydroxy-2,5-dihydrofuran-3-yl)-11,12dihydroxy-6-methoxy-4,4,8,10,13-pentamethyl-1,16-dioxo-6,7,9,11,12,17-hexahydro-5Hcyclopenta[a]phenanthren-7-yl] 3-methylbut-2-enoate (Compound) 6) and (10R,13S,14S,17S)-17-[1-(3,4-dihydroxy-5,5-dimethyloxolan-2-yl)ethyl]-4,4,10,13,14pentamethyl-1,2,5,6,9,11,12,15,16,17-decahydrocyclopenta[a]phenanthren-3-one (compound 12) with lowest binding affinity were investigated and reported.

Synergistic Antibacterial Screening of *Cymbopogon citratus* and *Azadirachta indica*: Phytochemical Profiling and Antioxidant and Hemolytic Activities.

Hussain S, Javed W, Tajammal A, Khalid M, Rasool N, Riaz M, Shahid M, Ahmad I, Muhammad R, Shah SAA.

ACS Omega. 2023 May 2;8(19):16600-16611. doi: 10.1021/acsomega.2c06785. PMID: 37214690

Current studies were performed to investigate the phytochemistry, synergistic antibacterial. antioxidant, and hemolytic activities of ethanolic and aqueous extracts of Azadirachta indica (EA and WA) and Cymbopogon citratus (EC and WC) leaves. Fourier transform infrared data verified the existence of alcoholic, carboxylic, aldehydic, phenyl, and bromo moieties in plant leaves. The ethanolic extracts (EA and EC) were significantly richer in phenolics and flavonoids as compared to the aqueous extracts (WA and WC). The ethanolic extract of C. citratus (EC) contained higher concentrations of caffeic acid (1.432 mg/g), synapic acid (6.743 mg/g), and benzoic acid (7.431 mg/g) as compared to all other extracts, whereas chlorogenic acid (0.311 mg/g) was present only in the aqueous extract of A. indica (WA). Food preservative properties of C. citratus can be due to the presence of -Gas chromatography-mass spectrometry benzoic acid (7.431 mg/g). analysis demonstrated the presence of 36 and 23 compounds in A. indica and C. citratus leaves, respectively. Inductively coupled plasma analysis was used to determine the concentration of 26 metals (Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, V, Zn, Zr, Ti); the metal concentrations were higher in aqueous extracts as compared to the ethanolic extracts. The extracts were generally richer in calcium (3000-7858 ppm), potassium (13662-53,750 ppm), and sodium (3181-8445 ppm) and hence can be used in food supplements as a source of these metals. Antioxidant potential (DDPH method) of C. *citratus* ethanolic extract was the highest $(74.50 \pm 0.66\%)$, whereas it was the lowest (32.22)± 0.28%) for the aqueous extract of A. indica. Synergistic inhibition of bacteria (Staphylococcus aureus and Escherichia coli) was observed when the aqueous extracts of both the plants were mixed together in certain ratios (v/v). The highest antibacterial potential was exhibited by the pure extract of C. citratus, which was even higher than that of the standard drug (ciprofloxacin). The plant extracts and their mixtures were more active against S. aureus as compared to E. coli. No toxic hemolytic effects were observed for the investigated extracts indicating their safe medicinal uses for human beings.



Antioxidant Efficacy of Green-Synthesized Silver Nanoparticles Promotes Wound Healing in Mice.

Lakkim V, Reddy MC, Lekkala VVV, Lebaka VR, Korivi M, Lomada D. Pharmaceutics. 2023 May 17;15(5):1517. doi: 10.3390/pharmaceutics15051517. PMID: 37242759

Developing an efficient and cost-effective wound-healing substance to treat wounds and regenerate skin is desperately needed in the current world. Antioxidant substances are gaining interest in wound healing, and green-synthesized silver nanoparticles have drawn considerable attention in biomedical applications due to their efficient, cost-effective, and non-toxic nature. The present study evaluated in vivo wound healing and antioxidant activities of silver nanoparticles from Azadirachta indica (AAgNPs) and Catharanthus roseus (CAgNPs) leaf extracts in BALB/c mice. We found rapid wound healing, higher collagen deposition, and increased DNA and protein content in AAgNPs- and CAgNPs (1% w/w)-treated wounds than in control and vehicle control wounds. Skin antioxidant enzyme activities (SOD, catalase, GPx, GR) were significantly (p < 0.05) increased after 11 days CAgNPs and AAgNPs treatment. Furthermore, the topical application of CAgNPs and AAgNPs tends to suppress lipid peroxidation in wounded skin samples. Histopathological images evidenced decreased scar width, epithelium restoration, fine collagen deposition, and fewer inflammatory cells in CAgNPs and AAgNPs applied wounds. In vitro, the free radical scavenging activity of CAgNPs and AAgNPs was demonstrated by DPPH and ABTS radical scavenging assays. Our findings suggest that silver nanoparticles prepared from C. roseus and A. indica leaf extracts increased antioxidant status and improved the woundhealing process in mice. Therefore, these silver nanoparticles could be potential natural antioxidants to treat wounds.

