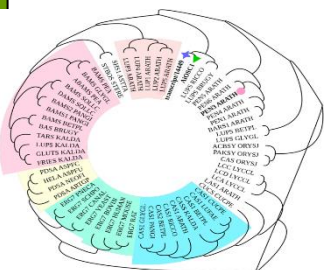
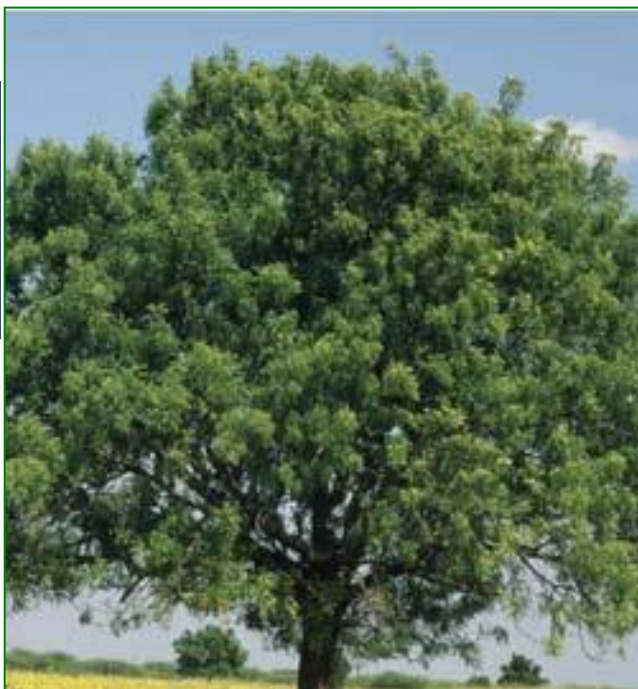




Neem Research Newsletter Volume 3, Issue 6, 2023



WORLD NEEM ORGANISATION (WNO)



From
The Editor's Desk.....

Research publications on neem continue and this quarterly newsletter which has now become monthly has exciting news for neem enthusiasts! The main focus this month appears to be on the health front. Neem is listed among the ten different Bangladeshi plant species in a medicinal plant dataset. This dataset can provide researchers in the field of machine learning and computer vision with a valuable resource to develop and evaluate algorithms for plant phenotyping, disease detection, plant identification, drug development, and other tasks related to medicinal plants. Components of neem have been shown to exert anti-inflammatory, anticancerous, and antimicrobial activities in animal models. In particular, neem is useful as an alternate treatment against lymphatic filariasis to help reduce the World Health Organization's burden of providing drugs for people in need of treatment every year. Neem is also used by the indigenous communities of Tororo District, Eastern Uganda for treatment of malaria. Druggable targets of active constituents of neem lung cancer were identified using network pharmacology and validation of activity through molecular docking analysis. Neem extract was demonstrated to alleviate intervertebral disc degeneration. Based on research data, it is proposed that nimbolide reduces neuroinflammation. On the environment, ecofriendly fabrication of cobalt nanoparticles using neem was found to effectively inhibit fungal infection in medicated nano-coated textile. Neem leaf powder was shown to mitigate oxidative stress and pathological alterations triggered by lead toxicity in Nile tilapia.

S. Nagini

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



Neem in Agriculture

Rosemary and neem methanolic extract: antioxidant, cytotoxic, and larvicidal activities supported by chemical composition and molecular docking simulations.

Alhaithloul HAS, Alqahtani MM, Abdein MA, Ahmed MAI, Hesham AE, Aljameeli MME, Al Mozini RN, Gharsan FN, Hussien SM, El-Amier YA.

Front Plant Sci. 2023 May 18;14:1155698. doi: 10.3389/fpls.2023.1155698. eCollection 2023. PMID: 37275255

This study aimed to employ GC-MS to assess the chemical composition of MeOH leaf extracts of *R. officinalis* and *A. indica* and evaluate their insecticidal, antioxidant, and antibacterial activities. Twelve components, representing 98.61% and 100% of the total volatile compounds, were deduced from the extracted *R. officinalis* and *A. indica*, respectively, using this method. In *R. officinalis* extract, limonene is typically positioned as the main component (23.03%), while the main chemicals identified in *A. indica* extract were methyl (E)-octadec-13-enoate (23.20%) and (2R)-1,3,8-trimethyl-4-propyl-5-ethyl-2-(1-hydroxyethyl)-7-methoxycardonyl-ethyl-6-methylenecarbonyl-porphyrin (23.03%). Both extracts of *R. officinalis* and *A. indica* exhibited different toxicity against the stored grain pest *T. castaneum*, with LC₅₀ values of 1.470 and 2.588 mg/ml, respectively. Additionally, after 4 and 5 h of treatment at a concentration of 0.2 mg/ml, the *A. indica* extract showed the highest levels of repellent action (81.4% and 93.4%), and the *R. officinalis* extract showed a good repellent rate (64.9% and 80.7%) against *T. castaneum* larvae. With an IC₅₀ value of 35.83 and 28.68 mg/L and a radical scavenging activity percentage of 67.76% and 72.35%, the leaf extract was found to be the most potent plant extract when tested for DPPH antioxidant activity. Overall results showed that MeOH extracts of *R. officinalis* and *A. indica* were more effective against *S. aureus* than *E. coli*. To determine how the investigated chemicals attach to the active sites of *E. coli* DNA gyrase A and *S. aureus* undecaprenyl diphosphate synthase, docking studies were carried out. The consensus score analysis showed that limonene exhibits the best binding energy with both enzymes in docking analysis and more stability in molecular dynamics simulations. The RMSD was obtained at 20.6 and 4.199 (Kcal/mole). The two compounds were successfully used in molecular dynamics simulation research to generate stable complexes with DNA gyrase A.

