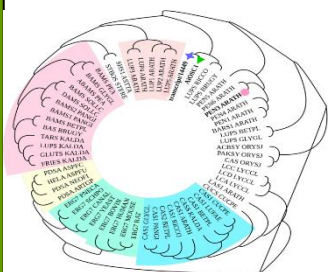


Neem Research Newsletter

Volume 2, Issue 7, 2022



WORLD NEEM ORGANISATION (WNO)



From
The Editor's Desk.....

Greetings! This issue of the newsletter features several research articles on neem in diverse fields. On the agriculture front, neem-based biopesticides were reported to be effective against cowpea, cabbage, and cauliflower pests. Furthermore, neem was demonstrated to enhance the shelf life of tomato. Several phytochemicals were identified in neem seed using GC-MS analysis. The first *de novo* synthesis of gedunin, a neem limonoid was reported. It is heartening to note that neem-based drug delivery systems have attracted the focus of researchers. Scientists have designed an effective gastro-retentive delivery using dual crosslinked LM pectin-neem gum mediated interpenetrating polymer network floating mucoadhesive microbeads. Based on research findings, azadiradione, has been proposed as a novel antitubercular agent. The most exciting developments are those that support neem seed oil as a suitable candidate for the industrial-scale manufacturing of biodiesel, which could eventually displace petro-diesel.

S. Nagini

Core Founding Member, WNO
Chief Scientific Coordinator &

Regional Director, South India



Neem in Agriculture

Field margins and botanical insecticides enhance *Lablab purpureus* yield by reducing aphid pests and supporting natural enemies.

Ochieng LO, Ogendo JO, Bett PK, Nyaanga JG, Cheruiyot EK, Mulwa RMS, Arnold SEJ, Belmain SR, Stevenson PC.

J Appl Entomol. 2022 Aug;146(7):838-849. doi: 10.1111/jen.13023. Epub 2022 May 20. PMID: 36249719

Botanical insecticides offer an environmentally benign insect pest management option for field crops with reduced impacts on natural enemies of pests and pollinators while botanically rich field margins can augment their abundance. Here, we evaluated the non-target effects on natural enemies and pest control efficacy on bean aphids in Lablab of three neem- and pyrethrum-based botanical insecticides (Pyrerin75EC®, Nimbecidine® and Pyeneem 20EC®) and determine the influence of florally rich field margin vegetation on the recovery of beneficial insects after treatment. The botanical insecticides were applied at the early and late vegetative growth stages. Data were collected on aphids (abundance, damage severity and percent incidence) and natural enemy (abundance) both at pre-spraying and post-spraying alongside Lablab bean yield. The efficacy of botanical insecticides was similar to a synthetic pesticide control and reduced aphid abundance by 88% compared with the untreated control. However, the number of natural enemies was 34% higher in botanical insecticide-treated plots than in plots treated with synthetic insecticide indicating that plant-based treatments were less harmful to beneficial insects. The presence of field margin vegetation increased further the number of parasitic wasps and tachinid flies by 16% and 20%, respectively. This indicated that non-crop habitats can enhance recovery in beneficial insect populations and that botanical insecticides integrate effectively with conservation biological control strategies. Higher grain yields of 2.55-3.04 and 2.95-3.23 t/ha were recorded for both botanical insecticide and synthetic insecticide in the presence of florally enhanced field margins in consecutive cropping seasons. Overall, these data demonstrated that commercial botanical insecticides together with florally rich field margins offer an integrated, environmentally benign and sustainable alternative to synthetic insecticides for insect pest management and increased productivity of the orphan crop legume, Lablab.

Prospects of Botanical Compounds and Pesticides as Sustainable Management Strategies Against *Spodoptera frugiperda*.

Ngegba PM, Cui G, Khalid MZ, Li Y, Zhong G.

J Econ Entomol. 2022 Oct 18:toac157. doi: 10.1093/jee/toac157. Online ahead of print. PMID: 36255020

Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae) (fall armyworm) is an extremely destructive insect pest that causes crop losses, especially cereal production across the world. Its management is challenged by its high migratory ability, polyphagous nature, high fecundity level, and short life cycle. It has become a serious threat across the globe that requires proactive and coordinated regional and global interventions. Although synthetic insecticides have been widely utilized to control the pest, there are numerous

inherent challenges associated with the overreliance and overuse of these chemicals, e.g., toxicity to humans, destruction of natural pest enemies and pollinators, environmental and food contamination, pest resurgence, secondary pest outbreaks, and resistance development. Plant-derived pesticides such as *Azadirachta indica*, *Eucalyptus globulus*, *Jatropha curcas*, *Lantana camara*, *Phytolacca dodecandra*, and *Piper guineense* have been evaluated under laboratory, greenhouse, and field conditions to control *S. frugiperda*. We are certain that the substantial potential of these plants under field conditions could be enhanced and promoted together with existing plant-based products (registered) for use against *S. frugiperda* as an alternative in integrated pest management schemes. Therefore, this review highlights challenges and prospects that will help refocus and increase research attention on the development and application of botanical pesticides under field conditions rather than only under laboratory and control conditions to increase the commercialization and adoption rate of this technology across the globe.

Biosynthesis, Characterization, Evaluation, and Shelf-Life Study of Silver Nanoparticles against Cotton Bollworm, *Helicoverpa armigera* (Hubner) (Noctuidae: Lepidoptera).

Anees MM, Patil SB, Kambrekar DN, Chandrashekhar SS, Jahagirdar S.

Nanomaterials (Basel). 2022 Oct 8;12(19):3511. doi: 10.3390/nano12193511. PMID: 36234639

Nanoparticles provide a promising and alternative platform of eco-friendly technologies that encompasses better cost-resilient remedies against one of the most economically harnessing insect pests of cotton. The main goal of this research was to provide a better management strategy through biologically synthesizing (sunlight exposure method) green nanoparticles from leaf extracts of *Azadirachta indica* and *Pongamia pinnata* and proving their bioefficacy on *H. armigera* (2nd instar). Characterization of bio-synthesized silver nanoparticles was carried out using UV-Visible spectroscopy for confirming the formation of nanoparticles, a Particle Size Analyzer (PSA) for determining the size/distribution of particles, and a Scanning Electron Microscope (SEM) for analyzing the surface topology of nanoparticles. The results obtained from PSA analysis showed that *A. indica* and *P. pinnata*-based silver nanoparticles had an average diameter of 61.70 nm and 68.80, respectively. Topographical images obtained from SEM proved that most of the green synthesized silver nanoparticles were spherical in shape. *A. indica*-based silver nanoparticles were found to be comparatively more efficient and have higher insecticidal activity compared to *P. pinnata*-based nanoparticles. *A. indica*-based AgNPs recorded larval mortality of 60.00 to 93.33 percent at the concentrations of 500 to 2000 ppm, followed by *P. pinnata*-based nanoparticles, with 60.00 to 90.00 percent larval mortality. Shelf-life studies revealed that *A. indica*-based AgNPs had the maximum negative zeta potential of -58.96 mV and could be stored for three months without losing bioefficacy and up to six months with negligible reduction in bioefficacy. Symptoms caused by silver nanoparticles were leakage of body fluids, sluggishness, inactiveness, brittleness, etc.

Evaluation of Biorational Insecticides for Management of *Euproctis chrysorrhoea* (Lepidoptera: Erebidae).

Groden E, Boyd KS, Donahue C.