The Determinants of Utilisation of Herbal Medicine Among Pregnant Women in the Asante Akim North District, Ghana.

Buor D, Agyemang S, Awuku P.

Matern Child Health J. 2023 May 20. doi: 10.1007/s10995-023-03676-7. PMID: 37209378

Background: Pregnant women especially in the developing countries resort to herbal medicines to manage their unpleasant conditions in pregnancy. The study examined the utilization of herbal medicine among pregnant women in Asante Akim North District of Ghana. Methods: Purposive, random and convenient sampling techniques were used to select pregnant women visiting antenatal clinics in the selected health institutions. The theoretical underpinning of the study was the theory of planned behaviour. The sequential mixed method approach was used to draw data from the respondents. The research was a cross-sectional study and instruments used for data collection were structured questionnaire and interview guide. Data were analysed using statistical tools such as frequencies, percentages and chi-square test of independence. **Results:** Results indicate that over 82% of respondents had ever used herbal medicine during pregnancy and they derived greater part of their medication from herbalists. Ginger and leaves of the neem tree were the herbs regularly used and the major health problems they faced during pregnancy were waist pains, malaria and anaemia. The factors that exhibited a statistically significant association with the use of herbal medicine were income ($X^2 = 41.601$; p=0.014) and religion ($X^2 = 9.422$; p=0.045). **Conclusions:** The rate of use of herbal medicine by pregnant women is high in the district. The theoretical underpinning of the study has been vindicated. The findings have

implications for global health given that maternal health issues engage serious attention of international donor organisations. Recommendations have been made to improve the efficacy of herbal medicine and to integrate herbal medicine into orthodox medicine.

Combined Effect of Isolated Bacteriophage and Neem Extract on Isolated Multiple Drug-Resistant Pathogenic *Escherichia coli* E1 From Well Water.

Sagar	SS,	Rani	S,	Р	ushpa	Sadanandan	S.
Environ	Health	Insights.	2023	May	19;17:1 <i>′</i>	1786302231166818.	doi:
10.1177/11	78630223	31166818. PN	/ID: 3722	3331			

Multiple drug-resistant Escherichia coli (E. coli) is a serious cause of concern, and they can be observed in hospital settings, natural environment, and animals. Dissemination of multiple drug-resistant (MDR) *E. coli* can pose a high risk to public health. Moreover, they are hard to control with commercial antibiotics, since they have acquired resistance against most of them. Therefore, to control multiple drug-resistant bacteria, alternative strategies have been adopted such as phage therapy, herbal remedies, nanoparticles etc. In the current study, the combined application of neem leaf extract and bacteriophage is used to control an isolated multiple drug-resistant E. coli E1. We have applied 0.1 mg/ml concentration of neem extract in combination with an isolated phage vB_EcoM_C2 of 10¹¹ titer and found that the combinatorial treatment approach significantly controls the growth of *E. coli* E1 as compared to a single non-combinatorial treatment. In this study, every E. coli cell is targeted by 2 antimicrobials (phage and neem extract) at the same time, which is more effective as compared to the sole treatment. Implementation of the neem extract with phage opens a new alternative approach to the chemotherapeutics for the control of multiple drug-resistant bacterial pathogens. This approach may be effective, economical, and eco-friendly to combat MDR.