Oviposition preferences of *Aedes aegypti* in Msambweni, Kwale County, Kenya.

Musunzaji PS, Ndenga BA, Mzee S, Abubakar LU, Kitron UD, Labeaud AD, Mutuku FM.

J Am Mosq Control Assoc. 2023 Jun 1. doi: 10.2987/22-7103. PMID: 37270926

Aedes aegypti is the primary vector of dengue fever virus (DENV) worldwide. Infusions made from organic materials have been shown to act as oviposition attractants for *Ae. aegypti*; however, studies on locally suitable infusion materials are lacking. The current study assessed the suitability of 4 locally available materials as oviposition infusions for use in surveillance and control of *Ae. aegypti* in Kwale County, Kenya. Oviposition infusion preferences were assessed in laboratory, semifield, and field conditions, using 4 infusions made from banana, grass, neem, and coconut. In addition, ovitrapping in wall, grass, bush, and banana microhabitats was done in 10 houses each in urban and rural coastal

households to determine suitable oviposition microhabitats. Overall, the highest oviposition responses were observed for banana infusion, followed by neem and grass infusions, which were comparable. Coconut infusion resulted in the lowest oviposition response. Although female *Ae. aegypti* did not show preference for any microhabitat, the oviposition activity across all the microhabitats was highly enhanced by use of the organic infusions. Banana, neem, and grass infusions could be used to attract gravid mosquitoes to oviposition sites laced with insecticide to kill eggs. Additionally, banana plantings could be important targets for integrated vector control programs.

Neem for Human Health

Bangladeshi medicinal plant dataset.

Borkatulla B, Ferdous J, Uddin AH, Mahmud P.

Data Brief. 2023 May 7;48:109211. doi: 10.1016/j.dib.2023.109211. PMID: 37383807

Medicinal plants have been used to treat diseases since ancient times. Plants used as raw materials for herbal medicine are known as medicinal plants [2]. The U. S. Forest Service estimates that 40% of pharmaceutical drugs in the Western world are derived from plants [1]. Seven thousand medical compounds are derived from plants in the modern pharmacopeia. Herbal medicine combines traditional empirical knowledge with modern science [2]. A medicinal plant is considered an important source of prevention against various diseases [2]. The essential medicine component is extracted from different parts of the plants [8]. In underdeveloped countries, people use medicinal plants as a substitute for medicine. There are various species of plants in the world. Herbs are one of them, which are of different shapes, colors, and leaves [5]. It is difficult for ordinary people to recognize these species of herbs. People use more than 50000 plants in the world for medicinal purposes. There are 8000 medicinal plants in India with evidence of medicinal properties [7]. Automatic classification of these plant species is important because it requires intensive domain knowledge to manually classify the proper species. Machine learning techniques are extensively used in classifying medicinal plant species from photographs, which is challenging but intriguing to academics. Artificial Neural Network classifiers' effective performance depends on the quality of the image dataset [4]. This article represents a medicinal plant dataset: an image dataset of ten different Bangladeshi plant species. Images of medicinal plant leaves were from various gardens, including the Pharmacy Garden at Khwaja Yunus Ali University and the Khwaja Yunus Ali Medical College & Hospital in Sirajganj, Bangladesh. Images were collected by taking pictures with high-resolution mobile phone cameras. Ten medicinal species, 500 images per species are included in the data set, namely, *Nayantara (Catharanthus roseus)*, *Pathor kuchi (Kalanchoe pinnata)*, *Gynura procumbens (Longevity spinach)*, *Bohera (Terminalia bellirica)*, *Haritaki (Terminalia chebula)*, *Thankuni (Centella asiatica)*, *Neem (Azadirachta indica)*, *Tulsi (Ocimum tenniflorum)*, *Lemon grass (Cymbopogon citratus)*, and *Devil backbone (Euphorbia tithymaloides)*. This dataset will benefit researchers applying machine learning and computer vision algorithms in several ways. For example, training and evaluation of machine learning models with this well-curated high-quality dataset, development of new computer vision algorithms, automatic medicinal plant identification in the field of botany and pharmacology for drug discovery and conservation, and data augmentation. Overall, this medicinal plant image dataset can provide researchers in the

field of machine learning and computer vision with a valuable resource to develop and evaluate algorithms for plant phenotyping, disease detection, plant identification, drug development, and other tasks related to medicinal plants.

Catechin, epicatechin, curcumin, garlic, pomegranate peel and neem extracts of Indian origin showed enhanced anti-inflammatory potential in human primary acute and chronic wound derived fibroblasts by decreasing TGF- β and TNF- α expression.

Monika P, Chandrababha MN, Murthy KNC.

BMC Complement Med Ther. 2023 Jun 2;23(1):181. doi: 10.1186/s12906-023-03993-y.