J Econ Entomol. 2022 Oct 6:toac153. doi: 10.1093/jee/toac153. PMID: 36201287

The browntail moth (*Euproctis chrysorrhoea* L.) is an invasive species which over the past five years, has been undergoing outbreaks on a scale not seen in the northeastern U.S. in over 100 years. Browntail moth larvae feed on and defoliate a number of deciduous tree species, but the health issues caused by contact with the toxic urticating hairs of the overwintered larvae have resulted in very low tolerance for this pest amongst homeowners and land managers. Few recent studies have been conducted to assess management options for browntail moth, which is abundant in ecologically sensitive areas along coastal waters, and around people's homes. We investigated the potential to manage overwintered larvae with currently available biorational insecticides. Laboratory bioassays revealed susceptibility to *Beauveria bassiana* (Balsamo) Vuillemin (Hypocreales: Cordycipitaceae), *Bacillus thuringiensis kurstaki* (Berliner), azadirachtin, and spinosad products. A field trial was conducted to assess efficacy of *B. bassiana*, Btk, and azadirachtin. All treatments reduced the abundance of larvae compared with the control, but only two applications of Btk and single application of a tank mix of *B. bassiana* and Btk reduced pupal nest abundance. A laboratory experiment revealed that temperature did not affect the feeding and survival of larvae exposed to the field trial foliage from the Btk and the Btk/*B. bassiana* tank mix treatments, whereas slower feeding rates and increased time to death were observed with the control and *B. bassiana* alone treatment.

Performance of a hermetic device and neem (*Azadirachta indica*) in storing wheat seed: Evidence from participatory household trials in central Bangladesh

TJ Krupnik, K Hossain, J Timsina, MM Uddin.

Journal of Stored Products Research 2022; [v.99](#) pp. 102024

Smallholder farmers in Bangladesh often use low-density polyethylene (LDPE) bags contained within woven polypropylene bags to store wheat seed during the summer monsoon that precedes winter season planting. High humidity and temperature during this period can encourage increased seed moisture and pests, thereby lowering seed quality. Following a farm household survey conducted to inform trial design, eighty farmers were engaged in an action research process in which they participated in designing and conducting trials comparing traditional and alternative seed storage methods over 30 weeks. Factorial treatments included comparison of hermetic SuperGrainbags® (Premium RZ) against LDPE bags, both with and without the addition of dried neem tree leaves (*Azadirachta indica*). SuperGrainbags® were more effective in maintaining seed moisture at acceptable levels close to pre-storage conditions than LDPE bags. Both seed germination and seedling coleoptile length were significantly greater in hermetic than LDPE bags. Neem had no effect on seed moisture, germination, or coleoptile length. SuperGrainbags® were also more effective in abating seed damage during storage, although inclusion of neem within LDPE bags also had significant damage. Quantification of seed predating insects and diseases suggested that SuperGrainbags® also suppressed Coleopteran pests and blackspot, the latter indicative of *Fusarium graminearum*.

Conversely, where farmers used LDPE bags, neem also had an additional though limited pest suppressive effect. Post-storage treatment scoring by farmers revealed a strong preference for SuperGrainbags® and no preference differences for or against neem. This study demonstrates a process by which farmers can be involved in the participatory co-design and testing of alternative wheat storage options, and stresses the need to develop SuperGrainbag® supply chains so hermetic storage can be made widely available.

A Cost-Benefit Analysis of Soil Disinfestation Methods against Root-Knot Nematodes in Mediterranean Intensive Horticulture.

Talavera-Rubia M, Vela-Delgado MD, Verdejo-Lucas S.

Plants (Basel). 2022 Oct 19;11(20):2774. doi: 10.3390/plants11202774. PMID: 36297797

Losses caused by phytoparasitic nematodes in crops depend directly on their soil densities at the start of the crop, so reducing their populations before planting is the main aim of nematological management. Efficacies in reducing *Meloidogyne* soil populations of soil disinfestation methods, such as agrochemicals, botanicals, or biosolarization were estimated on multiple field trials conducted over fourteen years in intensive horticultural crops. Soil nematode populations were reduced by 87 to 78% after fumigation with 1,3-dichloropropene + chloropicrin and dimethyl-disulphide, respectively. Non-fumigant nematicides such as azadirachtin, dazomet, fenamiphos, fluopyram, fosthiazate, metam-sodium, and oxamyl showed efficacies ranging from 51 to 64%, whereas the efficacy of natural products, such as abamectin, garlic extracts, or essential oils was 41 to 48%. Biosolarization with chicken manure had an efficacy of 73%. An economic cost-benefit study of nematode management methods was performed for seven vegetable-*M. incognita* pathosystems. Fumigation with 1,3-dichloropropene + chloropicrin and biosolarization with chicken manure were the only treatments able to reduce RKN populations above 1000 and 750 J2 per 100 cm³ of soil, respectively, to levels below the nematode economic damage threshold, keeping profitability. Fumigation was able to manage RKN soil densities up to 350 J2 per 100 cm³ of soil in most susceptible crops as aubergine or cucumber and up to 1000 J2 per 100 cm³ of soil for more tolerant crops, such as other cucurbits, pepper, or tomato. Other nematicidal treatments were not able to reduce RKN populations above 200-300 J2/100 cm³ of soil below the economic thresholds but were profitable when RKN densities were below the limits of 200-300 J2/100 cm³ of soil.

Population Dynamics of Insect Pests Associated with Cabbage and Cauliflower and Farmers' Friendly IPM

Singh B, Singh S, Singh N.

Indian J Entomol., 2022, <https://doi.org/10.55446/IJE.2022.804>

A field survey in the farmers' fields at Gurugram in Haryana, in few blocks focused on the incidence of pests of cabbage and cauliflower during rabi, 2017-18 and 2018-19. These revealed the occurrence of *Plutella xylostella* and *Spodoptera litura*. Maximum number of larvae of *P. xylostella* and *S. litura* was recorded in Pataudi block as compared to those of Farukhnagar, Sohana and Gurugram. Seven neem-based biopesticides were evaluated along with check carbosulfan at hot spots. Data revealed that NSKE 5% was quite effective followed by Nimbicidin and Neemgold. The cost benefit ratio was maximum with NSKE

(1:9.41, 1:9.53 for cabbage and cauliflower, respectively) followed by neem leaf extract (NLE) with (1:7.72 and 1:6.31). These results conclude that NSKE and NLE can be recommended against major pests of cabbage and cauliflower.

Efficacy of Neem and Papaya Leaf Powders on the Cowpea Bruchid *Callosobruchus maculatus* (Coleoptera: Chrysomelidae)

Wolali S. Nyamador, Abla D. Mondedji, Essoham Samié, and Isabelle A. Glitho

European Journal of Agriculture and Food Sciences, 2022, vol 4, 128-133. DOI: <http://dx.doi.org/10.24018/ejfood.2022.4.5.575>

Callosobruchus maculatus Fab (Coleoptera: Chrysomelidae) is a pest that causes enormous damage to cowpea stocks. To limit this damage, farmers resort to synthetic insecticides despite their consequences on the environment and human health. The objective of this study was to evaluate the efficacy of neem and papaya leaf powders as an alternative to control *C. maculatus* pests of *Vigna unguiculata* Walp. stocks (Fabaceae). Five hundred grams (500 g) of cowpea seeds contained in one-litre glass jars were infested with 10 pairs of *C. maculatus* aged 24 hours. Each of the powders was used to treat the seeds at 20, 40, 60 g/kg cowpea in each jar respectively. For each dose of each biopesticide used, four batches (Batch 1, Batch 2, Batch 3 and Batch 4) were prepared and monitored after 1, 2, 3 and 4 months of storage respectively. The rate of reduction of the *C. maculatus* population, and the weight losses of the cowpeas, were determined. The results showed that after 4 months of cowpea storage, neem caused, at doses of 20, 40 and 60 g/kg, a significant reduction in the bruchid population by $42.58 \pm 6.97\%$; $79.1 \pm 5.31\%$ and $84.27 \pm 5.7\%$; while at the same doses, papaya reduced the population by $14.32 \pm 4.53\%$; $42.18 \pm 5.83\%$ and $64.86 \pm 8.03\%$ compared to the negative control. No bruchids emerged from seeds treated with the synthetic insecticide (BEXTOXIN: fumigant) used at the dose of 0.25 g/kg during all storage periods. All doses significantly reduced cowpea weight losses, especially with the higher doses. Neem leaf powder was more effective than papaya leaf powder. Neem leaf powder could therefore be used as an alternative to synthetic chemicals in pest management of cowpea stocks.