Nimbin analogs stimulate glucose uptake and glycogen storage in the insulin signalling cascade by enhancing the IRTK, PI3K and Glut-4 mechanism in myotubes. Sudhakaran G, Rajesh R, Almutairi BO, Arokiyaraj S, Gopinath P, Arockiaraj J. Tissue Cell. 2023 May 6;82:102104. doi: 10.1016/j.tice.2023.102104. PMID: 37207372

Background: Diabetes Mellitus is a metabolic disorder characterized by insulin dysfunction or failure of the pancreatic β -cells to produce insulin resulting in hyperglycemia. Adverse effects of hyperglycemic conditions continue to be common, reducing treatment adherence. Intensified therapies are required for the constant loss of endogenous islet reserve. **Aim:** This study aimed to evaluate the effect of Nimbin semi-natural analogs (N2, N5, N7, and N8) from A. indica on high glucose-induced ROS and apoptosis with insulin resistance in L6 myotubes evaluated along with Wortmannin and Genistein inhibitors and the expression of key genes in the insulin signalling pathway. Materials and methods: The analogs were screened for antioxidant and anti-diabetic activity using cell-free assays; The ability of analogs to suppress ROS and prevent apoptosis induced by High glucose and uptake glucose and glycogen storage in L6 myotubes was evaluated using DCFH-DA, AO-PI and 2NBDG staining. Further, the glucose uptake was performed in the presence of Insulin Receptor Tyrosine Kinase (IRTK) inhibitors, and the expression of key genes PI3K, Glut-4, GS and IRTK in the insulin signalling pathway were evaluated. Key findings: The Nimbin analogs were not toxic to the L6 cells, and the analogs could scavenge ROS and suppress cellular damage induced due to high glucose. Enhanced glucose uptake was observed in N2, N5 and N7 compared to N8. The

maximum activity of optimum concentration was found to be 100 μ M. The N2, N5 and N7 showed an increase in IRTK, which is equivalent to insulin at a concentration of 100 μ M. The IRTK inhibitor with Genistein (50 μ M) confirmed the presence of IRTK-dependent glucose transport activation; it also supports the expression of key genes PI3K, Glut-4, GS and IRTK. As a result of PI3K activation, N2, N5, and N7 exhibited the insulin-mimetic effect by enhancing glucose uptake and glycogen conversion regulating glucose metabolism. **Significance:** N2, N5 and N7 could therapeutically benefit against insulin resistance by glucose metabolism modulation, insulin secretion, β -cell stimulation, inhibition of gluconeogenic enzymes and ROS protection.

Neem for Sustainable Environment

Formulation of Neem Leaf and Croton Seed Essential Oils as a Natural Insecticide Tested on Mosquitoes and Cockroaches.

Endris YA, Mekonnen KD.

ACS Omega. 2023 Apr 24;8(17):15052-15061. doi: 10.1021/acsomega.2c08026. eCollection 2023 May 2.PMID: 37151484

Essential oils are highly aromatic plant oils utilized as a new insect control alternative to synthetic insecticides because of environmental concerns. As a result, the purpose of this study was to evaluate the effects of essential oil extraction conditions on neem leaf and cotton seed, as well as to identify their chemical composition using gas chromatographymass spectrometry. Moreover, both extracted oils were subjected to bioinsecticide formulation in individual as well as mixed forms, which were tested on mosquitoes and cockroaches using the conventional roach killer and a blank control as a comparison. The results revealed that the maximum yields of essential oils from neem leaf and croton seed were respectively 30.54 and 14.75%. The extraction process was greatly affected by the particle sizes because of the mass transfer limitation between solute-solvent interactions. The insecticidal evaluation showed that the blended form of essential oils at the 20% concentration has better efficiency than the individual oils, which accounted for 80% mosquito and 71.8% cockroach death rates within 4 h, whereas the synthetic roach killer completely killed all of the insects within the same time frame. Terpineol, α -terpinyl acetate, eucalyptol, and δ -cadinene are the active insecticidal compounds in neem leaf oil, whereas the active compounds of croton seed oil are epiglobulol, copaene, δ -cadinene, α -cubebene, and β -guaiene.



Exploring the multipotentiality of plant extracts for the green synthesis of iron nanoparticles: A study of adsorption capacity and dye degradation efficiency. Kumari T, Phogat D, Shukla V.

Environ Res. 2023 Apr 29;229:116025. doi: 10.1016/j.envres.2023.116025. PMID: 37127105

