iJRASET
International Journal For Research in Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 13 **Issue:** XII **Month of publication:** December 2025

**DOI:** https://doi.org/10.22214/ijraset.2025.76030

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 13 Issue XII Dec 2025- Available at www.ijraset.com*

# Review - Phytomedicine (Neem)

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***Abstract:*** ***Neem (Azadirachta indica A. Juss) is a renowned tree in Asian and African countries, known for its extensive medicinal and industrial applications due to a rich array of bioactive compounds, particularly nutraceuticals and triterpenoids like azadirachtin, nimbin, and salannin. This review compiles recent research on the extraction, characterisation, and encapsulation of neem oil and its extracts into advanced delivery systems such as hydrogels, liposomes, and nanocapsules, alongside their biological evaluations and toxicity profiles. Various extraction methods, including hot (Soxhlet) and cold (maceration) solvent extraction, and hydro-distillation, have been employed to optimise yield, with methanol showing optimal results for oil extraction in some studies (7.68 ± 0.11% by weight). Characterisation techniques like FTIR, H-NMR, and LCMS have confirmed the presence of diverse functional groups and specific compounds. To overcome challenges such as photosensitivity and rapid degradation, and to enhance targeted delivery and efficacy, neem extracts have been successfully incorporated into hydrogels, liposomes, and polymeric nanocapsules. Liposomal formulations prepared with soya lecithin and cholesterol (4:1 ratio) showed 69.52 ± 1.9% entrapment efficiency and sustained drug diffusion (62.178% ± 0.91 over 24 hours), proving stable for three months at 2–8°C. This comprehensive review underscores neem's potential as a source of valuable bioactive compounds and the critical role of nanotechnology in developing efficient and safer delivery systems for its application in food, pharmaceuticals, agriculture, and cosmetics***

***Keywords: Phytomedicine, Neem, Mechanism of action of Neem, Application of Neem***

## I. INTRODUCTION

Phytomedicine can be defined as the herbal medicine with therapeutic and healing properties. It came into existence since the advent of human civilization. Sheng Nongs Herbal Book is known as one of the preliminary sources of traditional folk knowledge based on the use of herbs in China and dates back to around 3000 BC. It encompasses the details of almost 365 plants, animals, and minerals that find a place in medication. Our Earth houses approximately 420,000 species of plants; however, there is a lack of appropriate knowledge about them and their varied uses. There are three major areas, namely, food (foodstuffs), medicine (folk and traditional medicines), and research (phytochemical analysis), that predominantly find an immense use of herbal preparations and products and hence can be explored further. Gaining experience from random trials and careful observations from animal studies, people belonging to ancient periods started employing herbs as a therapeutic method against several illnesses. Based on this, the ever so popular Chinese herbal medicine (CHM) as well as Indian herbal medicine, native to and prominently developed in ancient China, Japan, Korea, and India, continue to rule and influence the modern health-care even today. As per the estimate of World Health Organization (WHO), herbal medicines are one of the most sought after primary health-care for around 3.5–4 billion people across the world, and a major portion of traditional medicine involves the plant extract–derived medicines and decoction which may also be termed as the “modern herbal medicine”A herbal medicine or a phytopharmaceutical preparation can be defined as a medicine derived exclusively from a whole plant or parts of plants and manufactured in a crude form or as a purified pharmaceutical formulation. Although with the setting in of the industrial revolution and the advancements in organic chemistry, there was an equivalent increase in the preference for synthetic products as well. However, the WHO emphasizes that between nearly 70% and 95% of the population residing in numerous developing countries still rely more on traditional herbal medicines for their primary medication against diseases (Mohamed et al., 2012). Over the last decade, there has been an enormous rise in the products derived from medicinal plants in terms of interest and use.Our planet is being ruled by plants for over 400 million years now that have successfully survived the test of time even after being challenged time and again by herbivores and microbes. Their defense mechanism is attributed to a range of structurally different secondary metabolites that evolved with time at various stages of development and provide protection against attacks by herbivores, bacteria, fungi, and viruses. Some of these metabolites act as signal compounds that can potentially attract animals that pollinate and disperse the seeds. They additionally act as antioxidants and UV protectants. As far as evolutionary pharmacology is concerned, the secondary metabolites of plant comprise an important collection of bioactive compounds selected and propagated naturally to be used as a remedy against various human infections and health disorders

 