The lethal effects of diatomaceous earth and aqueous-methanolic neem extract, *Melia azedarach* on *Tribolium confusum* and *Callosobruchus maculatus*

Faezeh Bagheri, Neda Mofidi, Mohammadali Akrami, Faezeh Bagheri

Appl Entomol Phytopathol, 2022; Doi: [10.22092/Jaep.2022.357763.1433](https://doi.org/10.22092/Jaep.2022.357763.1433)

Evaluation of single and integrated effects of diatomaceous earth and neem fruit extract, *Melia azedarach*, against 1-to-3-day-old insects of flour weevil, *Tribolium confusum* (Col., Tenebrionidae) and cowpea seed beetle *Callosobruchus maculatus* (Col., Chrysomelidae). Three replications were performed by contact toxicity by filter paper residue test and the mortality was measured 24 and 48 hours later. After 48 hours interval, the LC₅₀ level of Permaguard® formulation of diatomaceous earth against flour weevil was 4.6 times less than 24 hours interval. In the case of other species, this amount decreased by 3.2 times. Over time, from 24 to 48 hours intervals, the effect of the neem extract on both species increased. Also, there is a synergistic relationship between neem fruit extract and diatomaceous earth in both species and both times studied, which has increased with

increasing exposure time. Therefore, the simultaneous use of these two compounds improves the effectiveness of these compounds.

The Shelf Life of Tomato Fruits (*Solanum lycopersicum* L.) Treated with Extracts of Two Medicinal Plants: *Azadirachta indica* and *Vernonia amygdalina*.

Okolo, J.C., Igborgbor, J.C., Eze, E.M., Ogu, G.I. and Jonah, G.U. *International Journal of Environment*. 11, 2 (Oct. 2022), 124–140. DOI: <https://doi.org/10.3126/ije.v11i2.48653>.

Tomato remains one of the most nutritive edible berries but challenged by incessant attack and spoilage by fungi among others. The negative effects of synthetic preservatives have shifted attention to bio-preservatives. This study investigated the shelf-life of post-harvest tomato fruits treated with the two medicinal plants: *Azadirachta indica* (neem leaf) and *Vernonia amygdalina* (bitter leaf) extracts. Fresh tomato fruits and leaves of both plants were sourced from Lokoja. The leaves were air-dried, pulverized and extracted with distilled water and absolute ethanol. The extracts were analyzed phytochemically and graded concentrations (2.5 g/mL - 10.0 g/mL) were applied to the tomato samples in five replications each. Weight loss, appearance of fungal mycelia and deteriorations on the tomato samples were monitored for 30 days. Fungal isolates from the deteriorated samples were recovered and subjected to *in vitro* inhibitory activities. Alkaloids, glycosides, saponins, flavonoids and tannins were present in both extracts, except for *A. indica*, where saponins was not detected. Both extracts significantly ($p < 0.05$) reduce the weight loss (63.4 %) and extended the shelf life of the tomato fruits to 24 days at 10.0 g/mL. *Aspergillus niger*, *Fusarium oxysporum*, *Rhizopus stolonifer* and *Alternaria alternata* were recovered from the spoilt tomatoes. The most and least susceptible isolates were *R. stolonifera* (84.56 %) and *A. niger* (71.45 %), respectively. The bioactivities of both extracts were not significantly different ($p > 0.05$) from each other. These findings suggest that relatively higher concentrations of both plant extracts could be potential bio-preservatives to extend the shelf life of post-harvest tomatoes.

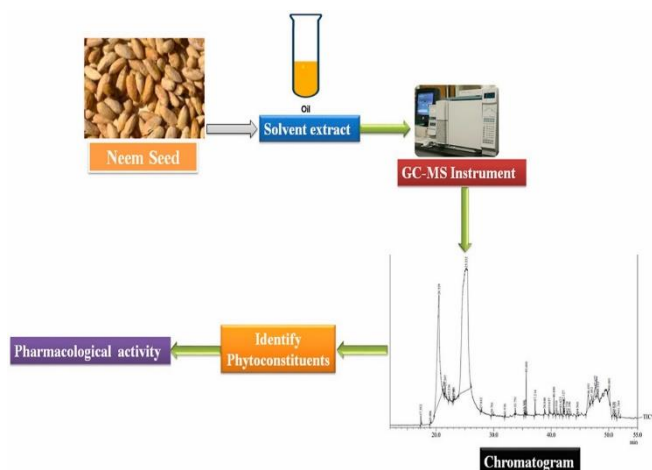
Neem- Component Analysis

Detection of phytoconstituents present in *Azadirachta indica* L. seeds extract by GC-MS analysis

Shehla Nasar Mir Najib Ullah Abdul Qadir Ahmed M. Abdelhaleem Ali Nausheen Khan Samreen Jahan Musarrat Husain Warsi

Journal of the Indian Chemical Society Volume 99, Issue 11, November 2022, 100765

Azadirachta indica L., commonly known as "Neem," belongs to the Meliaceae family. Traditionally, "Neem" has been used to cure diabetes, leprosy, and respiratory disorders. *Azadirachta indica* L. seed n-hexane extract was tested using GC-MS to determine the Phyto-components present. The analysis of *A. indica* L. seeds revealed the existence of Hexadecanoic acid, methyl ester (0.32%), n-Hexadecanoic acid (23.77%), 9-Octadecenoic acid (Z)- (0.07%), Methyl stearate (0.21%), Agaricic acid (0.06%), (E)-9-Octadecenoic acid ethyl ester (0.10%), 9-Octadecenoic acid (Z)-, methyl ester (0.48%), 6-Octadecenoic acid, (Z)- (64.25%), 9-Octadecenamide (0.06%), Oleic Acid (0.16%), Heneicosane (0.04%), Tetratetracontane (0.16%), Pentacosane (0.09%), Squalene (1.17%), Tetracontane (0.36%), γ -Tocopherol (0.16%), 2-[2-(6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl) ethyl]-6,6-dimethylbicyclo[3.1.1]hept-2-ene (0.44%), γ -Sitosterol (0.25%), Kryptogenin dioxime (1.53%), 9-Hexadecenoic acid, 9-octadecenyl ester, (Z,Z)- (1.34%), and Lupa-13(18),20(30)-dien-3-yl acetate (0.17%). The findings of this study provide a foundation for employing *A. indica* L. seeds as a herbal option for a variety of ailments. GC-MS analysis was used to determine the quality of these substances. In the pharmaceutical industry, GC-MS reports will be useful for identifying a wide range of phyto-bioconstituents in various plant extracts, polyherbal extracts, and the standardization of specific plant materials.

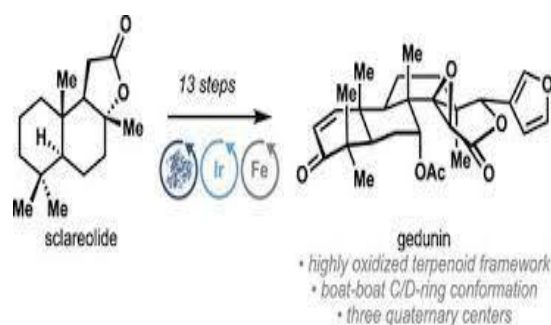


Concise Chemoenzymatic Synthesis of Gedunin.

Li J, Chen F, Renata H.

