



AZADIRACHTA INDICA A. JUSS (NEEM) ITS TAXONOMY, PHYTOCHEMISTRY, PHARMACOLOGICAL ACTIVITY RELATED FUTURE PROSPECTIVE: OVERARCHING OVERVIEW

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ABSTRACT

In traditional medicine, most diseases have been treated by plant or plant product administration. Neem (*Azadirachta indica* A. Juss) is India's most useful traditional medicinal plant. Each part of the neem tree has some medicinal properties. During the last five decades, apart from the chemistry of the neem compounds, considerable progress has been achieved regarding the biological activity and medicinal applications of neem. It is now considered as a valuable source of unique natural products for the development of medicines against various diseases and also for the development of industrial products. This review gives a bird's eye view mainly of the biological activities of the neem and some of the compounds isolated, T pharmacological actions of the neem extracts, clinical studies and plausible medicinal applications of neem along with their safety evaluation.

KEYWORDS: *Azadirachta indica* A. Juss (Neem), Taxonomy, Phytochemistry, Pharmacological Activity.

INTRODUCTION

Neem, or *Azadirachta indica*, is a plant that is native to India and has spread over most tropical and subtropical regions of the world. It is highly valued for its therapeutic properties. Alkaloids, flavonoids, triterpenoids, phenolic compounds, carotenoids, steroids, and ketones are among the chemical constituents that can be extracted from neem and are known to be biologically active.^[1]



Figure 1: *Azadirachta indica* A. Juss (Neem).

VERNACULAR NAME

- Bengali: Nim, Nimgachh.
- Gujarati: Danujhada, Limbado.
- Hindi: Nim, Nimb.
- Sanskrit: Arista, Nimba, Picumarda.
- English: Indian Lilac, Neem tree.

- Kannada: Bemu, Bivu, Kaybevu.
- Punjabi: Bakam, Drekh, Nim.^[2]

TAXONOMICAL CLASSIFICATION

Neem is classified according to the following taxonomy

- Kingdom: Plantae
- Order: Rules
- Suborder: Rutinae
- Family: Meliaceae
- Subfamily: Melioideae
- Tribe: Melieae
- Genus: *Azadirachta*
- Species: *Indica*.^[3]

BOTANICAL DESCRIPTIN

The tree is at least forty to fifty feet tall, with a broad, spherical crown formed by long, spreading branches and a straight trunk. Its bark is rough, dark brown, and features extensive longitudinal cracks that are divided by flat ridges. Each of the compounds, imparipinnate leaves has five to fifteen leaflets. The compound leaves themselves to switch between each other. The majority of its flowering panicles are found in the leaf axils. The ovoid, roughly- centimetre-long seel has fragrant, white oblanceolate petals. It yields ellipsoid, glabrous, golden drupes that are 12 – 20 mm long. The green fruits turn yellow as they ripen and have a garlic-like scent. March through April brings flowers and new foliage. Fruits

ripen from April to August, depending on the region.^[4]

PHYTOCHEMISTRY

The bitter principles of Neem oil originate from biologically active principles that have been extracted from multiple parts of the plant, which include azadirachtin, meliacin, gedunin, nimbidin, nimbolides, salanin, nimbin, and valassin. The oil's characteristic odour is also attributed to tignic acid, which is present in the seed. Neem kernels contain 30 – 50 % oil, which is mainly consumed by the pharmaceutical, soap, and pesticide industries.^[5]

PHARMACOLOGICAL ACTION

- Abortifacient, Analgesic.
- Anthelmintic, Antibacterial, Antiyeast,
- Antiulcer.
- Antifertility, Antifilarial, Antifungal.
- Antihyperglycemic, Anti-inflammatory, Antiviral.
- Antimalarial, Diuretic.
- Antinematodal, Antipyretic.
- Antispasmodic, Insecticidal.
- Antispermatogetic, Antitumor.
- Hypercholesteremic, Hypoglycaemic.
- Immunomodulator.^[6]

MEDICINAL USE

All parts of the tree have been used medicinally for centuries. It has been used in Ayurvedic medicine for more than 4000 years due to its medicinal properties. The earliest Sanskrit medical writings refer to the benefits of Neem's fruits, seeds, oil, leaves, roots and bark. Each has been used in Indian Ayurvedic and Unani medicine and is now being used in the pharmaceutical and cosmetics industries.^[7]

