



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



Review Paper

A Comprehensive Review on the Pharmacognostic Characteristics, Phytochemical Profile and Pharmacological Activities of *Achyranthes Aspera* and *Azadirachta Indica*

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ARTICLE INFO

Published: 03 Apr 2026

Keywords:

Pharmacognosy;
Phytochemical constituents;
Medicinal plants;
Achyranthes aspera;
Azadirachta indica;
Pharmacological activities;
Bioactive compounds;
Herbal medicine

DOI:

10.5281/zenodo.19398065

ABSTRACT

It has long been understood that medicinal plants are important sources of bioactive substances with substantial therapeutic potential. Due to their various pharmacological characteristics, *Achyranthes aspera* and *Azadirachta indica* are two of them that are frequently utilized in traditional medical systems. The goal of this review is to give a thorough summary of these two medicinal plants' pharmacognostic traits, phytochemical makeup, and pharmacological actions. Important diagnostic aspects that aid in the correct identification and authentication of the plant materials are revealed by pharmacognostic research. These features include macroscopic and microscopic traits of the leaves, stems, roots, and seeds. Numerous bioactive components, including alkaloids, flavonoids, saponins, tannins, terpenoids, phenolic compounds, and glycosides, have been identified by phytochemical studies. Compounds including ecdysterone, achyranthine, and oleanolic acid have been found in *Achyranthes aspera*, whereas *Azadirachta indica* has a number of physiologically active limonoids, including nimbin, nimbolide, azadirachtin, and salannin. Numerous pharmacological properties, including antibacterial, anti-inflammatory, antioxidant, antidiabetic, anticancer, hepatoprotective, and immunomodulatory effects, are attributed to these phytoconstituents. The study underscores the potential of these plants as natural sources for the creation of new pharmacological compounds as well as their therapeutic significance. To confirm their historic benefits and investigate their prospective uses within modern medicine, more scientific research and clinical trials are required.

INTRODUCTION

The development of both traditional and contemporary healthcare systems has been greatly

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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.



aided by medicinal plants. Because of its medicinal qualities and comparatively lesser side effects than synthetic medications, plant-derived products have been used for ages to cure and prevent a variety of disorders. A sizable section of the world's population uses herbal medicine as their main source of healthcare, according to the World Health Organization. Medicinal plants are valuable sources for drug discovery and development because they are abundant in bioactive chemicals with a variety of pharmacological actions.

Achyranthes aspera and *Azadirachta indica* are two of the many medicinal plants used in traditional medicine that have drawn a lot of interest because of their many therapeutic uses. Many ancient medical systems, including Ayurveda, Unani medicine, and Siddha medicine, have made extensive use of these herbs to treat a wide range of illnesses. Their widespread usage in traditional medicine has prompted scientists to look into their pharmacognostic characteristics, phytochemical components, and pharmacological actions. The annual or perennial herb *Achyranthes aspera*, sometimes referred to as prickly chaff flower, is a member of the *Amaranthaceae* family. The plant is found in many tropical and subtropical areas of Africa, Asia, and other parts of the world. Inflammation, asthma, digestive issues, skin illnesses, and urinary issues have all historically been treated using various parts of the plant, including the leaves, roots, seeds, and stems. The plant includes a number of significant bioactive substances, including alkaloids, saponins, flavonoids, glycosides, terpenoids, and steroids, according to phytochemical analyses. Prominent components such as oleanolic acid, ecdysterone, and achyranthine are thought to contribute to the plant's pharmacological characteristics.