J Am Chem Soc. 2022 Oct 12. doi: 10.1021/jacs.2c09048. PMID: 36222746

The limonoids have attracted significant attention from the synthetic community owing to their striking structural complexity and medicinal potential. Recent efforts notwithstanding, synthetic access to many intact or ring D-seco limonoids still remains elusive. Here, we report the first *de novo* synthesis of gedunin, a ring D-seco limonoid with HSP90 inhibitory activity, that proceeds in 13 steps. Two enabling features in our strategy are the application of modern catalytic transformations to set the key quaternary centers in the carbocyclic core and the use of biocatalytic oxidation at C3 to establish a chemical handle to access the A-ring enone motif. The strategy presented herein may provide an entry point to a wider range of oxidized limonoids.



Neem For Human Health

Antimicrobial & Anticancer Effects

Antibacterial and Anti-Quorum Sensing Studies of Extracellularly Synthesized Silver Nanoparticles from *Azadirachta indica* (Neem) Leaf Extract.

Mishra R, Gwalani K, Nashikkar N, Bundale S.

Biosci Biotech Res Asia 2022;19(4).

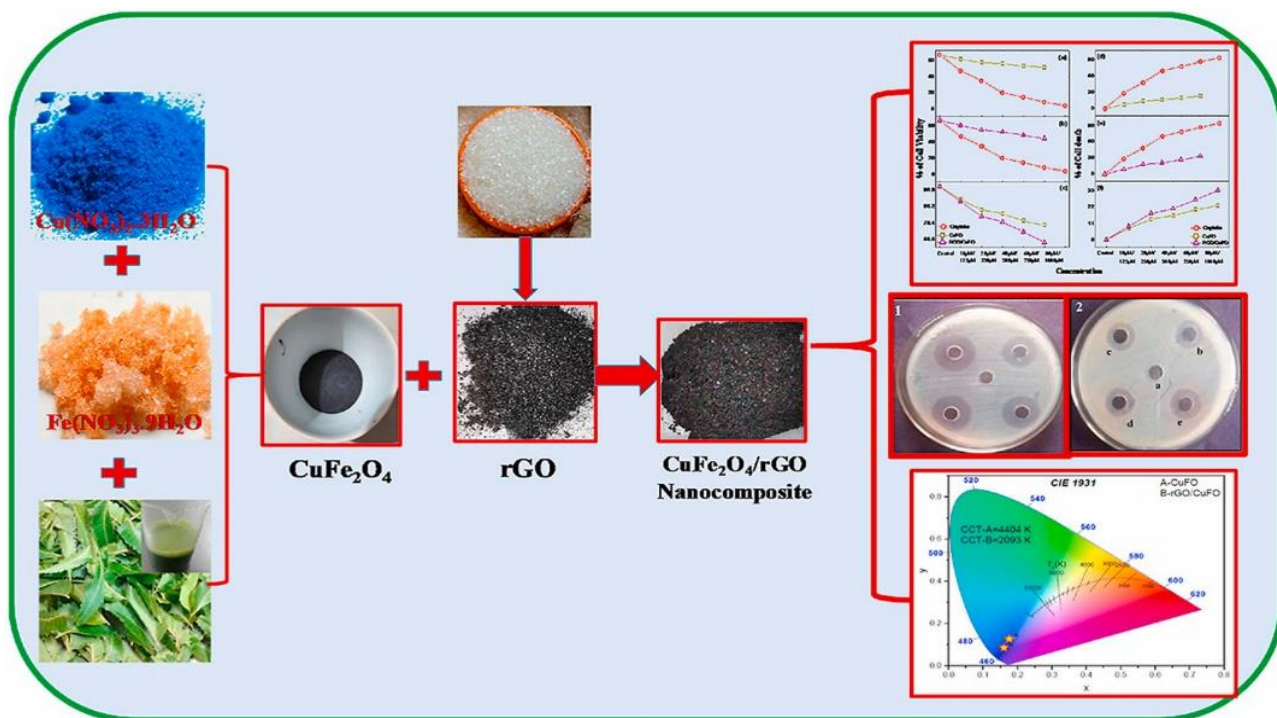
Azadirachta indica (Neem) is an important medicinal plant with proven strong antiseptic, antiviral, antifungal and antibacterial properties. The study here presents the antibacterial and QS (Quorum Sensing) inhibitory potential of biogenic Silver nanoparticles (AgNPs) from *Azadirachta indica* leaf extracts. The nanoparticles were synthesized using an aqueous extract of *Azadirachta indica* leaves and silver nitrate solution. The size, crystal structure, elemental composition and other physical properties of nanoparticles were determined using different microscopic and spectroscopic techniques. The average diameter of the nanoparticles was found to be between 20-43 nm with crystalline morphology. These extracellularly synthesized AgNPs strongly inhibited Gram negative pathogenic species and exhibited demonstrable anti-Quorum Sensing (QS) activity as evident from pigment inhibition and 75- 80% decrease in biofilm mass on AgNPs treatment in a dose dependent manner.

Neem Leaves mediated green synthesis of copper ferrite decorated reduced graphene oxide nanocomposite for photoluminescence, gamma/X-ray radiation shielding, antimicrobial and anticancer properties

BC Reddy, S Manjunatha, HC Manjunatha, YS Vidya et al.

Solid State Sciences, Volume 134, 2022, 107029

Copper ferrite (CuFO) and RGO/CuFO nanocomposites (NCs) were synthesized by Solution combustion method (SCM) using neem leaves as an extract for the first time. The synthesized NPs were characterized with various approaches. The PXRD pattern of CuFO and CuFO/RGO shows the formation of spinel cubic structure which was further confirmed with Rietveld refinement. Morphologically, agglomeration of the NPs were observed. Agglomeration is found to be more in RGO/CuFO NCs. The Wood and Tauc's relation gives direct energy band gap of 1.55 eV. The photoluminescence spectra (emission) of CuFO NPs noted at an excitation wavelength of 250 nm and CIE graph shows deep blue color whereas the addition of RGO increases its intensity. Theoretically, mass attenuation coefficient at different energy range was estimated for CuFO and CuFO/RGO NCs. Antimicrobial and anti-cancerous properties of CuFO NPs were studied. The present CuFO and RGO/CuFO NCs might be a good nanophosphor material for display applications and also useful in the antibacterial, anticancer and X-ray/gamma absorption properties.



Antifungal Potential of Some Herb Decoctions and Essential Oils on *Candida* Species.

Noites A, Araújo B, Machado J, Pinto E.

Healthcare (Basel). 2022 Sep 21;10(10):1820. doi: 10.3390/healthcare10101820. PMID: 36292266

1) Background: Candidiasis is a fungal infectious disease caused by opportunistic *Candida* species. The incidence of candidiasis has improved, due to prolonged antibiotic therapy and an increased number of immunocompromised patients. The purpose of this study was to evaluate if decoctions and essential oil (EO) of neem (*Azadirachta indica*, Meliaceae family), coptidis (*Coptis chinensis*, Ranunculaceae family), magnolia (*Magnolia officinalis*, Magnoliaceae family), scutellaria (*Scutellaria barbata*, Lamiaceae family), and the EO of manuka (*Leptospermum scoparium*, Myrtaceae family), have antifungal activity in vitro against some clinically prevalent species of *Candida*. (2) Methods: The antifungal activity was studied by the determination of the minimum inhibitory concentration (MIC) and minimum lethal concentration (MLC) against five *Candida* strains. The effect in dimorphic transition of *Candida albicans* was also evaluated for the two plants with higher antimicrobial behavior. (3) Results: *C. chinensis* decoction and EO and *L. scoparium* EO exhibited antifungal activity in *Candida* spp. In addition to the fact that both *C. chinensis* decoction and EO proved strong antifungal activity, *L. scoparium* EO also displayed a relevant inhibitory effect on the dimorphic transition. (4) Conclusions: The results provided support for the potential use of *C. chinensis* and *L. scoparium* in the treatment of infections by *Candida* spp.

Nephroprotective Effects

Deacetyl epoxyazadiradione protects aminoglycoside antibiotic-induced renal cell apoptosis, in vitro.

