



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

Neem (*Azadirachta indica*): A Review of ITS Phytochemical Constituents, Pharmacological Activities, and Therapeutic Applications

Usman^{1*}, Pramod Kumar Mishra², Sujeet Pratap Singh³, Dr. Tarkeshwar Prasad Shukla⁴

¹ Student Of Bachelor Of Pharmacy, SCPM College Of Pharmacy, Gonda 271003, Uttar Pradesh, India.

^{2,3} Assistant Professor, Department Of Pharmaceutics, SCPM College Of Pharmacy, Gonda 271003, Uttar Pradesh, India.

⁴ Principal and Professor, Department Of Pharmaceutics, SCPM College Of Pharmacy, Gonda 271003, Uttar Pradesh, India.

ARTICLE INFO

Published: 28 Oct 2026

Keywords:

Neem, Azadirachta indica, azadirachtin, limonoids, nimbin, medicinal plant, pharmacological activity

DOI:

10.5281/zenodo.23726985

ABSTRACT

Neem (*Azadirachta indica* A. Juss.) is an evergreen tree of the family Meliaceae which grows widely in India and other tropical countries. It has been used in Ayurveda, Unani and Siddha for thousands of years, and people in villages still call it the "village pharmacy". Many parts of the tree, such as leaves, bark, seeds, flowers and oil, are used as medicine. Neem contains a large number of chemical compounds, mainly limonoids (azadirachtin, nimbin, salannin), flavonoids, polyphenols and fatty acids. Because of these compounds, neem shows many pharmacological activities, for example antibacterial, antifungal, antiviral, anti-inflammatory, antidiabetic, antimalarial, anticancer and wound healing effects. This article gives a simple review of the botanical features, chemical constituents, pharmacological activities, therapeutic uses and safety of neem, based on the available literature.

INTRODUCTION

Plants have been the first source of medicines for human beings. Even today, a large part of the world population depends on traditional medicine for primary health care, and many modern drugs such as morphine, quinine and digoxin were first obtained from plants.

Medicinal plants are cheap, easily available and are usually thought to have fewer side effects, so research on them is increasing every year.

Neem is one of the most famous medicinal plants of India. The name *Azadirachta indica* is believed to come from the Persian words "azad", "dirakht" and "i-Hind", which together mean "free tree of India". In

***Corresponding Author:** Usman

Address: Student Of Bachelor Of Pharmacy, SCPM College Of Pharmacy, Gonda 271003, Uttar Pradesh, India.

Email ✉: kusmankhan890@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



Sanskrit it is called *Nimba* and it is also known as *Arishtha*, meaning "reliever of sickness". Neem is mentioned in old Ayurvedic texts such as Charaka Samhita and Sushruta Samhita for treating skin diseases, fever, worms and wounds. In Hindi it is called *Neem* and in English it is sometimes called Indian lilac or margosa tree.

The aim of this review is to collect and present the basic information about neem in an easy way, so that a beginner pharmacy student can understand its chemistry, actions and uses.

2. Botanical Description

Table 1: Scientific Classification of Neem

Category	Details
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Sapindales
Family	Meliaceae
Genus	<i>Azadirachta</i>
Species	<i>A. indica</i> A. Juss.

Neem is a fast-growing tree which can reach a height of about 15 to 20 metres. The trunk is straight and short, and the bark is rough, dark grey and has deep cracks. The leaves are compound and pinnate, and each leaf has many small leaflets with serrated (saw-like) edges. The leaflets taste very bitter. The flowers are small, white and have a honey-like smell, and they come in clusters. The fruit is a smooth, olive-like drupe which turns from green to yellow when ripe, and each fruit usually has one seed (kernel). The seeds are rich in oil, which is known as neem oil or margosa oil.

Neem grows well in hot and dry climates and can tolerate poor soil and low rainfall. It is found in India, Pakistan, Bangladesh, Sri Lanka, Nepal and also in parts of Africa, Australia and America where it has been introduced.

3. Phytochemical Constituents

Neem is a rich source of biologically active compounds. More than 300 compounds have been isolated from different parts of the tree. They are broadly grouped into isoprenoids (terpenoids, mainly limonoids) and non-isoprenoids (such as proteins,

sulphur compounds, polyphenols, flavonoids and carbohydrates).

3.1 Limonoids (triterpenoids)

Limonoids are the most important and most studied compounds of neem. They give the bitter taste to the plant. The main ones are:

- **Azadirachtin:** the best-known compound, mostly present in the seed kernel. It is famous for its insect antifeedant and growth-regulating action.
- **Nimbin and nimbidin:** found in seeds and oil; they have anti-inflammatory, antipyretic and antifungal activity.
- **Salannin:** has insect repellent properties.
- **Gedunin:** shows antimalarial and antifungal activity.
- **Nimbolide:** present in leaves and flowers; reported to have antibacterial and anticancer effects.