THERAPEUTIC USES

The mature female consumes the bark's hot water extract orally as a tonic and emmenagogue. For leprosy, anthraquinone-containing dried flowers, fruits, and leaves are consumed orally. The flower and leaf extract in hot water is applied topically to heal wounds and consumed orally as an anti-hysteric. For diabetes, the dried flower is used orally. Dried fruit extract dissolved in hot water is applied topically to ulcers and skin diseases, as well as piles. The whole plant is extracted in hot water and used as a purgative, pesticide, and anthelmintic. Oral bark extracts from *Andrographis puniculata*, *Azadirachta indica*, and *Tinospora cardifolia* are used to treat filariasis. Steam inhalation of bark is useful in inflammation of the throat. In addition, the hot water extract is used as a tonic, refrigerant, anthelmintic, and treatment for fever and diabetes. To cure common fever, powdered fruit leaves and roots are combined with dried ginger and given orally with lukewarm water as "Triphala." Because of their insecticidal qualities, leaves are preserved for a long time in wool and other materials. Leucorrhoea and gonorrhoea are treated with leaf juice. Leaves are used as a poultice to treat boils;

their infusion is used as an antiseptic wash to aid in ulcer and wound healing. Leaf paste is applied topically to wounds, ringworms, eczema, and ulcers. Neem leaf baths are helpful for skin conditions such as rashes. Leaf juice is applied topically to the nose to treat worm infections.^[8]

BIOACTIVE COMPOUNDS OF AZADIRACHTA INDICA L. (NEEM)

- The herb neem (*Azadirachta indica*) is well-known for having a variety of therapeutic uses. Azadirachtin is one of the main bioactive substances present in neem. Azadirachtin, a potent pesticide, gives the plant its capacity to ward off and eliminate a wide range of insect pests.
- The bioactive substances nimbin, nimbidin, and nimbidol are also present in neem. These substances possess antifungal, antibacterial, and anti-inflammatory properties. They have also been demonstrated to support immune system function and may have anti-cancer properties.
- Quercetin is another flavonoid component found in neem that has anti-inflammatory and antioxidant qualities. Neem also has a high concentration of important fatty acids, vitamins, and minerals, all of which support its general health benefits.^[9]

Azadirachta indica, commonly known as neem, contains several active compounds that give it its medicinal properties. Some of the key active compounds found in neem include.^[9]

1. Nimbin: A major active compound found in neem seeds, Nimbin has anti-inflammatory, anti-fungal, and anti-bacterial properties.
2. Azadirachtin: This is a potent insecticidal compound found in neem seeds and leaves. It is often used in organic pest control products.
3. Nimbidin: A compound found in neem seeds and leaves, nimbidin has anti-inflammatory and antimicrobial properties.
4. Nimbinin: Another active compound found in neem seeds and leaves, nimbinin also has anti-inflammatory and anti-bacterial properties.
5. Quercetin: A flavonoid with antioxidant properties found in neem leaves, quercetin helps to neutralize free radicals and reduce inflammation.
6. Beta-sitosterol: This plant sterol found in neem leaves has anti-inflammatory properties and helps to reduce cholesterol levels.

These are just a few of the active compounds found in *Azadirachta indica*. Neem has a wide range of medicinal benefits and has been used in traditional medicine for centuries to treat various health conditions.^[10]

IMPACT OF NEEM IN PHARMACOLOGICAL

Neem's pharmacological qualities have been the subject of much research, and these studies have demonstrated a

variety of potential advantages for the field of pharmacovigilance.