Murugan R, Rajesh R, Velayutham M, Juliet A, Gopinath P, Arockiaraj J.

Cell Biol Int. 2022 Sep 29. doi: 10.1002/cbin.11915. Online ahead of print. PMID: 36177496

Aminoglycoside antibiotics such as gentamicin are used frequently to treat bacterial infections in humans. Excessive consumption of these antibiotics lead to renal dysfunction. One of the factors contributing to renal dysfunction is oxidative damage, which causes apoptosis. Hence, this study investigates the effect of the antioxidant compound deacetyl epoxyazadiradione (DEA) in reducing cell death induced by gentamicin treatment in kidney cells (Madin-Darby canine kidney cells). The antioxidant experiments showed that reactive oxygen species level is decreased up to $27.06 \pm 0.18\%$ in $150 \mu\text{M}$ of DEA treatment. At this concentration, the activity of antioxidant enzymes such as superoxide dismutase increased from 0.4 ± 0.04 to $1.46 \pm 0.05 \mu\text{mol}/\text{min}/\text{L}$ and catalase increased from 7.48 ± 0.39 to $17.6 \pm 0.74 \text{ U}/\text{mg}$. The relative folds of gene expression of mitochondrial enzymes such as GST, GPx and GR restored from 0.596 ± 0.019 , 0.521 ± 0.013 and 0.775 ± 0.014 to 0.866 ± 0.013 , 0.669 ± 0.015 and 0.8615 ± 0.028 , respectively. Consequently, the percentage of cell viability increases upto 91.8 ± 2.01 from 61.93 ± 1.63 with much less fragmentation in genomic DNA. Additionally, molecular docking results showed that DEA could bind to Bax, Bcl- 2, Caspase- 3 and Caspase- 9 proteins. These results indicate that DEA could reduce cell apoptosis by reducing oxidative stress due to antibiotics and interrupting the apoptotic signal pathway in kidney cells.

Drug Design & Delivery

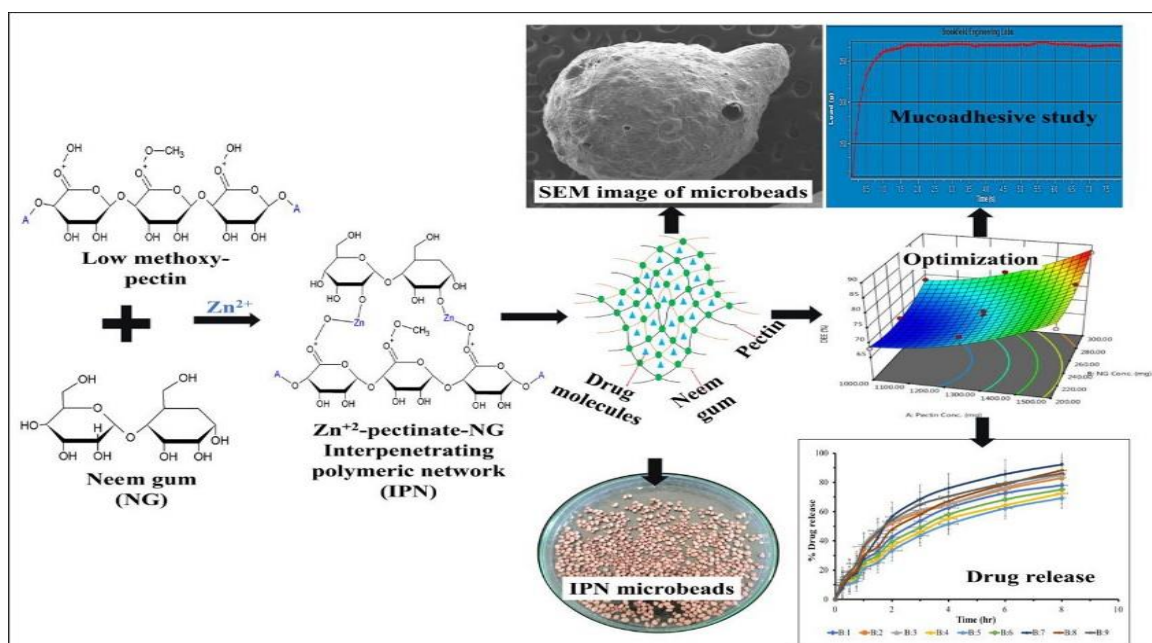
Formulation, optimization, and in-vitro-ex-vivo evaluation of dual-crosslinked zinc pectinate-neem gum-interpenetrating polymer network mediated lansoprazole loaded floating microbeads

Rajput K, Tawade S, Nangare S, Shirsath N, Bari S, Zawar L.

Int J Biol Macromol. 2022 Sep 28:S0141-8130(22)02155-9. doi: 10.1016/j.ijbiomac.2022.09.216. PMID: 36181884

Low methoxy pectin (LM pectin) suffers from burst release owing to its high swellability and solubility in water. Consequently, in ways to design an ideal drug delivery system, these obstacles must be surmounted. Therefore, the work aimed to design dual crosslinked LM pectin -neem gum (NG) mediated interpenetrating polymer network (IPN) floating mucoadhesive microbeads for lansoprazole (LNZ) gastro-retentive delivery. In short, LNZ-loaded floating microbeads were achieved by using the ionic gelation method wherein zinc acetate was preferred as a crosslinking agent. The optimization of IPN microbeads was performed employing a 3^2 -factorial design wherein concentration of pectin and NG was considered as independent factors whereas dependant factors are entrapment efficiency

and drug release. Importantly, carboxylic functionality of low methoxy (LM) pectin and hydroxylic functionality NG cross-linked with Zn^{2+} forms a 3D network. Diffractogram and thermogram revealed that conversion of drug from crystalline to amorphous form because of entrapment of drug within polymeric network. Anticipated floating microbeads showed that polymer concentration had considerable effect on drug encapsulation efficiency and drug release. Briefly, optimizing floating microbeads (Batch B:5) showed maximum drug entrapment (87.47 %) with a delayed drug release (69.20 %, at 8 h) due to formation of strong IPN. Moreover, it showed good mucoadhesive aptitude with goat stomach mucosa because of entanglement between gum and mucus layer. In addition, use of calcium silicate assists to modulate floating profile of IPN microbeads. Therefore, designing dual crosslinked zinc-pectinate-NG mediated IPN floating mucoadhesive microbeads will offer a new substitute for floating delivery.



Computer-aided drug design of Azadirachta indica compounds against nervous necrosis virus by targeting grouper heat shock cognate protein 70 (GHSC70): quantum mechanics calculations and molecular dynamic simulation approaches.
Islam SI, Saloa S, Mahfuj S, Islam MJ, Mou MJ.