PMID: 37268940

Background: Although chronic wounds are devastating and can cause burden at multiple levels, chronic wound research is still far behind. Chronic wound treatment is often less efficient due to delay in diagnosis and treatment, non-specific treatment mainly due to lack of knowledge of wound healing or healing resistance genes. It's known that chronic wounds do not progress towards healing, because it gets stalled in inflammatory phase of wound healing. **Objective:** We aimed to use phytoextracts possessing excellent anti-inflammatory properties to regulate the unbalanced levels of cytokines responsible for increased inflammation. **Methods:** Evaluation of anti-inflammatory activity of selected phytoextracts namely, *Camellia sinensis* (L.) Kuntze, *Acacia catechu* (L.f) Willd., *Curcuma longa* (L.), *Allium sativum* (L.), *Punica granatum* (L.) and *Azadirachta indica* A. hereafter, called as catechin, epicatechin, curcumin, garlic, pomegranate and neem extracts, respectively in Acute wound fibroblasts (AWFs) and Chronic wound fibroblasts (CWFs) using flow cytometry. **Results:** The phytoextracts exhibited no cytotoxicity below 100 $\mu\text{g/ml}$ on normal Human Dermal fibroblasts (HDFs), while garlic extract showed highest cell viability followed by catechin, epicatechin, curcumin, pomegranate peel and neem based on IC_{50} value. Garlic, catechin and epicatechin extracts showed highest anti-inflammatory activities for both TGF- β and TNF- α in both AWFs and CWFs treated cells. After treatment of AWFs with catechin, epicatechin and garlic extracts, TGF- β and TNF- α expression was significantly reduced compared to untreated AWFs and reached to almost normal HDFs level. Also, after treatment of CWFs with catechin, epicatechin and garlic extracts, TGF- β and TNF- α expression was significantly reduced compared to untreated CWFs and was lesser than untreated AWFs. **Conclusion:** The present findings reveal the potential of catechin, epicatechin and garlic extracts for the treatment of acute and chronic wounds with excellent anti-inflammatory properties.

Use of medicinal plants as a remedy against lymphatic filariasis: Current status and future prospect.

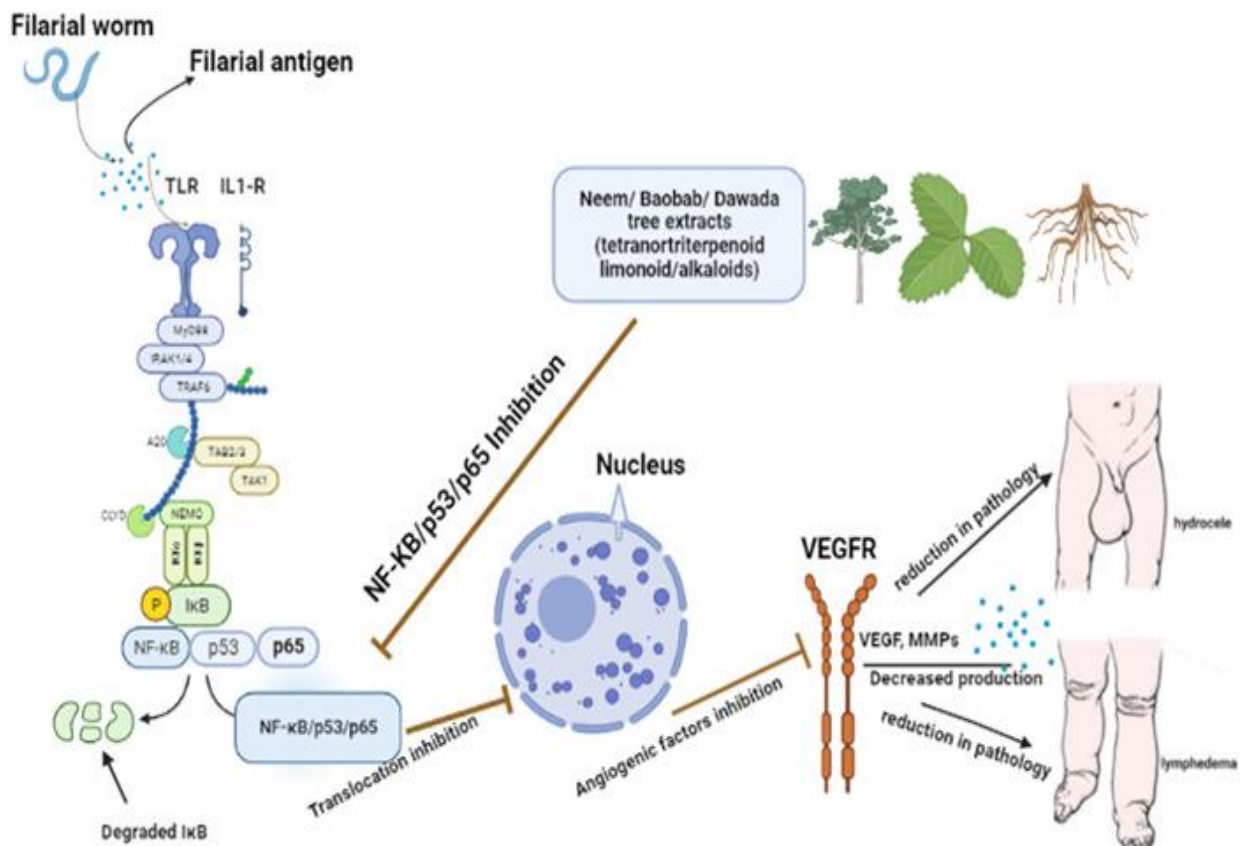
Fordjour FA, Osei-Poku P, Genfi AKA, Ainooson KG, Amponsah K, Arthur PK, Stephenson GR, Kwarteng A.