## II. NEEM

Azadirachta indica L. (neem) shows therapeutics role in health management due to rich source of various types of ingredients. The most important active constituent is azadirachtin and the others are nimbolinin, nimbin, nimbidin, nimbidol, sodium nimbinate, gedunin, salannin, and quercetin. Leaves contain ingredients such as nimbin, nimbanene, 6-desacetylnimbinene, nimbandiol, nimbolide, ascorbic acid, n-hexacosanol and amino acid, 7-desacetyl-7-benzoylazadiradione, 7-desacetyl-7-benzoylgedunin, 17-hydroxyazadiradione, and nimbiol [15–17]. Quercetin and ß-sitosterol, polyphenolic flavonoids, were purified from neem fresh leaves and were known to have antibacterial and antifungal properties [6] and seeds hold valuable constituents including gedunin and azadirachtin.Azadirachta indica, commonly known as neem, margosa, nimtree or Indian lilac,[3] is a tree in the mahogany family Meliaceae. It is one of the two species in the genus Azadirachta. It is native to the Indian subcontinent and to parts of Southeast Asia, but is naturalized and grown around the world in tropical and subtropical areas. Its fruits and seeds are the source of neem oil. *Nim* is a Hindustani noun derived from Sanskrit *nimba* (निंब).

| | |
|---|---|
| Kingdom: | Plantae |
| *Clade*: | Tracheophytes |
| *Clade*: | Angiosperms |
| *Clade*: | Eudicots |
| *Clade*: | Rosids |
| Order: | Sapindales |
| Family: | Meliaceae |
| Genus: | *Azadirachta* |
| Species: | ***A. indica*** |
| **Binomial name** | |
| ***Azadirachta indica*** | |

The neem tree is a fast-growing tree that can reach a height of 15–20 metres (49–66 ft), and rarely 35–40 m (115–131 ft). It is evergreen, shedding many of its leaves during the dry winter months. The branches are wide and spreading. The fairly dense crown is roundish and may reach a diameter of 20–25 m (66–82 ft). The opposite, pinnate leaves are 20–40 cm (8–16 in) long, with 20 to 30 medium to dark green leaflets about 3–8 cm (1+¼–3+¼ in) long.[7] The terminal leaflet often is missing. The petioles are short.

The fruit is a smooth (glabrous), olive-like drupe which varies in shape from elongate oval to nearly roundish, and when ripe is 14–28 mm (½–1+⅛ in) by 10–15 mm (⅜–⅝ in). The fruit skin (exocarp) is thin and the bitter-sweet pulp (mesocarp) is yellowish-white and very fibrous. The mesocarp is 3–5 mm (⅛–¼ in) thick. The white, hard inner shell (endocarp) of the fruit encloses one, rarely two, or three, elongated seeds (kernels) having a brown seed coat.

Phytochemicals

Neem fruit, seeds, leaves, stems, and bark contain diverse phytochemicals, some of which were first discovered in azadirachta seed extracts, such as azadirachtin established in the 1960s as an insect antifeedant, growth disruptor, and insecticide.[19][20] The yield of azadirachtin from crushing 2 kg of seeds is about 5 g.[19]

In addition to azadirachtin and related limonoids, the seed oil contains glycerides, diverse polyphenols, nimbolide, triterpenes, and beta-sitosterol.[19][21] The yellow, bitter oil has a garlic-like odor and contains about 2% of limonoid compounds.[19] The leaves contain quercetin, catechins, carotenes, and vitamin C

Neem is a tree in the mahogany family Meliaceae. It is native to India, Myanmar, Bangladesh, Sri Lanka, Malaysia and Pakistan. It grows in tropical and semi-tropical regions. It was also the state tree of Hyderabad Deccan.

Neem is a fast-growing tree in India that can reach up to 15–20 m (about 50–65 feet) tall, and sometimes even to 35–40 m (115–131 feet). It is evergreen. It is found in some major parts of Tamil nadu like tuticorin,tirunelveli ,etc.

Uses

Products made from neem have been used in India for over two millennia for their medicinal properties. They are said to be antifungal, antidiabetic, antibacterial, antiviral, contraceptive and sedative. Neem products are also used in selectively controlling pests in plants. Neem is considered a part of Ayurvedic medicine.[1][2][3]

Neem is also known as the' village pharmacy'. All parts of neem are used for preparing many different medicines, especially for skin disease.[4]

- A compound from the Neem tree can be used as a spermicide .
- Neem oil is used for preparing cosmetics (soap and shampoo, ozone as well as lotions and others), and is useful for skin care such as acne treatment. Neem oil has been used effectively as a mosquito repellent.
- Neem is useful for damaging over 500 types of insects, mites, ticks, and nematodes, by changing the way they grow and act. Neem does not normally kill pests right away, rather it slows their growth and drives them away. As neem products are cheap and not poisonous to animals and friendly insects, they are good for pest control
- In the UK, plant protection products that contain azadirachtin, the active ingredient of neem oil, are illegal.[5]