3.2 Flavonoids and polyphenols

The leaves contain flavonoids such as quercetin, kaempferol and rutin, along with polyphenolic compounds. These substances work as antioxidants and help in protecting cells from damage caused by free radicals. Quercetin, in particular, is also linked to anti-inflammatory action.

3.3 Other constituents

Neem seed oil contains fatty acids like oleic acid, stearic acid, palmitic acid and linoleic acid. The bark contains tannins and a small amount of polysaccharides. Neem gum contains sugars and amino acids, and the leaves also contain carbohydrates, proteins and some sulphur-containing compounds which give neem oil its typical garlic-like smell.



Table 2: Major Constituents and the Plant Part in Which They Are Found

Constituent	Chemical group	Main plant part	Reported activity
Azadirachtin	Limonoid	Seed	Insecticidal, antifeedant
Nimbin	Limonoid	Seed, oil, leaves	Anti-inflammatory, antipyretic
Nimbidin	Limonoid mixture	Seed oil	Anti-ulcer, anti-inflammatory
Nimbolide	Limonoid	Leaves, flowers	Antibacterial, anticancer
Gedunin	Limonoid	Seed, bark	Antimalarial, antifungal
Quercetin	Flavonoid	Leaves, flowers	Antioxidant
Fatty acids	Lipids	Seed oil	Skin conditioning, antimicrobial

4. Pharmacological Activities

4.1 Antibacterial activity

Extracts of neem leaves, bark and oil have shown activity against many bacteria in laboratory studies, including *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus mutans* and *Pseudomonas aeruginosa*. The antibacterial effect is thought to be due to compounds such as nimbidin and nimbolide, which may damage the bacterial cell wall. Because of this, neem twigs (datun) have been used for cleaning teeth in India for many years, and neem is now added to some toothpastes and mouthwashes.

4.2 Antifungal activity

Neem oil and leaf extracts have been found to stop the growth of fungi like *Candida albicans* and dermatophytes (for example *Trichophyton* species), which cause skin infections such as ringworm and athlete's foot. This is one reason why neem is commonly used in creams and soaps for skin problems.

4.3 Antiviral activity

Some studies report that neem extracts can reduce the growth of viruses such as herpes simplex virus and dengue virus in cell cultures. However, most of these results are from laboratory experiments, so more clinical studies are needed before neem can be recommended as an antiviral drug.

4.4 Anti-inflammatory and analgesic activity

Nimbidin, nimbin and flavonoids of neem have been shown to reduce inflammation in animal models such as carrageenan-induced paw oedema in rats. The effect is thought to be related to reduced release of inflammatory mediators like prostaglandins. Neem has also

shown pain-relieving and fever-reducing (antipyretic) effects in experimental animals.

4.5 Antidiabetic activity

Leaf extract of neem has been reported to lower blood glucose in diabetic animals. Possible mechanisms are increased insulin secretion, better glucose uptake by tissues and reduced absorption of glucose from the intestine. Neem is used along with regular treatment in traditional medicine for diabetes, but it should never replace prescribed anti-diabetic drugs.

4.6 Antimalarial and antiparasitic activity

Gedunin and nimbolide are reported to act against *Plasmodium falciparum*, the parasite that causes malaria. Neem is also traditionally used against intestinal worms and head lice, and neem oil is used as a mosquito repellent which helps in preventing malaria and dengue.

4.7 Anticancer activity

Laboratory studies suggest that nimbolide and other limonoids can stop the growth of cancer cells and may induce apoptosis (programmed cell death) in breast, colon and prostate cancer cell lines. Neem also has antioxidant action, which may help in protecting cells from DNA damage. At present this research is at an early stage and there is no proof that neem can cure cancer in humans.

4.8 Antioxidant and hepatoprotective activity

The polyphenols and flavonoids in neem scavenge free radicals. In animal studies neem leaf extract protected the liver from damage caused by chemicals such as paracetamol and carbon tetrachloride, mainly by reducing oxidative stress.



4.9 Wound healing and skin effects

Neem oil and leaf paste are applied on wounds, boils, acne and eczema in traditional practice. Studies suggest that neem can help wound healing by its antimicrobial action and by improving collagen formation.

4.10 Anti-ulcer and gastroprotective activity

Neem bark and nimbidin have reduced the formation of stomach ulcers in experimental animals. The effect may be due to decreased gastric acid secretion and protection of the stomach lining.