Health Sci Rep. 2023 May 27;6(5):e1295. doi: 10.1002/hsr2.1295. eCollection 2023

PMID: 37251521

Despite the successes achieved so far with the Global Programme to Eliminate Lymphatic Filariasis, there is still an appreciable number of lymphatic filarial patients who need alternative treatment and morbidity management strategies. The unresponsiveness of some cohorts to the drugs used in the mass drug administration program is currently raising a lot of questions and this needs urgent attention. Natural medicinal plants have a long-standing history of being effective against most disease conditions. Countries such as India have

been able to integrate their natural plant remedies into the treatment of lymphatic filarial conditions, and the results are overwhelmingly positive. Components of *Azadirachta indica*, *A. Juss*, *Parkia biglobosa*, *Adansonia digitata*, and *Ocimum* spp have been shown to have anti-inflammatory, anticancerous, and antimicrobial activities in animal models. Therefore, this review calls for attention toward the use of natural plant components as an alternate treatment against lymphatic filariasis to help reduce the World Health Organization's burden of providing drugs for people in need of treatment every year.



Comparative evaluation of antimicrobial efficacy of nanosilver solution, *Azadirachta indica*, sodium hypochlorite, and normal saline as root canal irrigants in primary teeth.

Tanvir Z, Jabin Z, Agarwal N, Anand A, Waikhom N. *J Indian Soc Pedod Prev Dent.* 2023 Jan-Mar;41(1):76-82. doi: 10.4103/jisppd.jisppd_74_23.PMID: 37282416

Background: Microorganisms are the main cause of pulpal and periapical diseases. Hence, the elimination of such potential microbes is achieved by endodontic treatment. Mechanical preparation is the main mechanism to reduce the bacterial load in canals which is enhanced by intracanal irrigants. Despite these procedures, some bacteria might persist within the canals. It is important to disinfect the pulp space and dentinal tubules thoroughly with an effective endodontic irrigant to prevent reinfection of a treated root canal. **Aim:** This study aimed to evaluate and compare the antimicrobial efficacy of nanosilver (NS) Solution, *Azadirachta indica*, sodium hypochlorite, and normal saline when used as irrigants in infected root canals of primary teeth. **Settings and design:** The study was a prospective randomized control trial which was conducted as per the consort statement. **Materials and**

methods: Eighty pulpally involved primary teeth requiring endodontic treatment of children aged 5-12 years were selected for this study. The subjects were randomly allocated to 4 groups (3 irrigant and control groups) consisting of 20 children each where Group I = NS solution, Group II = A. indica, Group III = Sodium hypochlorite (2.5%), and Group IV = Control group. Microbiological samples were collected at the baseline (before irrigation) and postirrigation after biomechanical preparation using the selected irrigant. The samples were subjected to an anaerobic bacterial culture test. Microbial colonies were identified and expressed as colony forming units per milliliter. **Statistical analysis:** Data were analyzed using one-way analysis of variance, Paired t-test, and Post hoc Bonferroni test. **Results:** NS solution showed the highest mean of $4.384 \times 10^3 \pm 1.019$ followed by Sodium hypochlorite with a mean of $3.500 \times 10^3 \pm 1.193$ and A. indica of $2.590 \times 10^3 \pm 0.778$. **Conclusion:** Based on the results of this study, NS solution can be used as an alternative to other root canal irrigating solutions in primary teeth.

Medicinal plants used for treatment of malaria by indigenous communities of Tororo District, Eastern Uganda.

Tabuti JRS, Obakiro SB, Nabatanzi A, Anywar G, Nambejja C, Mutyaba MR, Omara T, Waako P.

Trop Med Health. 2023 Jun 12;51(1):34. doi: 10.1186/s41182-023-00526-8.PMID: 37303066

Background: Malaria remains the leading cause of death in sub-Saharan Africa. Although recent developments such as malaria vaccine trials inspire optimism, the search for novel antimalarial drugs is urgently needed to control the mounting resistance of Plasmodium species to the available therapies. The present study was conducted to document ethnobotanical knowledge on the plants used to treat symptoms of malaria in Tororo district, a malaria-endemic region of Eastern Uganda. **Methods:** An ethnobotanical study was carried out between February 2020 and September 2020 in 12 randomly selected villages of Tororo district. In total, 151 respondents (21 herbalists and 130 non-herbalists) were selected using multistage random sampling method. Their awareness of malaria, treatment-seeking behaviour and herbal treatment practices were obtained using semi-structured questionnaires and focus group discussions. Data were analysed using descriptive statistics, paired comparison, preference ranking and informant consensus factor. **Results:** A total of 45 plant species belonging to 26 families and 44 genera were used in the preparation of herbal medicines for management of malaria and its symptoms. The most frequently mentioned plant species were Vernonia amygdalina, Chamaecrista nigricans, Aloe nobilis, Warburgia ugandensis, Abrus precatorius, Kedrostis foetidissima, Senna occidentalis, Azadirachta indica and Mangifera indica. Leaves (67.3%) were the most used plant part while maceration (56%) was the major method of herbal remedy preparation. Oral route was the predominant mode of administration with inconsistencies in the posology prescribed. **Conclusion:** This study showed that the identified medicinal plants in Tororo district, Uganda, are potential sources of new antimalarial drugs. This provides a basis for investigating the antimalarial efficacy, phytochemistry and toxicity of the unstudied species with high percentage use values to validate their use in the management of malaria.