In a similar vein, *Azadirachta indica*, or neem, is a well-known medicinal tree in the *Meliaceae* family. The plant is found in various tropical and

subtropical areas and is native to the Indian subcontinent. Because of its wide range of medicinal properties, neem has been widely employed in traditional medicine for ages. Numerous phytochemicals, including as limonoids, flavonoids, tannins, phenolic compounds, and steroids, may be found in the plant's leaves, bark, seeds, flowers, and roots. Azadirachtin, nimbin, nimbolide, salannin, and gedunin are significant bioactive chemicals found in neem that are responsible for many of its therapeutic qualities. In order to identify, authenticate, and control the quality of crude pharmaceuticals, pharmacognostic examination of medicinal plants is essential. Plant parts' macroscopic and microscopic qualities offer useful diagnostic traits that aid in separating authentic plant materials from adulterants or substitutes. Furthermore, phytochemical analysis aids in identifying the active components found in medicinal plants, which are in charge of their pharmacological and biological effects.

A variety of pharmacological properties, including as antibacterial, antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, anticancer, and immunomodulatory effects, have been shown by several experimental research involving *Achyranthes aspera* and *Azadirachta indica*. The presence of diverse secondary metabolites found in different plant sections is primarily responsible for these functions. Thus, the goal of this study is to gather and condense the scientific data that is currently accessible about the pharmacognostic traits, phytochemical profile, and pharmacological activity of *Achyranthes aspera* and *Azadirachta indica*. Gaining an understanding of these elements might aid in the creation of new medicinal compounds derived from natural sources as well as validate their traditional applications.



A. ACHYRANTHES ASPERA

TAXONOMIC CLASSIFICATION ^[1]

Table 1: Taxonomical classification of *Achyranthes aspera*

Kingdom	Plantae
Subkingdom	Tracheobionta
Super Division	Spermatophyta
Division	Mangoliophyta
Class	Mangoliopsida
Subclass	Caryophyllidae
Order	Caryophyllales
Family	Amaranthaceae
Genus	<i>Achyranthes</i>
Species	<i>Aspera</i>

SYNONYMS

Table 2: Synonyms of *Achyranthes aspera*

Latin	<i>Achyranthes aspera</i>
Sanskrit	Aghata
Hindi	Latjira, Chirchira
Gujarati	Safad Aghedo
Tamil	Shiru kadaladi
Telugu	Uttaraene
Malayalam	Kadaladi
Punjabi	Kutri
Unani	Chirchitaa
Ayurvedic	Apaamaarga, Chirchitaa, Shikhari, Shaikharika
Persian	Khare vazhun
Arabian	Atkumah
French	<i>Achyranth a feuilles rudes, collant, gendarme</i>
Spanish	Mosotillo, rabo de gato, rabo de chango, rabo de raton

BOTANICAL DESCRIPTION ^[19]

Height: 0.2–2.0 meters in height. The base is woody, simple or branching, angular or ribbed, and has bulging nodes that are frequently tinted pink.

Root: Yellowish-brown in hue, cylindrical, 0.1–1.0 cm thick, somewhat ribbed, progressively tapering, with secondary and tertiary roots.

Stem: Hairy, upright, cylindrical, yellowish-brown, branching, square, firm, and hollow when dried.



Fig. 1,2: Plant of Achyranthes Aspera

Leaf: Ovate or widely rhomate, obovate, petiolate or elliptic, simple, subsessile, somewhat acuminate estipulate, wavy edge, opposite, decussate, and pubescent because of a dense covering of long, simple hairs. 5–22 cm long and 2–5 cm wide. occur in different sizes. The lower epidermis has stomata that are anomocytic in nature.



Fig. 3: Leaf of Achyranthes Aspera

Flower: Eight to thirty centimeters long, three to seven millimeters wide, bisexual, greenish-white, numerous, sessile, bracteate with two bracteoles, one spine-lipped, actinomorphic, hypogynous, five perianth segments, membranous, five stamens, short filament, anther, two-celled, seven gynoeceium bicarpellary, syncarpous, ovary superior, single ovule; style, single stigma, white or red flower. Summertime is when flowers appear.



Fig. 4: Flower of Achyranthes Aspera

Fruit: A persistent, perianthal, indehiscent, dry utricle surrounded by bracteoles.