The plant is well recognized for its medicinal as well as health benefits that it provides to mankind. The presence of certain compounds makes this plant a must-add to your daily routine. It is specifically used for treating outer skin infections like fungi and bacteria. The two medicinal compounds that make Neem essential to be used for treating or preventing fungal infection are nimbidol and gedunin. It possesses the capability to fight and inhibit the growth of fungus spores.[6]

## III. CONCLUSION

Neem is an extraordinarily versatile and ecologically beneficial plant, serving as a natural resource with widespread applications in agriculture, medicine, and the environment. Its rich composition of bioactive compounds, such as azadirachtin, provides antimicrobial, anti-inflammatory, anti-diabetic, and anti-carcinogenic properties. This makes neem invaluable as a sustainable and environmentally friendly alternative to synthetic pesticides and medicines. Continued research into neem's complex chemical interactions and mechanisms will likely unlock even more applications and insights for future human welfare and global ecological health.

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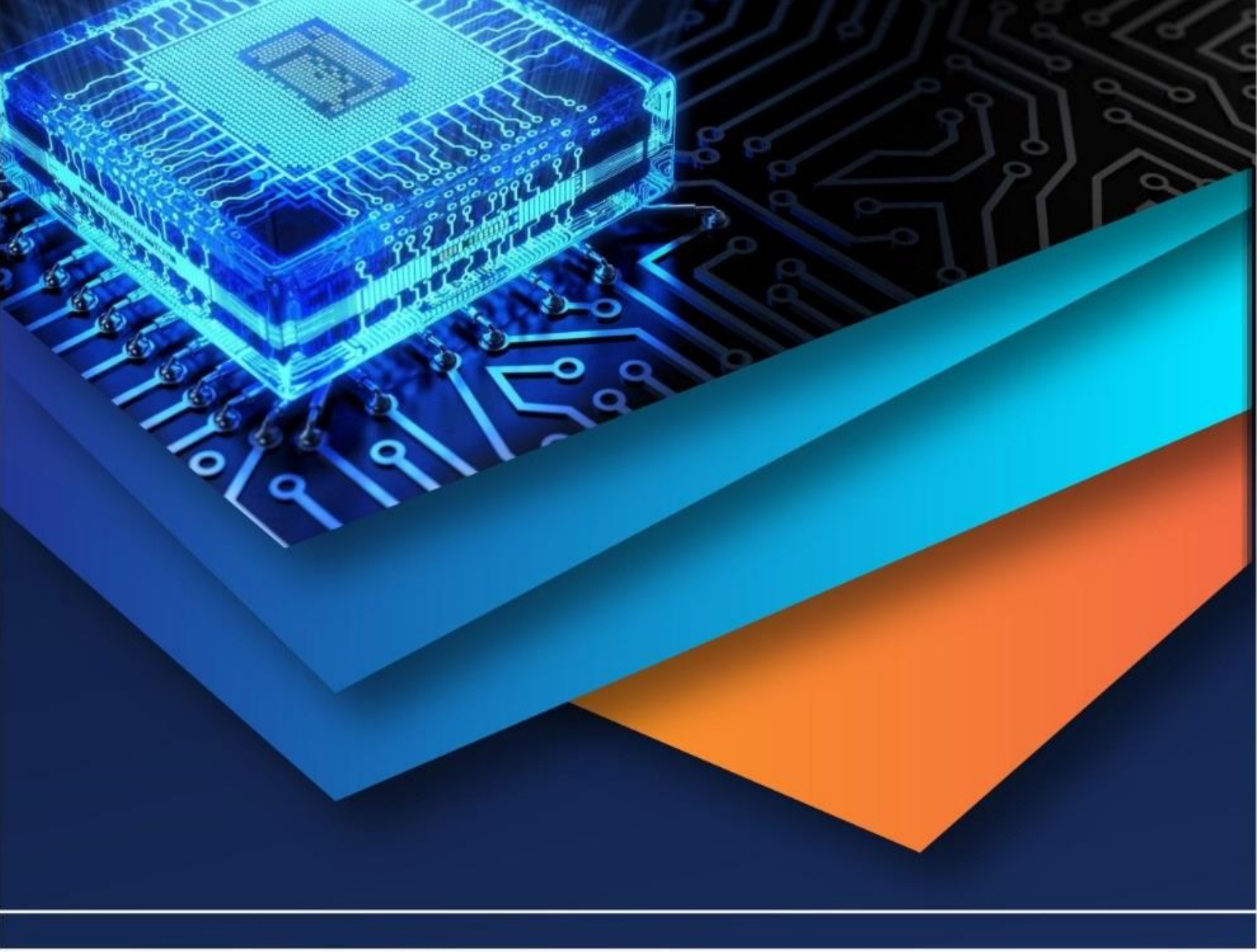

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