Identifying druggable targets from active constituents of *Azadirachta indica* A. Juss. for non-small cell lung cancer using network pharmacology and validation through molecular docking.

Nath R, Baishya S, Nath D, Nahar L, Sarker SD, Choudhury MD, Talukdar AD. *Phytochem Anal.* 2023 Jun 19. doi: 10.1002/pca.3254. PMID: 37337376

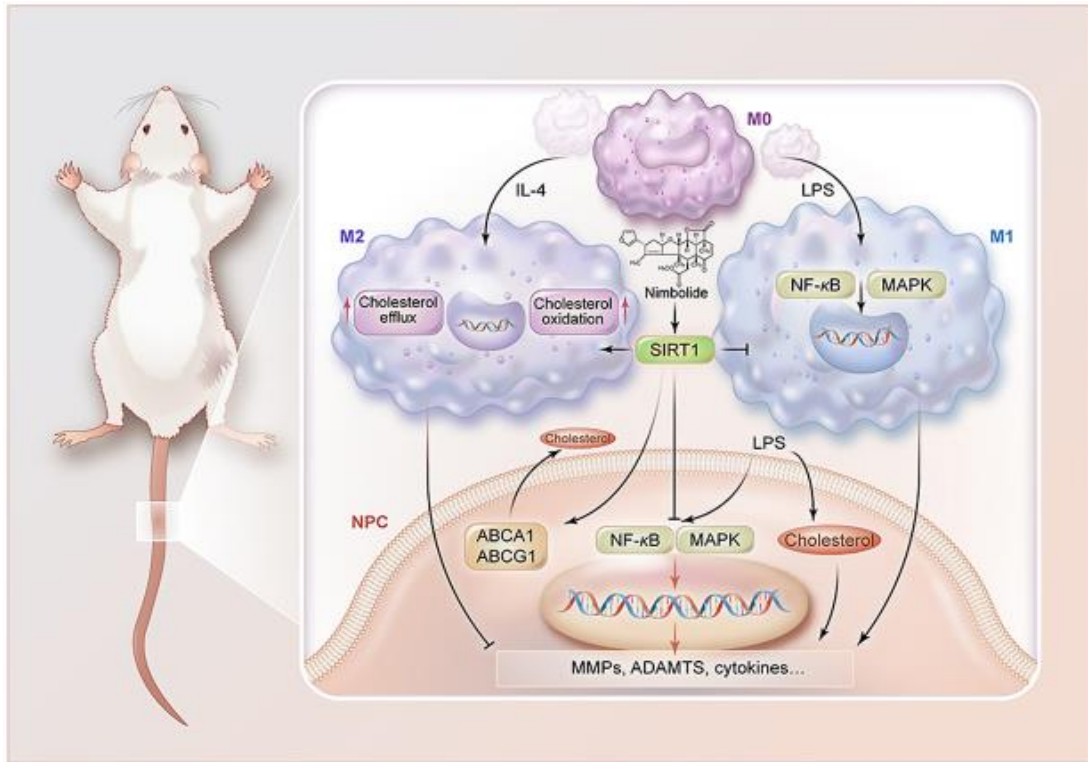
Introduction: *Azadirachta indica* A. Juss. is a well-known medicinal plant that has been used traditionally to cure various ailments in every corner of the globe. There are many in vitro and in vivo experimental evidences in connection with the bioactivity of the extracts of this plant. Lung cancer is the deadliest form of cancer and contributes to the most cancer related deaths. The mode of action of anticancer components of this plant is still to be established explicitly. **Objective:** The objective of this study is to identify druggable targets of active constituents of *A. indica* A. Juss. for non-small cell lung cancer (NSCLC) using network pharmacology and validation of activity through molecular docking analysis. **Methodology:** Targets of all the active phytochemicals from *A. indica* were predicted and genes related to NSCLC were retrieved. A protein-protein interaction (PPI) network of the overlapping genes were prepared. Various databases and servers were employed to analyse the disease pathway enrichment analysis of the clustered genes. Validation of the gene/protein activity was achieved by performing molecular docking, and ADMET profiling of selected phytochemicals was performed. **Result:** Gene networking revealed three key target genes as EGFR, BRAF and PIK3CA against NSCLC by the active components of *A. indica*. Molecular docking and ADMET analysis further validated that desacetylnimbin, nimbandiol, nimbin, nimbinene, nimbolide, salannin and vepinin are the best suited anti-NSCLC among all the phytochemicals present in this plant. **Conclusion:** The present study has provided a better understanding of the pharmacological effects of active components from *A. indica* and its potential therapeutic effect on NSCLC.

Nimbolide targeting SIRT1 mitigates intervertebral disc degeneration by reprogramming cholesterol metabolism and inhibiting inflammatory signaling.