1. **Antimicrobial activity:** Neem possesses strong antibacterial qualities that can aid in the management and avoidance of several infections. This can be very helpful in pharmacovigilance to track and control antibiotic side effects and other antimicrobial medication side effects.^[11]
2. **Anti-inflammatory effects:** Neem has also been demonstrated to have anti-inflammatory qualities, which may help reduce the side effects of several drugs that are associated with inflammation.^[12]
3. **Hepatoprotective effects:** Research has indicated that neem possesses hepatoprotective qualities, which may aid in shielding the liver from harm brought on by specific drugs.^[13]
4. **Antioxidant activity:** Neem is a strong source of antioxidants, which might help in protecting cells from harm caused by free radicals. This can be used in pharmacovigilance to monitor and manage harmful effects of medications that may produce oxidative stress. Neem's overall contribution to pharmacovigilance stems from its ability to offer safe, natural substitutes for treating and averting drug side effects. To completely comprehend the modes of action and possible advantages of neem in pharmacovigilance, more investigation is required.^[14]

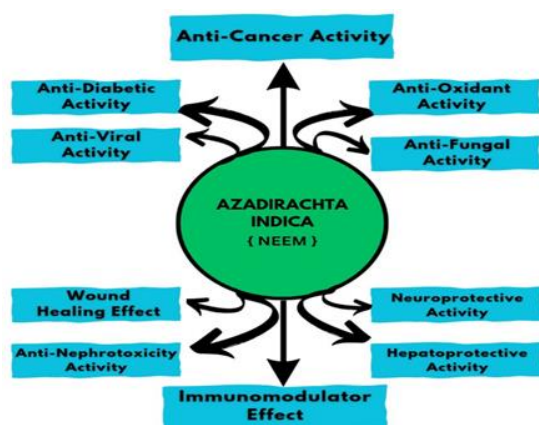


Figure 2: Impact of Neem in Pharmacological.

ADVANTAGES OF VARIOUS NEEM PARTS

Neem oil has several uses, including medicine, cosmetics, and Pest control.

- **Neem Seed Cake:** An organic pesticide and fertilizer.
- **Neem Leaves:** Effective against term it is, beneficial against chickenpox, boosts Immunity, lowers fever from malaria, treats a variety of foot fungi, and relieves neuromuscular ches.
- **Neem Barks And Roots:** Prevent fleas and ticks from biting pets; treat diabetes, AIDS, cancer, heart disease, herpes, allergies, ulcers, hepatitis, and a host

of other ailments; fight against skin infections like acne, psoriasis, scabies, eczema, etc.^[15]

PRODUCT CATEGORIES FOR HEALTH AND PERSONAL CARE

Neem seed, oil, and leaf are used to make a variety of personal care items. These include skin care items like eczema cream, antiseptic cream, and nail care; hair care items like shampoo and hair oils; oral hygiene items like toothpaste and neem twigs; therapeutic items like loose Neem leaves, tea, vegetarian capsules, and powders; and household items like soaps, candles, and insect repellent (lotion and spray).^[16-18]



Figure 3: Part of *Azadirachta indica* A. Juss (Neem).

PATENT ON NEEM

During the past five decades intensive investigations on the diverse properties of neem have been carried out. As a result large numbers of research publications and books have been published. Many conferences have been conducted at national and international level. Among the patented neem inventions are the following: A patent covering a process for making a mixture comprising neem oil to control pests in agriculture.

- A neem-based formulation patent for the treatment of acne and other skin disorders.
- A neem-based toothpaste patent for dental hygiene.
- A patent for a biopesticide based on neem that keeps insects out of grain that has been stored.

These patents show how neem can be used for a variety of purposes and how its qualities are still being researched and developed.^[19-22]

AFFORESTATION OF NEEM

Neem tree plantations on a big scale aid in the fight against desertification, deforestation, soil erosion, and excessive global warming. Because neem produces more oxygen than many other tree species and has a high rate of photosynthesis, it helps to purify the atmosphere.

Products made from neem cleanse water. One possible application for neem leaf powder is as a biosorbent to remove colors from water, such as congo red.

In the northern regions of India during the hot summer

months, it has been observed that the temperature beneath the neem tree is approximately 10 degrees Celsius lower than the ambient temperature.