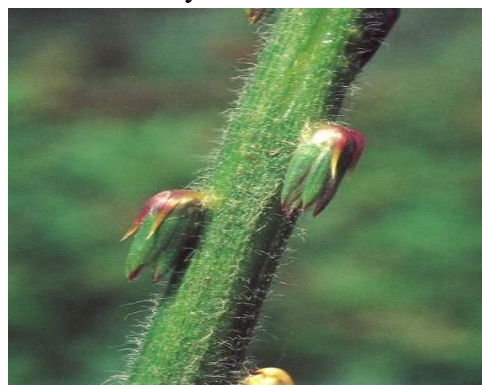


Fig. 5: Fruit of Achyranthes Aspera

Seeds: A brown, endospermic, spherical at the base, sub-cylindric, and truncate at the top.



Fig. 6: Seeds of Achyranthes Aspera

GEOGRAPHICAL DISTRIBUTION

In South Andaman Islands and across India up to an elevation of 2100 meters, it grows as a weed on the sides of roads, along field boundaries, and in waste areas. Additionally, the plant is common in Australia, America, Africa, Tropical Asia, Baluchistan, and Ceylon. In northern Bangladesh, it was identified as an invasive alien species. It was discovered to be an exotic medicinal plant in the district of Lalitpur, Uttar Pradesh, India, and the most common herb in the Shivbari holy grove in Himachal Pradesh. [20-23]

PHYTOCHEMISTRY

The plant *Achyranthes aspera* has an abundance of phytochemicals. Saponins A and B, which are found in seeds, have been identified as D-glucuronic acid and β -Dgalactopyranosyl ester of D-glucuronic acid, respectively. Oleanolic acid glycosides are found in three different forms in *Achyranthes* seeds. α -Lrhamnopyranosyl-(1-4)-(β -Dglucopyranosyluronic acid)-(1-3)-oleanolicacid, α -Lrhamnopyranosyl-(1-4)-(β -Dglucopyranosyluronicacid)-(1-3)-oleanolicacid-28-O- β - α - and D-glucopyranoside (1-4)-(β -Dglucopyranosyluronicacid)-(1-3)-oleanolicacid-28-O- β -Lrhamnopyranosyl β glucopyranoside (D-glucopyranosyl-(1-4)). Pentatriaontane, 6-pentatriacontanone, hexatriacontane, and

tritriacontane were separated from the stem after saponin was extracted from the fruits. Ecdysterone was isolated from the *Achyranthes aspera* root methanolic extract. Achyranthine is a water-soluble alkaloid that was extracted from *Achyranthes aspera* and has pharmacological effects such as blood vessel dilatation, blood pressure reduction, heart depression, and heart rate increase. [24-27]

TRADITIONAL USES

The herb has historically been used to treat cough and asthma. Pungent, antiphlegmatic, antiperiodic, diuretic, purgative, and laxative, it helps with boils, skin eruptions, oedema, dropsy, and piles. Pneumonia is treated by boiling crushed plant in water. When it comes to digestive issues, the root infusion is a moderate astringent. The blooming spikes or seeds are crushed into a paste with water and used externally to treat cutaneous conditions and night blindness caused by toxic snake and reptile bites. When a patient has been bitten by a snake, the ground root is administered with water till they throw up and regain consciousness. It is recommended to inhale the fume of *Achyranthes aspera* combined with the roots of *Smilax ovalifolia* in order to increase appetite and treat a variety of stomach conditions. It helps with hemorrhoids; the leaves and seeds are hydrophobic, carminative, emetic, relieve swelling, aid in digestion, and clear phlegm. The plant's ash is applied topically to treat warts and ulcers. on relieve a tight back, apply crushed leaves on it. The toothbrush is made from a fresh piece of root. Ophthalmia and corneal opacities are treated with a paste made from the roots in water. Fresh leaf paste is useful to relieve wasp bite discomfort. The herb can help with scabies, rheumatism, liver problems, and other skin conditions. Additionally, it has calming qualities.[28-32]