4.11 Contraceptive and insecticidal activity

Neem oil has been used as a vaginal spermicide in some experiments, but this use is not approved as a regular medicine. Azadirachtin is widely used as a natural insecticide in agriculture because it stops insects from feeding and disturbs their growth, while being relatively safe for mammals and the environment.

5. Therapeutic Applications

Table 3: Traditional and Modern Uses of Different Parts of Neem

Plant part	Common uses
Leaves	Skin diseases, wounds, fever, worms, diabetes support, eye disorders
Bark	Fever, ulcers, dental problems (as datun), skin diseases
Seed and oil	Skin infections, lice, fungal infections, mosquito repellent, soaps and creams
Flowers	Digestive problems, loss of appetite, tonic
Fruit	Piles, urinary problems, worms
Gum	Tonic, skin conditions, used as a binding agent

In modern products, neem is present in toothpastes, mouthwashes, shampoos, face washes, soaps, hand sanitisers, herbal creams, mosquito repellents and bio-pesticides. In pharmaceutical technology, neem gum has been studied as a natural binder and release-controlling agent in tablets, which is interesting for formulation students. Neem is also used in veterinary medicine and in organic farming.

6. Safety and Toxicity

Neem is generally safe when used in normal amounts for a short time, but some precautions should be known:

- Neem oil taken by mouth can be toxic, especially in infants and small children, and has caused vomiting, seizures and liver and brain damage in some case reports.
- Large doses or long use may harm the kidney and liver.
- Pregnant women should avoid neem because of its possible effect on the uterus and fertility. Men and women who plan a child should also avoid it.
- Neem can lower blood sugar, so people on anti-diabetic drugs must be careful because of the risk of hypoglycaemia.
- Some people may get allergic skin reactions on applying neem oil, so a patch test is advised.

Because herbal products are not always standardised, the quantity of active compounds can differ from one product to another. This is why quality control methods such as chromatography are important for neem products.

DISCUSSION

The literature shows that neem has a very wide range of activities, which is mainly because it contains many different compounds that work together. But most of the pharmacological studies are done in cell lines or animals, and the number of well-designed human clinical trials is small. Also, different studies use different extracts, solvents and doses, so the results are difficult to compare. For this reason, standardisation of extracts, isolation of pure active compounds and proper toxicity studies are necessary before neem can be accepted as a modern drug.

CONCLUSION

Neem (*Azadirachta indica*) is a valuable medicinal plant with a long history of use in India. Its limonoids, flavonoids and other compounds give it antibacterial, antifungal, anti-inflammatory, antidiabetic, antimalarial, antioxidant, wound healing and possible anticancer effects. Although the results are promising, more clinical research and safety evaluation is needed. As a



student of pharmacy, I understand that studying such plants is useful, because they can become a source of new, safe and affordable drugs in the future.

REFERENCES

1. Biswas K, Chattopadhyay I, Banerjee RK, Bandyopadhyay U. Biological activities and medicinal properties of neem (*Azadirachta indica*). *Current Science*. 2002;82 (11):1336-1345.
2. Subapriya R, Nagini S. Medicinal properties of neem leaves: a review. *Current Medicinal Chemistry – Anti-Cancer Agents*. 2005;5 (2):149-156.
3. Alzohairy MA. Therapeutics role of *Azadirachta indica* (Neem) and their active constituents in diseases prevention and treatment. *Evidence-Based Complementary and Alternative Medicine*. 2016;2016:7382506.
4. Brahmachari G. Neem – an omnipotent plant: a retrospection. *ChemBioChem*. 2004;5 (4):408-421.
5. Kumar VS, Navaratnam V. Neem (*Azadirachta indica*): prehistory to contemporary medicinal uses to humankind. *Asian Pacific Journal of Tropical Biomedicine*. 2013;3 (7):505-514.
6. Schmutterer H. Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*. *Annual Review of Entomology*. 1990;35:271-297.
7. Kokate CK, Purohit AP, Gokhale SB. *Pharmacognosy*. Nirali Prakashan, Pune.
8. Khare CP. *Indian Medicinal Plants: An Illustrated Dictionary*. Springer; 2007.

HOW TO CITE: Usman, Pramod Kumar Mishra, Sujeet Pratap Singh, Dr. Tarkeshwar Prasad Shukla, Neem (*Azadirachta Indica*): A Review of ITS Phytochemical Constituents, Pharmacological Activities, and Therapeutic Applications, Int. J. of Pharm. Sci., 2026, Vol 4, Issue 10, 4453-4457.
<https://doi.org/10.5281/zenodo.23726985>