The goal of the project was to create environmentally friendly and economically viable materials for thoroughly purifying contaminated water. An affordable, phytogenic, and multifunctional plant-based nanomaterial was prepared in this context. The work demonstrates an effective green synthesis method for producing iron nanoparticles (FeNPs) using six different plant extracts as a reducing agent. The characterization of green synthesized catalysts was concluded via Spectroscopy (tauc plot), XRD, FE-SEM, and FT-IR. The produced nanomaterial, which had an X-ray diffractogram (XRD) peak at 43.33° and a size range of 1.82-63.63 nm, functioned as a highly effective nano-photocatalyst for the degradation of cationic dye. Due to the presence of a lower overall secondary metabolites quota, Ocimum sanctum plant extract reduced iron precursor produced the highest yield of dried NPs, followed by Azadirachta indica, Prosopis cineraria, Syzygium cumini, Citrus limon, and Salvadora oleoides. Further, the synthesized catalyst was tested for its effectiveness against gentian violet dye degradation. Ocimum sanctum plant extract reduced iron precursor produced the highest yield of dried NPs, followed by Azadirachta indica, Prosopis cineraria, Syzygium cumini, Citrus limon, and Salvadora oleoides, in that order. The dye removal efficiency of nanoparticles was 51% (Azadirachta indica), 83% (Ocimum sanctum), 59% (Syzygium cumini), 40% (Salvadora oleoides), 59% (Prosopis cineraria), and 63% (Citrus limon) after 12 h of visible light irradiation. The key factor in the process of deterioration is •O²⁻. As a result, the nanoparticles can be used in antibacterial and photocatalytic processes. The reduced band gap was responsible for the increased photocatalytic quantity. The maximum adsorption capacity at the time of equilibrium was obtained in order as Ocimum sanctum > Citrus limon > Prosopis cineraria > Syzygium cumini > Azadirachta indica > Salvadora oleoides. The simplicity of production, low cost, magnetic property, and high adsorption capacity will increase the efficacy of the water treatment method. This article reports on the creation of unique iron nanoparticles and their use in the purification of water.

Efficient photo-adsorptive eradication of endocrine disrupting pesticides by chitosan co- decorated metal oxide bio-nanocomposite.

Yadav J, Rani M, Zhang TC, Shanker U.

Environ Sci Pollut Res Int. 2023 May 12. doi: 10.1007/s11356-023-27376-5. PMID: 37170054

Extensive consumption, toxicity and bioaccumulation of malathion (MLT) and lindane (γ-HCH) pesticides collectively attract the world's attention. Herein, the nanocomposite of chitosan wrapped NiO@ZnO was synthesized by a green methodology using Azadirachta indica leaves extract. Structural and morphological analysis of chitosan-NiO@ZnO showed hollow sphere-flake shaped image adsorbed on a solid chitosan surface with a large surface area of 73 m²g⁻¹. A decrease in values of lattice strain, dislocation density and crystallite size described the imperfection in crystal geometry and new peaks in FT-IR spectra at 698 cm⁻

¹ and 448 cm⁻¹ of Ni-N and Zn-N, which respectively confirm the coupling. Chitosan-NiO@ZnO and individual nanoparticles (NiO and ZnO) were well-characterized and utilized for degradation MLT and γ-HCH under direct sunlight and dark conditions. The highest degradation of pesticides (above 94%) resulted with 2 mg L⁻¹ and 10 mg L⁻¹ of MLT (π - π) and y-HCH, respectively with a 20 mg catalyst dose, and pH of \sim 7 under daylight exposure (5 h). Chitosan-NiO@ZnO substantially suppressed the half-life of the targeted pesticides (MLT: 0.48 h; HCH 0.51 h) and demonstrated the first-order kinetics with a high adsorption capacity, X_m (MLT: 14.5 mg g⁻¹ and y-HCH 20.7 mg g⁻¹), which also confirmed the strong binding with the pesticides, followed by their conversion into safer and smaller metabolites. separation mechanism was elucidated by UV The charge reflectance and photoluminescence data. Hydroxyl radicals were most frequently responsible for the degradation of pesticides as confirmed by scavenger analysis. The synthesized green-nano photocatalyst showed high reusability (up to 10th cycles), sensitivity, and stability within the degradation process, presumably making it suitable for industrial applications.

A biochemical and morphological study with multiple linear regression modelingbased impact prediction of ambient air pollutants on some native tree species of Haldwani City of Kumaun Himalaya, Uttarakhand, India.

GoswamiM,KumarV,SinghN,KumarP.EnvironSciPollutResInt.2023May20:1-16.doi:10.1007/s11356-023-27563-4.PMID:37208511