Genomics Inform. 2022 Sep;20(3):e33. doi: 10.5808/gi.21063. PMID: 36239110

Nervous necrosis virus (NNV) is a deadly infectious disease that affects several fish species. It has been found that the NNV utilizes grouper heat shock cognate protein 70 (GHSC70) to enter the host cell. Thus, blocking the virus entry by targeting the responsible protein can protect the fishes from disease. The main objective of the study was to evaluate the inhibitory potentiality of 70 compounds of Azadirachta indica (Neem plant) which has been reported to show potential antiviral activity against various pathogens, but activity against the NNV has not yet been reported. The binding affinity of 70 compounds was calculated against the GHSC70 with the docking and molecular dynamics (MD) simulation approaches. Both the docking and MD methods predict 4 (PubChem CID: 14492795, 10134, 5280863, and 11119228) inhibitory compounds that bind strongly with the GHSC70 protein with a binding

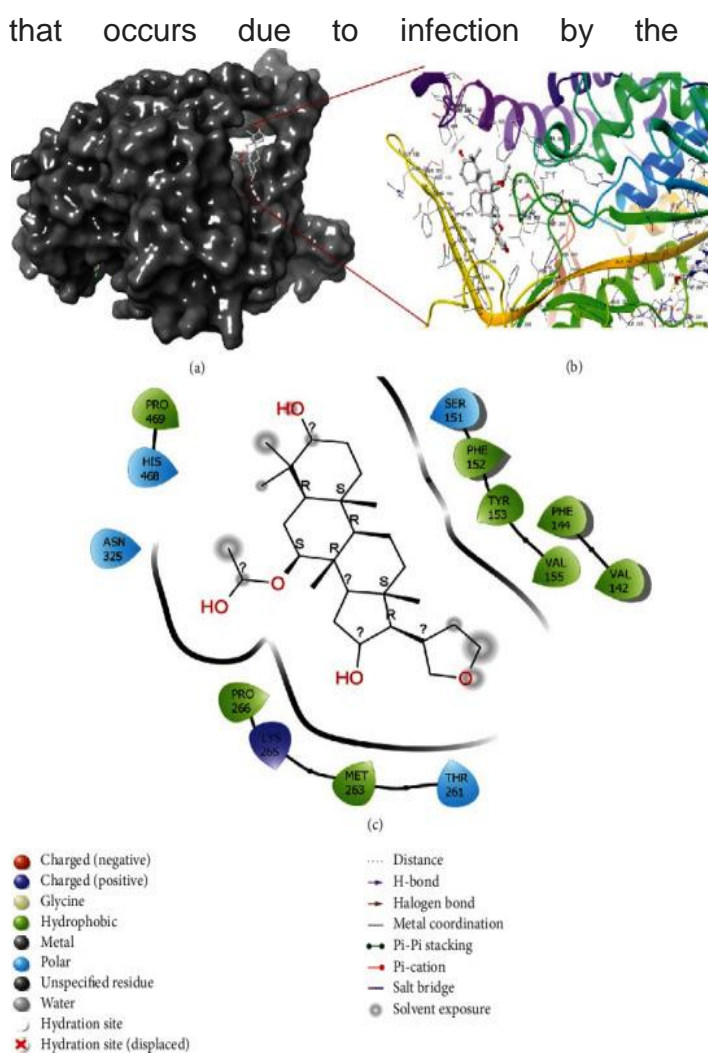
affinity of -9.7, -9.5, -9.1, and -9.0 kcal/mol, respectively. Also, the ADMET (absorption, distribution, metabolism, excretion, and toxicity) properties of the compounds confirmed the drug-likeness properties. As a result of the investigation, it may be inferred that Neem plant compounds may act as significant inhibitors of viral entry into the host cell. More in-vitro testing is needed to establish their effectiveness.

Identification of Concomitant Inhibitors against Glutamine Synthetase and Isocitrate Lyase in *Mycobacterium tuberculosis* from Natural Sources.

Chanda A, Kalita S, Mishra AK, Changkakoti L, Sarma JB, Biswas K, Kakati D, Mohanta YK, Tanti B, Mahanta S, Saravanan M.

Biomed Res Int. 2022 Oct 3;2022:4661491. doi: 10.1155/2022/4661491. eCollection 2022.PMID: 36225979

Tuberculosis (T.B.) is a disease that occurs due to infection by the bacterium, *Mycobacterium tuberculosis* (Mtb), which is responsible for millions of deaths every year. Due to the emergence of multidrug and extensive drug-resistant Mtb strains, there is an urgent need to develop more powerful drugs for inclusion in the current tuberculosis treatment regime. In this study, 1778 molecules from four medicinal plants, *Azadirachta indica*, *Camellia sinensis*, *Adhatoda vasica*, and *Ginkgo biloba*, were selected and docked against two chosen drug targets, namely, Glutamine Synthetase (G.S.) and Isocitrate Lyase (I.C.L.). Molecular Docking was performed using the Glide module of the Schrödinger suite to identify the best-performing ligands; the complexes formed by the best-performing ligands were further investigated for their binding stability via Molecular Dynamics Simulation of 100 ns. The present study suggests that Azadiradione from *Azadirachta indica* possesses the potential to inhibit Glutamine Synthetase and Isocitrate Lyase of *M. tuberculosis* concomitantly. The excellent docking score of the ligand and the stability of receptor-ligand complexes, coupled with the complete pharmacokinetic profile of Azadiradione, support the proposal of the small molecule, Azadiradione as a novel antitubercular agent. Further, wet lab analysis of Azadiradione may lead to the possible discovery of a novel antitubercular drug.

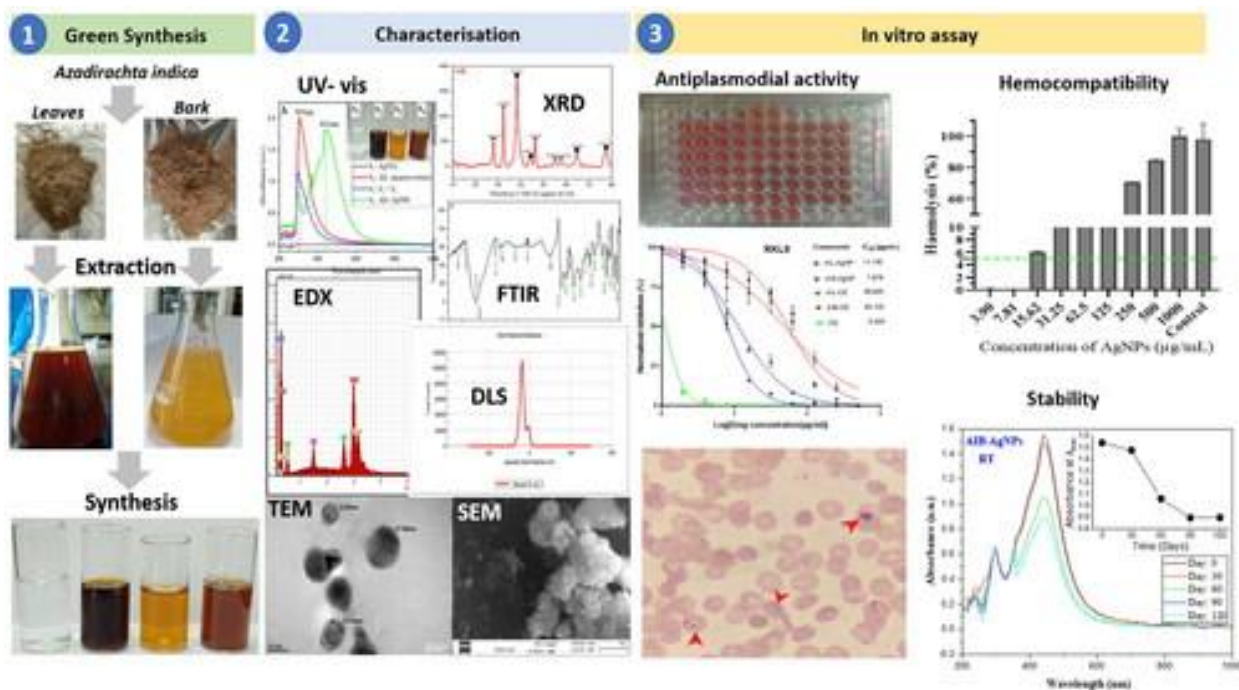


In vitro antiplasmodial activity, hemocompatibility and temporal stability of *Azadirachta indica* silver nanoparticles.

Hawadak J, Kojom Foko LP, Pande V, Singh V.