Teng Y, Huang Y, Yu H, Wu C, Yan Q, Wang Y, Yang M, Xie H, Wu T, Yang H, Zou J. *Acta Pharm Sin B.* 2023 May;13(5):2269-2280. doi: 10.1016/j.apsb.2023.02.018. PMID: 37250166

Inflammation, abnormal cholesterol metabolism, and macrophage infiltration are involved in the destruction of the extracellular matrix of the nucleus pulposus (NP), culminating in intervertebral disc degeneration (IDD). Whether nimbolide (Nim), a natural extract, can alleviate IDD is unclear. In this study, we demonstrated that Nim promotes cholesterol efflux and inhibits the activation of the nuclear factor kappa B (NF- κ B) and mitogen-activated protein kinase (MAPK) signaling pathways by activating sirtuin 1 (SIRT1) in nucleus pulposus cells (NPCs) during inflammation. Thus, Nim balanced matrix anabolism and catabolism of NPCs. However, the inhibition of SIRT1 significantly attenuated the effects of Nim. We also found that Nim promoted the expression of SIRT1 in RAW 264.7, which enhanced the proportion of M2 macrophages by facilitating cholesterol homeostasis reprogramming and impeded M1-like macrophages polarization by blocking the activation of inflammatory signaling. Based on these results, Nim can improve the microenvironment and facilitate matrix metabolism equilibrium in NPCs. Furthermore, *in vivo* treatment with

Nim delayed IDD progression by boosting SIRT1 expression, modulating macrophage polarization and preserving the extracellular matrix. In conclusion, Nim may represent a novel therapeutic strategy for treating IDD.



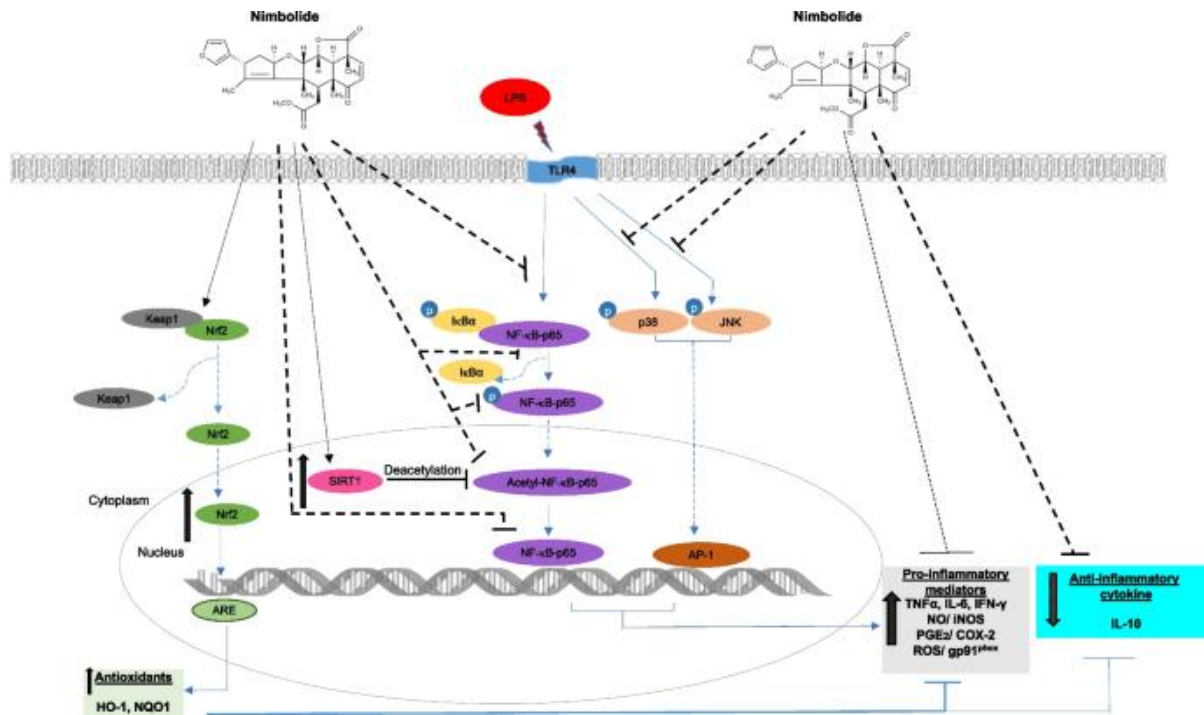
Nimbolide Targets Multiple Signalling Pathways to Reduce Neuroinflammation in BV-2 Microglia.

Katola FO, Olajide OA.

Mol Neurobiol. 2023 Jun 14. doi: 10.1007/s12035-023-03410-y. PMID: 37314658

Nimbolide, a limonoid compound found in the neem plant, was investigated for effects on neuroinflammation in BV-2 microglia activated with lipopolysaccharide (LPS). Cultured BV-2 cells were treated with nimbolide (125, 250 and 500 nM) followed by stimulation with LPS (100 ng/ml). Results showed that nimbolide caused a significant reduction in the levels of TNF α , IL-6, IFN γ , NO/iNOS and PGE $_2$ /COX-2 in LPS-activated BV-2 cells. Further experiments revealed that LPS-induced increased expression of phospho-p65 and phospho-IkB α proteins were reduced in the presence of nimbolide. Also, LPS-induced NF- κ B acetylation, increased binding to consensus sites and transactivation, as well as phosphorylation of p38 and JNK MAPKs were reduced by nimbolide. Reduction of cellular ROS generation by nimbolide was accompanied by a reduction in gp91phox protein levels, while antioxidant effects were also observed through elevation in protein levels of HO-1 and NQO-1. It was observed that treatment of BV-2 microglia with nimbolide resulted in reduced levels of cytoplasmic Nrf2, which was accompanied by increased levels in the nucleus. Furthermore, treatment with this compound resulted in increased binding of Nrf2 to

antioxidant responsive element (ARE) consensus sites accompanied by enhanced ARE luciferase activity. Knockdown experiments revealed a loss of anti-inflammatory activity by nimbolide in cells transfected with Nrf2 siRNA. Treatment with nimbolide resulted in nuclear accumulation of SIRT-1, while siRNA knockdown of SIRT-1 resulted in the reversal of anti-inflammatory activity of nimbolide. It is proposed that nimbolide reduces neuroinflammation in BV-2 microglia through mechanisms resulting in dual inhibition of NF- κ B and MAPK pathways. It is also proposed that activation of Nrf2 antioxidant mechanisms may be contributing to its anti-inflammatory activity.