The current study was conducted around the province of Haldwani City, Uttarakhand, India, to understand the seasonal variation of ambient air pollutants (PM_{2.5}, PM₁₀, SO₂, and NO₂) and their impact on four tree species, i.e., neem (Azadirachta indica), mountain cedar (Toona ciliate), bottlebrush (Callistemon citrinus), and guava (Psidium guajava) during 2020-2021. Multiple linear regression (MLR)-based prediction analysis showed that the selected air quality variables (PM_{2.5}, PM₁₀, SO₂, and NO₂) had a significant impact on the biochemical responses of selected tree spp. including, pH, ascorbic acid (AA), total chlorophyll content (T. Chl.), relative water content (RWC), and dust deposition potential. In this, the coefficient of variance (R²) of the developed models was in the range of 0.70-0.98. The ambient air pollutants showed significant seasonal variations as depicted by using the air pollution tolerance index (APTI) and anticipated performance index (API). The tree species from polluted sites observed more pollution tolerance than the tree species from the control site. Regression analysis showed a significant positive association between the biochemical characteristics and APTI, with the highest influence by AA ($R^2 = 0.961$) followed by T. Chl., RWC, and pH. The APTI and API score was observed as maximum for A. indica and minimum for C. citrinus. The impact of air pollutants on the morphology of foliar surface was investigated by the scanning electron microscopy (SEM) and recorded various dust deposition patterns, stomatal blockages, and damage of guard cells in the trees growing along the polluted site (S2). The present study can assist environmental managers to examine the pollution-induced variables and develop an effective green belt for combating air pollution in polluted areas.

Formation and characterization of leaf waste into organic compost.

Mahongnao S, Sharma P, Singh D, Ahamad A, Kumar PV, Kumar P, Nanda S. Environ Sci Pollut Res Int. 2023 May 25. doi: 10.1007/s11356-023-27768-7. PMID: 37227644

In solid waste management, pollution-free disposal of leaf waste in urban areas is still not standardized and adopted. According to the World Bank report, 57% of wastes generated in South East Asia are consisted of food and green waste, which can be recycled into valuable bio-compost. The present study shows a method of leaf litter waste management by composting it using essential microbe (EM) method. Different parameters, such as pH, electrical conductivity, macronutrients, micronutrients, and potentially toxic elements (PTE) were measured at zero to 50 days of composting using appropriate methods. The microbial composting was shown to mature within 20 to 40 days, and its maturity could be evaluated by the attainment of stable pH (8), electrical conductivity (0.9 mS/cm), and C:N ratio \geq 20. The analysis was also performed on other bio-composts viz. kitchen waste compost, vermicompost, cow dung manure, municipal organic waste compost, and neem cake compost. The fertility index (FI) was evaluated based on six parameters viz. total carbon, total nitrogen, N ratio, phosphorus, potassium, and sulphur contents. The PTE values were used to calculate their clean index (CI). The results showed that leaf waste compost has a higher fertility index (FI = 4.06) than other bio-composts, except the neem cake compost (FI = 4.44). The clean index of the leaf waste compost (CI = 4.38) was also higher than other bio-composts. This indicates that leaf waste compost is a valuable bio-resource with high nutritive value and low PTE contamination, with a favourable prospective to be used in organic farming.



Optimised neem oil-bilayer tablets: A safe, effective and stable tool for the prevention of vector-borne disease outbreaks by Aedes albopictus.

Swathy KK, Sarath Chandran C, Mukundan M, Sreejith KR, Sourav K, Jafna MC,MukundAV,KappallyS,NairRS,JosephJ.Exp Parasitol. 2023 May 23:108550. doi: 10.1016/j.exppara.2023.108550. PMID: 37230323

The control of mosquito breeding is an essential step towards the reduction of vector-borne disease outbreaks. Synthetic larvicidal agents produce resistance in vectors and cause safety concerns in humans, animals and aquatic species. The drawback of synthetic larvicides opened a new avenue for natural larvicidal agents, but poor dosage accuracy, need for frequent applications, low stability and sustainability are the major challenges with them. Hence, this investigation aimed to overcome those drawbacks by developing bilayer tablets loaded with neem oil to prevent mosquito breeding in stagnant water. The optimised batch of neem oil-bilayer tablets (ONBT) had 65%w/w hydroxypropyl methylcellulose K100M and 80%w/w ethylcellulose in its composition. After the completion of 4th week, 91.98 ± 0.871% azadirachtin was released from the ONBT, which was followed by a subsequent drop in the in vitro release. ONBT reported long-term larvicidal efficacy (>75%) and a good deterrent effect which was better than neem oil-based marketed products. The acute toxicity study on a non-target fish model (Poecilia reticulata), OECD Test No.203 confirmed the safety of the ONBT on non-target aquatic species. The accelerated stability studies predicted a good stability profile for the ONBT. The neem oil-based bilayer tablets can be used as an effective tool for the control of vector-borne diseases in society. The product may be a safe, effective and eco-friendly replacement for the existing synthetic as well as natural products in the market.