Artif Cells Nanomed Biotechnol. 2022 Dec;50(1):286-300. doi: 10.1080/21691401.2022.2126979.PMID: 36214490

Recently green nanotechnology has gained great interest as a promising tool for drug discovery. In the present study, we synthesized and characterized silver nanoparticles (AgNPs) using *Azadirachta indica* (AI) and evaluated their hemocompatibility and effect against *Plasmodium falciparum* strains. AI leaves and barks were used for aqueous extracts (AIL and AIB) and AgNPs synthesis. AgNPs were characterized using spectroscopic, diffraction, electron microscopic and electrostatic techniques. Anti-plasmodial and haemolytic activity were assessed following the SYBR Green I fluorescence assay and Miki *et al.* protocol, respectively. The normalized fluorescence counts were plotted against the log-transformed drug concentration and half-maximal inhibitory concentration (IC₅₀) determined by analyzing the dose-response curves. AgNPs were stored for 120 days at room temperature-RT, +4 °C and -20 °C and subsequently their stability was evaluated by spectroscopy. Both NPs were predominantly spheroidal, crystalline in nature, stable, well dispersed with mean size of 13.01 nm for AIL-NPs and 19.30 nm for AIB-NPs and exhibited good antiplasmodial activity against 3D7 and RKL9 *P. falciparum* strains with IC₅₀ of 9.27 µg/mL and 11.14 µg/mL for AIL-NPs, 8.10 µg/mL and 7.87 µg/mL for AIB-NPs, respectively. *A. indica* contain bioactive phyto-compounds indicating great potential for anti-malarial drug development through green nanotechnology. The AgNPs were structurally stable after 120 days but antiplasmodial activity was considerably affected. A significant haemolytic activity (>25%) was observed with AIL- and AIB-AgNPs at concentrations ≥125 µg/mL.



Efficacy Of Neem (Azadirachta Indica), Shahtra (Fumaria Parviflora) Leaves And Kalonji (Nigella Sativa) Seeds Against Haemonchus contortus Infection In Locally Bred Rambouillet Sheep In Pakistan

M. Naeem , Z. Iqbal and N. Roohi

Journal of Animal & Plant Sciences, 32(5): 2022, Page: 1452-1459.

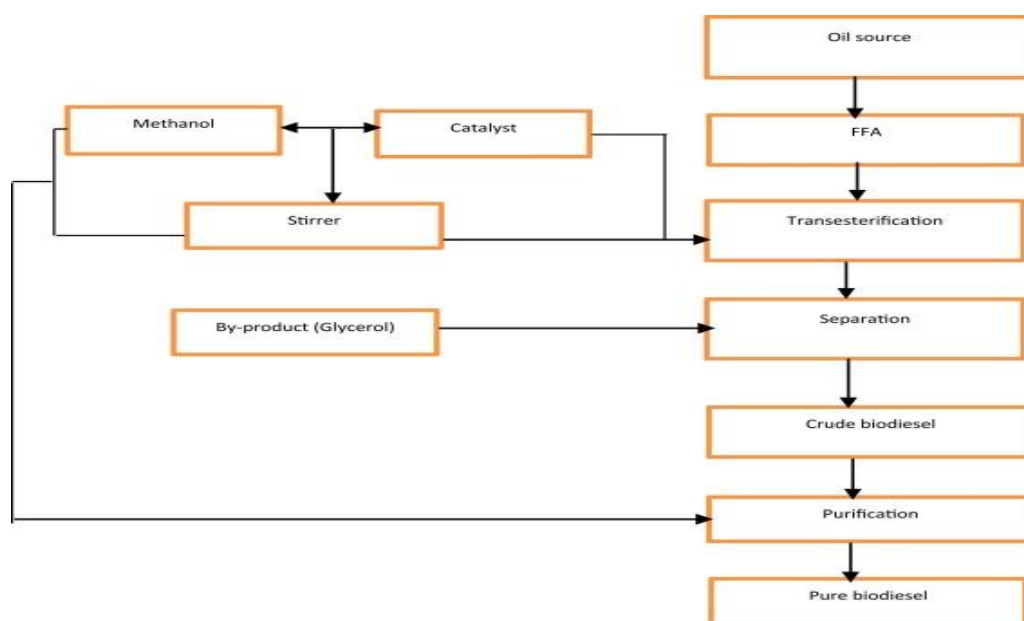
Sheep farming is the backbone of Pakistan's rural economy and haemonchosis is a major impediment in its way. The objective was to evaluate the efficacy of three medicinal plants Azadirachta indica (Neem), Fumaria parviflora (Shahtra) leaves and Nigella sativa (Kalonji) seeds against Haemonchus contortus (H. contortus) infection in locally bred Rambouillet sheep. One hundred and ten naturally infected female sheep diagnosed on the basis of identification of the parasite and faecal egg count, were selected. The animals were assigned to 11 treatments in a completely randomized (CR) design with 10 animals per treatment. The treatments were Albendazole 7.5 mg/kg BW (positive control), Neemleaves extract (NLE) 50 mg/kg BW, NLE 100 mg/kg BW, NLE 150 mg/kg BW, Shahtra leaves extract (SLE) 50 mg/kg BW, SLE 100 mg/kg BW, SLE 150 mg/kg BW, Kalonji seeds extract (KSE) 50 mg/kg BW, KSE 100 mg/kg BW, KSE 150 mg/kg BW and un-treated infected (Negative control). All the extracts were prepared in aqueous solution. Treatments were administered as single dose orally. Faecal egg count was recorded on zero, 7th, 14th, 21st and 28th-day post-treatment for analysis. Faecal egg count reduction percentage (FECR%) was recorded to assess the efficacy of the drugs. None of the treatments could fully eliminate faecal egg production by the 28th-day post-treatment. Albendazole showed significantly higher FECR% as compared to Shahtra and Kalonji treated groups ($p \leq 0.01$). FECR% on day 28 showed no significant difference between Albendazole, NLE 100 and NLE 150 ($p > 0.05$). The three medicinal plant extracts showed a limited efficacy against H. contortus indicated by FECR% when compared with untreated animals. However, the efficacy of NLE 100 was closest to Albendazole showing its potential as an anthelmintic ($p > 0.05$).

Neem- Industrial Applications & Sustainable Environment

Transesterification of non-edible oil and effects of process parameters on biodiesel yield Wisdom C.Ulakpa Ruth O.E.Ulakpa Michael C.Egwunyenga Titus

Cleaner Waste Systems Volume 3, December 2022, 100047

Because of its many advantages over petro-diesel, biodiesel is being promoted as a sustainable fuel option. Nonetheless, its economic viability is hampered by the high manufacturing costs associated with it, mainly because of the excessively high cost of commonly-used cooking oils as raw materials and the synthetic calcium oxide used as a catalyst. The cost barriers to biodiesel production can be alleviated through the exploration of non-edible oils as raw materials and the use of waste resources. This work contributes to the development of a catalyst from waste bone for biodiesel synthesis from neem seed oil. The discarded bones were via thermal method calcined at 800 °C, and impregnation methods using alkaline (NaOH) impregnation at a 1:6 ratio and an acid (H₃PO₄) impregnation at a 1:4 ratio. Performance parameters were optimized using the response surface methodology (RSM), and the observed optimal conditions were catalyst concentration 4 wt%, methanol to oil ratio 8:1, reaction temperature 55°C, reaction time 4 h, and agitation speed 400 rpm. Maximum yields were achieved with a 94% acid catalyst, 93% alkaline catalyst, and 92% thermal catalyst for transesterification. Under ideal conditions, the fuel characteristics of neem oil methyl esters were found to be well within the range recommended by ASTM D6751 for biodiesel. Therefore, the waste-bone catalysts produced for transesterification of neem seed oil towards biodiesel generation can be deemed an effective and active catalyst. The study's results suggest that non-edible neem seed oil could be a good choice for the industrial-scale manufacturing of biodiesel, which could eventually displace petro-diesel.