Neem for Sustainable Environment

Potential plant leaves as sustainable green coagulant for turbidity removal.

Khalid Salem A, Fadhile Almansoori A, Al-Baldawi IA.
Heliyon. 2023 May 15;9(5):e16278. doi: 10.1016/j.heliyon.2023.e16278. PMID: 37251892

Chemical coagulation-flocculation has been used widely in water and wastewater treatment. In the present study, green coagulant was investigated. The role of Iraqi plants was examined to remove turbidity by using kaolin synthetic water. Thirteen selected plants were prepared as powdered coagulant. The experiment was run based on coagulant mass varied from 0 to 10,000 mg/L for each plant with a rapid mixing speed of 180 rpm for 5 min, slow mixing speed at 50 rpm for 15 min and settling time for 30 min. The seven best green coagulants are *Albizia lebbek* (L.), *Clerodendrum inerme* (10,000 mg/L), *Azadirachta indica*, *Conocarpus lancifolius*, *Phoenix dactylifera* (5000 mg/L), *Dianthus caryophyllus* (3000 mg/L) and *Nerium oleander* (1000 mg/L) with turbidity removal rates of 39.3%, 51.9%, 67.2%, 75.5%, 51.0%, 52.6% and 57.2%, respectively. The selected seven plants that were used as green coagulants are economically feasible to achieve the highest turbidity and removal of other compounds.

Immobilization effects of co-pyrolyzed neem seed mixed with poultry manure on potentially toxic elements in soil and the phytoremediation potentials of native *Manihot esculenta* and *Jatropha curcas* in ensuring sustainable land use.

Mensah MK, Drebenstedt C, Ola IM, Hoth N, Dampety FG, Wiafe ED.
Environ Monit Assess. 2023 Jun 1;195(6):793. doi: 10.1007/s10661-023-11430-3.
PMID: 37261537

This study evaluated the effects of neem seed biochar, poultry manure, and their combinations at varying rates of 15 and 25% (w/w) on potentially toxic elements (PTEs) in soils. Afterward, the suitability of *Manihot esculenta* and *Jatropha curcas* in removing Cd, As, Zn, Pb, and Hg from mine spoils were appraised in a 270-day outdoor pot experiment. Using ICP-Mass Spectrometry, the elemental contents of target PTE in the shoot, root, and soil specimens were determined for each treatment. The obtained average values were further subjected to a nonparametric test of samples using IBM SPSS Statistic 29. The applied organic amendments resulted in significant differences $p < 0.05$ in PTE availability for plant uptake after the Independent-Samples Kruskal-Wallis Test was made. Nonetheless, applying a 25% (w/w) mixture of neem seed biochar and poultry manure was efficient in immobilizing more PTEs in soils which caused lower PTEs presence in plants. Organic amendments further significantly enhanced the fertility of the mine soils leading to about a 6- 25.00% increase in the biomass yield ($p < 0.05$) of both plants. No significant difference ($p > 0.05$) was however observed between the phytoremediation potentials of both plants after the Independent-Sample Mann-Whitney U test. Even that, *Manihot esculenta* was averagely more efficient in PTE uptake than *Jatropha curcas*. Larger portions of the bioaccumulated PTEs were stored in the roots of both plants leading to high bioconcentration factors of 1.94- 2.47 mg/kg and 1.27- 4.70 mg/kg, respectively, for *Jatropha curcas* and *Manihot esculenta*. A transfer factor < 1 was achieved for all PTEs uptake by both plants and indicated their suitability for phytostabilization. Techniques for easy cultivation of root-storing PTEs are required to enhance their large-scale use as their biomass could further be used in clean energy production.

Ecofriendly fabrication of cobalt nanoparticles using *Azadirachta indica* (neem) for effective inhibition of *Candida*-like fungal infection in medicated nano-coated textile.

Singh D, Sharma P, Pant S, Dave V, Sharma R, Yadav R, Prakash A, Kuila A.
Environ Sci Pollut Res Int. 2023 Jun 7. doi: 10.1007/s11356-023-28061-3. PMID: 37286837

This study involves the formulation of cobalt nanoparticles by means of ethanolic *Azadirachta indica* (neem) extract (CoNP@N). Later, the formulated buildup was incorporated into cotton fabric in order to mitigate antifungal infection. Optimization of the formulation was carried out by considering the effect of plant concentration, temperature, and revolutions per minute (rpm) used, through design of the experiment (DOE), response surface methodology (RSM), and ANOVA of the synthetic procedure. Hence, graph was plotted with the aid of effecting parameters and the related factors (size of particle and zeta potential). Further characterization of nanoparticles was performed through scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Attenuated total reflection-Fourier transform infrared (ATR-FTIR) was considered for the detection of functional groups. The structural property of CoNP@N was calculated with the aid of powder