Benefits of neem products in agroforestry included shade, firewood, timber, windbreaks, shelter belts, and a check on desertification in northern Nigeria's semi-arid zone.^[23]

PHEROMOPESTICIDES

Pheromones are chemical substances that an animal or animals create and exude that affect the growth and behavior of other animals in the same species. Additionally, it possesses the strong power to reject, obstruct mating, or prevent the growth of several or particular insect species. For this reason, pheromones possessing this capability are called pheromopesticides. Sex pheromones, when combined with traps, can assist in identifying the insect pests that are present in a crop and what additional steps or plant protection measures may be required to ensure the least amount of crop damage. Pheromone traps and the "attract and kill" method can help achieve some control if the attractant is particularly effective and the population level is very low.^[24,25]

On the whole, though, mating disruption works better. Similar to the natural pheromone, synthetic pheromone is released from multiple sources dispersed around the crop that has to be safeguarded. A range of semi chemicals are employed by the southern pine beetle to mediate mass attacks on host pine trees. Frontalin and transverbenol are two aggregation pheromones that help coordinate the mass attack of a host tree that is required for successful colonization. Two anti-aggregation pheromones, verbenone and endo-brevican, are released to direct beetles to other trees once the tree is overtaken, eliminating the need for additional beetles.^[26]

REPELLENT

Among the many qualities of neem plant extracts is their ability to repel pests. The repellent properties of Azatrol, Triple Action Neem Oil, and Pure Neem Oil depend entirely on the concentration employed, according to Shannag et al. (2014). He demonstrated how the three compounds may keep aphids from feeding on sweet pepper plants away at higher concentrations. Additionally, discovered that articulus had antifeedant and repellent qualities against *T. castaneum*.^[27]

SCIENTIFIC REPORTS

- **LARVICIDAL ACTIVITY:** Lab-raised larvae were exposed to 1, 2, 3, 4, and 5 ppm concentrations of the extracts of *Azadirachta indica* A Juss, *Gymnema Sylvestre*, *Nerium indicum* mill, and *Datura metel* L., respectively, in the zoology research laboratory of D. A-V Degree College, Kanpur, India, to test the larvicidal properties of the aqueous extracts of the four plants. The results indicated that *D. metel* caused 19–54% death to larvae, *G. sylvestre* 44–89%, *N. indicum* 41–74%,

and *Azadirachta indica* 70–99% mortality. It was discovered that *A. indica* and *G. sylvestre* extracts were highly effective at controlling *Culex* larvae.

- **ANTIBACTERIAL ACTIVITY:** Utilizing the cup plate agar diffusion method, the antimicrobial activity of petroleum ether, methanol, and aqueous extracts of the leaves of *Azadirachta indica* (Meliaceae), bulbs of *Allium cepa* (Liliaceae), and methanol extract of gel of *Aloe vera* (Liliaceae) was assessed. Six microorganisms were tested on them: four Gram-negative bacteria (*Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, and *Salmonella typhi*) and two Gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*).
- **ANTIDIABETIC EVALUATION:** In diabetic rats, the pharmacological hypoglycemic activity of *Azadirachta indica* has been studied. *Azadirachta indica* 250mg/kg (single dosage trial) decreased triglycerides (32%), glucose (18%), cholesterol (15%), urea (13%), creatinine (23%), and lipids (15%) after therapy for 24 hours. For fifteen days, multiple-dose research also decreased glucose, triglycerides, urea, lipids, and creatinine. Rats with diabetes treated with 250 mg/kg of neem extract showed considerably lower glucose levels in a glucose tolerance test than the control group. In diabetic rats, *azadirachta indica* dramatically lowers blood glucose levels by day fifteen.
- **ANTIOXIDANTS:** Young flowers and leaves can yield powerful antioxidant extracts. Malondialdehyde (MDA), a marker of oxidative stress, decreased by 46.0% and 50.6% for extracts derived from flowers and leaves, respectively. This led to the suggestion that neem be used as a bitter vegetable tonic to support overall health.
- **SKIN DISORDERS:** Neem is useful in healing a variety of skin conditions, such as lice and scabies. Whenever used as a paste along with *Curcuma longa* (turmeric), neem is beneficial for treating scabies in 814 cases; 97% of these cases showed improvement in 3 to 15 days, with no adverse effects.
- **ANTI- HIV/AIDS:** A 12-week oral acetone water neem leaf extract (IRAB) treatment significantly affected in vivo CD4 cells (which HIV decreases) in HIV/AIDS patients without causing any side effects. Fifty of the sixty patients who finished their treatment met all laboratory test requirements. The number of HIV/AIDS pathologies dropped from 120 at baseline to 5, and there were notable gains in body weight (12%), haemoglobin concentration (24%), and lymphocyte differential count (24%). The mean levels of CD4 cells increased by 159% in 50 patients, which is a considerable rise. As a component of a program for HIV/AIDS medication treatment, IRAB is advised.^[28]