PHARMACOLOGICAL ACTIVITIES

Anti arthritic activity: In Swiss albino mice and wister rats, the whole ethanolic extract of *Achyranthes aspera* prevents Freund's full adjuvant-induced arthritis and carrageen-induced paw oedema³¹. According to reports, the plant may help prevent arthritis brought on by formaldehyde. An alkaloid called achyranthine was extracted from the plant. In adjuvant arthritis, it works against the secondary lesions. The plant's methanolic seed extract prevents the denaturation of proteins and regulates the synthesis of autoantigens to prevent rheumatic illnesses. Phytochemicals such as phenolic compounds, flavonoids, and tannins are what give plants their anti-arthritic properties.[33,34]

Antiparasitic activity: *Achyranthes aspera* ethyl extracts have been shown to have antiparasitic properties by Zahir et al. The larvae of the sheep internal parasite *Rhipicephalus* (*Boophilus*) *microplus* (*Acarilxodidae*), a cow tick, have been investigated. *Achyranthes aspera* dried flower, leaf, and seed extracts are inhibited by *Paramphistomum cervi*. [35]

Anti snake venom activity: In India, *Achyranthes aspera* extract has long been used as a remedy for snake bites. By neutralizing the venom's poisonous and enzymatic properties, the plant's aqueous leaf extract shows promise against the venom of snakes belonging to the viperidae famil. *Bitis arietans* (*Viperidae* family) venom is also neutralized by the plant's stem extract. The aqueous solution of the whole plant and the root paste are commonly used as remedies for snake bites. [36-40]

Analgesic and antipyretic activity: Aspirin is used as a typical medication to extract leaves for their analgesic and antipyretic properties utilizing hot plate and brewer's yeast-induced procedures.

Achyranthes aspera's leaves and seeds have analgesic properties. Using the hot plate technique and acetic acid-induced writhing reaction, both leaves and seeds exhibit analgesic efficacy in mice. In adult male albino rats, the hydroalcoholic extract of the roots and leaves of *Achyranthes aspera* exhibits peripherally acting analgesic action using aspirin as the standard medication and centrally acting analgesic activity utilizing tail flick, hot plate, and acetic acid-induced writhing. 200 mg/kg and 400 mg/kg were the dosages given. The animal with the highest analgesic efficacy was the one given a dosage of 400 mg/kg leaf extract. In rats, the water-soluble alkaloid achyranthine had a modest antipyretic effect [41-43].

Hypolipidemic Activity: Triton-induced hyperlipidemic rats showed a 100 mg/kg reduction in blood cholesterol (TC), phospholipid (PL), triglyceride (TG), and total lipids (TL) when exposed to the alcoholic extract of *A. aspera*. Rats fed sesame oil were used to assess the plant's hypolipidemic effectiveness. The plant's effect on lipid peroxidation caused by sesame oil has been documented. This medication reduced blood TC, PL, TG, and TL by 56, 62, 68, and 67% in normal rats given the identical dosages over a 30-day period. This was followed by a significant decrease in hepatic lipid levels. This medication caused a 24% and 40% rise in the excretion of cholic acid and deoxycholic acid in the feces. *A. aspera*'s potential mode of action for decreasing cholesterol might be attributed to the quick excretion of bile acids, which results in decreased cholesterol absorption. [44-46]

Anti-Inflammatory Activity: *A. aspera* has been shown to have anti-inflammatory properties. Using the cotton pellet granuloma test and the carrageenan-induced paw edema technique, it was discovered that alcoholic plant extract was the most effective in the majority of Wistar rats. Using



the formalin paradigm and the induced paw edema approach, alcoholic leaf and seed extracts exhibit anti-inflammatory action in rats. *Achyranthes aspera* alcohol extract was evaluated in albino male rats with cotton pellet granuloma and hind paw oedema caused by carrageenin. Diclofenac sodium was administered as a normal medication, and the paw volume was measured plethysmometrically at 0, 1, 2, 3, 4, and 5 hours. After three hours of carrageenan-induced rat paw oedema, the alcohol extract (375 and 500 mg/kg) demonstrated the greatest suppression of oedema of 65.38% and 72.37%, respectively. In a long-term experiment, the extract reduced granuloma weight by 40.03% and 45.32%. [47-49].