X-ray diffraction (PXRD). The surface property was measured with the use of a surface area analyzer (SAA). The values of Inhibition concentration (IC_{50}) and zone of inhibition (ZOI), were calculated, so as to determine the antifungal property against both the strains (*Candida albicans*, MTCC 227 and *Aspergillus niger*, MTCC 8652). The further nano-coated cloth was subjected to a durability test, and hence the cloth was washed (through the purpose of time 0; 10; 25; and 50 washing cycles), and then its anti-fungal operation to a couple of strains was retained. Primarily, 51 $\mu\text{g/ml}$ of cobalt nanoparticles incorporated on the cloth was retained but after 50 washing cycles in 500 ml of purified water, the cloth showed more efficiency contrary to *C. albicans* than towards *A. niger*.

Neem leaf powder (*Azadirachta indica*) mitigates oxidative stress and pathological alterations triggered by lead toxicity in Nile tilapia (*Oreochromis niloticus*).

Abu-Elala NM, Khat tab MS, AbuBakr HO, Helmy S, Hesham A, Younis NA, Dawood MAO, El Basuini MF.

Sci Rep. 2023 Jun 6;13(1):9170. doi: 10.1038/s41598-023-36121-4. PMID: 37280317

This study investigated the clinical and pathological symptoms of waterborne lead toxicity in wild Nile tilapia collected from a lead-contaminated area (the Mariotteya Canal: $\text{Pb} = 0.6 \pm 0.21 \text{ mg L}^{-1}$) and a farmed fish after 2 weeks of experimental exposure to lead acetate ($5\text{--}10 \text{ mg L}^{-1}$) in addition to evaluating the efficacy of neem leaf powder (NLP) treatment in mitigating symptoms of lead toxicity. A total of 150 fish ($20 \pm 2 \text{ g}$) were alienated into five groups (30 fish/group with three replicates). G1 was assigned as a negative control without any treatments. Groups (2-5) were exposed to lead acetate for 2 weeks at a concentration of 5 mg L^{-1} (G2 and G3) or 10 mg L^{-1} (G4 and G5). During the lead exposure period, all groups were reared under the same conditions, while G3 and G5 were treated with 1 g L^{-1} NLP. Lead toxicity induced DNA fragmentation and lipid peroxidation and decreased the level of glutathione and expression of heme synthesis enzyme delta aminolaevulinic acid dehydratase (ALA-D) in wild tilapia, G2, and G4. NLP could alleviate the oxidative stress stimulated by lead in G3 and showed an insignificant effect in G5. The pathological findings, including epithelial hyperplasia in the gills, edema in the gills and muscles, degeneration and necrosis in the liver and muscle, and leukocytic infiltration in all organs, were directly correlated with lead concentration. Thus, the aqueous application of NLP at 1 g L^{-1} reduced oxidative stress and lowered the pathological alterations induced by lead toxicity.

Comparative investigation of gas sensing performance of liquefied petroleum gas using green reduced graphene oxide-based sensors.

Olorunkosebi AA, Olumurewa KO, Fasakin O, Adedeji AV, Taleatu B, Olofinjana B, Eleruja MA.

RSC Adv. 2023 Jun 2;13(24):16630-16642. doi: 10.1039/d3ra01684f. PMID: 37274401

Herein, we report the comparative gas sensing performance (at room temperature) of reduced graphene oxide sensors obtained by reducing graphene oxide using extracts of pumpkin leaf, neem leaf and methionine. An interdigitated pattern was designed on soda-lime glass using a stamp method and the dispersed solution of rGO was spin coated on the pattern. The electrical response of the sensors was investigated (using a simple in-house measurement set up) by measuring change in resistance of graphene with varying gas concentration on exposure to liquefied petroleum gas (LPG). From the characterization

results using FTIR, SEM, EDX and UV-Visible, methionine reduced graphene oxide (MRGO 12H) indicated a greater degree of reduction compared to pumpkin reduced graphene oxide (PRGO 12H) and neem reduced graphene oxide (NRGO 12H). The LPG sensing results showed an increase in the resistance of the sensor materials upon the introduction of the gas and, an increased sensitivity as the concentration of the test gas increased from 100 ppm to 200 ppm while the MRGO 12H sensor was more selective towards LPG sensing. Furthermore, it was observed that the sensor response for the fabricated sensors is strongly dependent on the concentration of gas exposed to the sensors and the degree of removal of oxygen functional groups in the graphene-based materials. Hence, the MRGO 12H sensor had a sensor response of 23.58% at 200 ppm. PRGO 12H at 100 ppm illustrates the least sensor response while NRGO 12H showed very poor sensor response that ranged between 5.10% and 7.56%. The sensor response of the materials demonstrates an improvement in results obtained for pure rGO based sensors. We obtained a response time as low as 5.3 seconds for MRGO 12H while the recovery time of the sensors ranged between 6.46 seconds and 41.50 seconds. The MRGO 12H sensor typified the best recovery time and thus outperformed results from most of the reported literature. Considering different performance metrics such as sensor response, response time, recovery time and sensing period, MRGO 12H is more selective towards detecting LPG. Our results showed that a greater restoration of the sp^2 carbon chain brought about by increased reduction of graphene oxide is largely responsible for the sensing behavior of rGO towards LPG.