- **ANTI ULCER:** Gastritis, duodenal and oesophageal ulcers, and human stomach acid hypersecretion were all reduced by neem bark extract. The duodenal ulcers healed nearly after ten weeks; one case of oesophageal and intestinal ulcers healed completely after six weeks.
- **ANTI-MALARIAL ACTIVITY:** The antimalarial characteristics of the bark and leaf tablet suspension of *Azadirachta indica* were assessed in mice harbouring *Plasmodium yoelli nigeriensis* infection. The tablet suspensions showed very little curative schizonticidal action and a significant prophylactic, moderate suppressive impact. The average percentage (%) of parasitaemia achieved in chemosuppression by the tablet suspensions containing 800 mg/kg of leaf and bark and 62.5 mg/kg of chloroquine per kg of body weight were 79.6%, 68.2%, and 99.5%, respectively. Additionally, in the preventative treatment, the leaf, bark, and pyrimethamine tablet solutions at 800 mg/kg and 0.35 mg/kg, respectively, resulted in an average reduction in parasitaemia of 75.3%, 65.6%, and 98.3%. There was ample evidence of a somewhat positive impact.
- **ANTI-TUMOUR EFFECT:** A study on *Azadirachta indica* has revealed a chemopreventive capability by regressing the hepatocarcinogenesis induced by diethyl Nitrosamine (DEN)/2 Acetylaminofluorene (AAF) carcinogens on Sprague- Dawley rats.
- **ANTI-FERTILITY EFFECT:** In rodents and primates, neem and seed extracts given orally at the start of the post-implantation stage caused pregnancy termination with no long-term consequences. The exact method of action is unknown.^[23] Praneem is a polyherbal vaginal tablet licensed to Panacea Biotech, India, that is successful in immobilizing sperm.
- **ANTI-DENTAL CARIES:** Dental gel made from neem extract considerably decreased bacteria and plaque (as measured by *Streptococcus mutans* and *Lactobacilli* species) compared to the control group, which used mouthwash that was readily accessible in stores and contained the germicide chlorhexidine gluconate (0.2% w/v).^[26] According to preliminary research, neem reversed incipient carious lesions, or primary dental caries, and inhibited *Streptococcus mutans*, the bacteria that causes tooth decay.
- **ANTI-HYPERTENSIVE AND ANTI-HYPERCHOLESTEREMIC EFFECT:** In rats, the administration of neem aqueous extract and DOCA salt inhibited the development of hypertension.^[28] Rats' serum cholesterol was markedly reduced after the mature leaf extract was administered, but their levels of protein, urea, and

uric acid remained unchanged.^[29,30]

ETHICAL STATEMENT

It is the responsibility of a pharmacist to act honourably and truthfully. A pharmacist abstains from acts that undermine their commitment to serving their patients' best interests, including discriminatory practices, conduct, and working conditions that impair professional judgment. A pharmacist upholds their level of expertise.

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CONFLICT OF INTEREST

The authors attest that they are free of any known financial or personal conflicts of interest that would taint the findings of this study.

INFORMED CONSENT

Using websites, review articles, and other sources to produce research content.

CONCLUSION

The information gathered above about *Azadirachta Indica*'s global use is compared to the body of literature that is currently available. The traditional and ethnobotanical applications of natural substances, particularly those derived from plants, have garnered a lot of attention in recent years because of their well-established efficacy and widespread belief that they are safe for human usage. It is the most effective traditional method for finding novel compounds to treat a range of illnesses. A thorough review of the literature on *Azadirachta indica* revealed that it is widely used as a therapy for illnesses by traditional healers, Unani, Ayurvedic, and other ethnic groups. Because this herb has many unknown therapeutic qualities, researchers are looking at its potential for treatment.

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