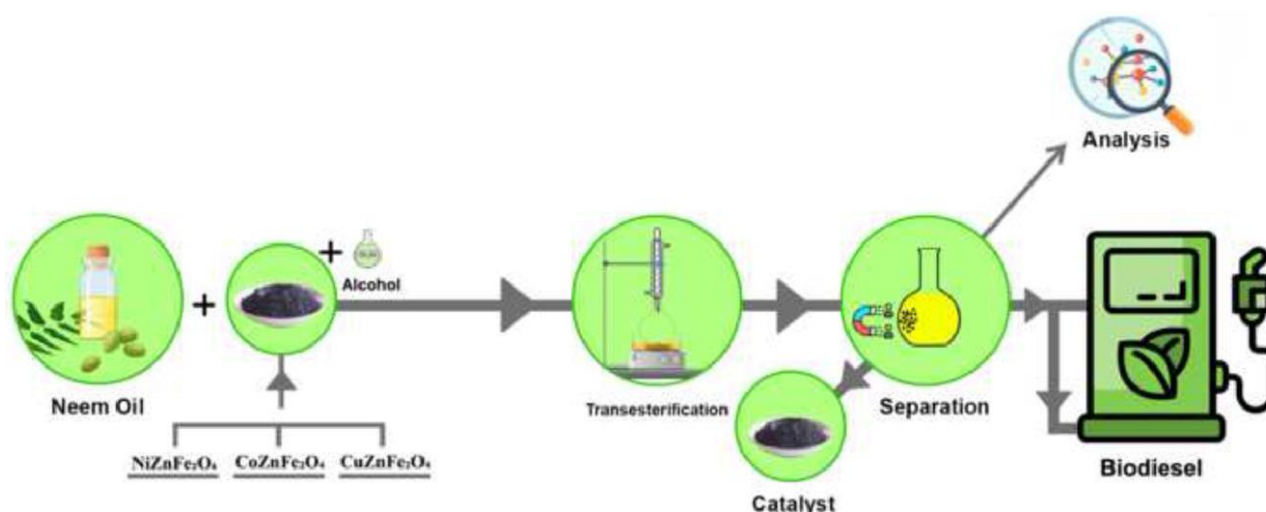


Catalytic activity of bimetallic spinel magnetic catalysts ($\text{NiZnFe}_2\text{O}_4$, $\text{CoZnFe}_2\text{O}_4$ and $\text{CuZnFe}_2\text{O}_4$) in biodiesel production process from neem oil: Process evaluation and optimization

Farokhi G, Saidi M.

Chemical Engineering and Processing - Process Intensification Vol 181, 2022, 109170

The non-edible neem seed oil contains a suitable amount of fatty acids. Neem seed has attracted the attention of many researchers due to the lack of impact on the supply of food and raw materials, and the possibility of growing in non-cultivable land compared to other biomass generations. In this research, the feasibility of producing high-quality biodiesel from neem seed oil via esterification process was investigated. This study aimed to optimize the catalytic performance of $\text{CoZnFe}_2\text{O}_4$, $\text{NiZnFe}_2\text{O}_4$, and $\text{CuZnFe}_2\text{O}_4$ bimetallic spinel magnetic catalysts in the esterification/transesterification reaction of the neem synthetic oil for biodiesel production. The catalysts were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD), vibrating sample magnetometry (VSM), and Brunauer Emmett and Teller (BET) methods. Biodiesel production process parameters, including reaction temperature (40-100°C), molar ratio of methanol-to-oil (3 to 30), catalyst weight percentage (1-5 wt.%), and reaction time (10-90 min), were optimized by response surface methodology (RSM) based on the central composite design (CCD). Statistical analysis revealed that the developed quadratic polynomial model is statistically significant and was highly efficient for describing the real relationship between experimental results and modeling data. Overall, the maximum biodiesel production under optimum condition using $\text{CoZnFe}_2\text{O}_4$, $\text{NiZnFe}_2\text{O}_4$, and $\text{CuZnFe}_2\text{O}_4$ spinel catalysts was 99.29%, 93%, and 90.86%, respectively. Under optimal conditions, $\text{CoZnFe}_2\text{O}_4$, $\text{NiZnFe}_2\text{O}_4$, and $\text{CuZnFe}_2\text{O}_4$ spinel catalysts were reused in 12, 10, and 6 cycles, respectively. The $\text{CoZnFe}_2\text{O}_4$ in the seven cycles, the $\text{NiZnFe}_2\text{O}_4$ catalysts in the five cycles, and the $\text{CuZnFe}_2\text{O}_4$ catalyst in the first three cycles provided excellent results.



Briquette production as a sustainable alternative for waste management in the tannin extraction industry.

de Souza EC, Gomes JPS, Pimenta AS, de Azevedo TKB, Pereira AKS, Gomes RM, Brito JO, Dias Júnior AF.

Environ Sci Pollut Res Int. 2022 Oct 7. doi: 10.1007/s11356-022-23490-y. PMID: 36205870

Tannins are polyphenols that can be extracted from different parts of the plant and have different known commercial applications. The extraction of tannins generates a significant amount of low-density wastes. An alternative that can be applied to ensure energy reuse of this low-density waste is a densification process, such as briquetting. Thus, this research work aimed to assess the energy potential of the residue from the extraction of tannins of different forest species, aiming at its energy reuse in the form of briquettes. Stem barks of 6 forest species (Acacia mangium, AM; Anacardium occidentale, AO; Anadenanthera colubrina, AC; Azadirachta indica, AI; Mimosa caesalpiniaefolia, MC; Mimosa tenuiflora, MT) were used after tannin extraction. Bulk density, energy (higher, lower, and net heating value) and thermal (TG/DTG) properties, and chemical constitution (extractives, lignin, and holocellulose) of the materials were determined. In addition, briquette compaction ratio, apparent density, volumetric expansion, and water adsorption over the days were evaluated. The highest bulk densities were found in the barks of Anadenanthera colubrina (0.529 g.cm⁻³) and Mimosa tenuiflora (0.407 g.cm⁻³), whereas the species that showed the best result of higher heating value was Acacia mangium (20.44 MJ.kg⁻¹), followed by Azadirachta indica (19.39 MJ.kg⁻¹) and Mimosa caesalpiniaefolia (18.85 MJ.kg⁻¹). Briquetting increased the density of the evaluated material by 2.3 to 4.9 times. All briquettes produced with wastes from tannin extraction evaluated in this work showed potential for energy production. With more information on the quantification of waste generated and data on the economic viability of production, these tannin-producing industries can benefit both environmentally and economically, by reusing these wastes for energy production.

Azadirachta indica leaf extract mediated silver nanoparticles impregnated nano composite film (AgNP/MCC/starch/whey protein) for food packaging applications.

Pandian J H, Senthilkumar K, Ratnam M V, M N, S S.

Environ Res. 2022 Oct 22:114641. doi: 10.1016/j.envres.2022.114641. Online ahead of print. PMID: 36283439

In order to be used in food packaging, the study aims to develop a composite film based on microcrystalline cellulose (MCC) and coated with silver nanoparticles (AgNPs). The MCC was derived from sugar cane bagasse. Protein, starch, and poly-ethylene glycol 1500 (PEG-1500) are employed to improve the tensile strength, flexibility, and durability of the packaging film. The AgNPs was synthesized by a green route employing Azadirachta indica leaf extract as reducing agent. The determined average crystallite size of AgNPs was seen at 20 nm. The X-ray diffraction (XRD) studies of the final film prepared have an elevated peak with a crystallinity of 37.5%. The scanning electron microscopic images (SEM) of the AgNPs and the prepared samples, reveal their surface morphology. The Fourier transform infrared spectroscopic studies (FT-IR) disclose the functional group changes during the film preparation. The antibacterial activity of the amalgamated AgNPs against five bacterial pathogens studied was found to be highly active against tested food pathogens, except for

Proteus vulgaris. When coated over a vegetable, the produced nanocomposite film displayed an increased shelf life for the vegetable by limiting the decay impact caused by food pathogens. According to the findings, the AgNPs-impregnated MCC/Starch/Whey protein has the potential to be employed as an antimicrobial packaging material.