Wound Healing Activity: The plant has demonstrated the ability to heal wounds. A study comparing the protein profiles of granulation tissues from burn, diabetic, and immunocompromised wounds treated with a 5.0% (w/w) plant methanol extract ointment has been published. *Achyranthes aspera* leaf extracts in ethanol and water have the ability to cure wounds. Two wound models—the excision wound model and the incision wound model—were used to examine the wound healing activities. [48,49]

Cardiac Activity: The saponin of *A. aspera* seed has been shown to have cardiac stimulant effect when it increases the contraction force of an isolated, undamaged hypodynamic heart. Cardiovascular toxicity has been linked to leaf decoction. In dogs under anesthesia, the water-soluble alkaloid achyranthine reduced blood pressure, decreased heart rate, and increased breathing rate and amplitude. Rat cardiac phosphorylase activity in relation to *A. aspera* saponin. The plant was discovered to have cardiovascular system activation in tropical West Africa. Achyranthine, a water-soluble alkaloid that was extracted from *Achyranthes aspera*, dilated

blood vessels, raised the rate and amplitude of breathing in frogs and dogs, and lowered heart rate and blood pressure. The alkaloid's contractile impact on frog rectus abdominal muscle at 0.5 mg/ml was smaller than that of acetylcholine (0.1 mg/ml), and tubocurarine did not prevent its spasmogenic effect. [50,51]

Anti-Dandruff Activity: As a component of a polyherbal hair oil (PHO), the methanolic leaf extract of *A. aspera* demonstrated anti-dandruff properties. *Achyranthes aspera* crude extracts include coumarin, which in clinical studies inhibits *Pityrosporum ovale* development and lowers dandruff scales. [52]

Anti-Depressant Activity: The rats were given 200, 400, and 600 mg/kg of *A. aspera* methanolic extract, and the duration of immobility was measured. When taken orally, *Achyranthes aspera*'s methanolic extract (600 mg/kg) significantly reduced the immobility period, demonstrating its antidepressant-like properties. [53]

Diuretic Activity: In adult male albino rats, a saponin extracted from *Achyranthus aspera* seeds has a notable diuretic effect. In rats, the optimal oral dosage of saponin was 10 mg/kg, which increased urine production in a manner similar to that of an oral dose of acetazolamide (10 mg/kg) [53].

Spermicidal Activity: *Achyranthes aspera* root extracts have been shown to have spermicidal effects on human and rat sperm. The most efficient extracts for sperm immobility, viability, acrosome state, 5'-nucleotidase activity, and nuclear chromatin decondensation were determined to be hydroethanolic, n-hexane, and chloroform [54].

Immunostimulant activity: It was discovered that *Achyranthes aspera* extract induced the

humoral antibody response specific to ovalbumin (OVA) in mice. IgM, IgG, and IgG3 antibody levels significantly increased. Passive cutaneous anaphylaxis (PCA) and ELISA for IgE and other classes of antibodies, respectively, were used to assess the antibody response. PCA titers showed a substantial suppression of antibody increase. Several mouse strains were used to investigate the adjuvant property. It was discovered that the herb's roots and seed exhibited comparatively more activity.

Certain primary, secondary, and tertiary IgG antibodies were observed to be produced more when *Achyranthes aspera* Linn extract was administered intraperitoneally. The extract's dosages for *Achyranthes aspera*'s stimulatory action were 10, 50, 100, and 200 µg, respectively. The H-2d, H-2b, and H-2q haplotype mice, which demonstrated stimulatory action throughout the genetic diversity, were used to further investigate the immunostimulant activity. On the other hand, it was discovered that *Achyranthes aspera* extract increased the release of ova, particular IgM, IgG, and subtypes of IgG1 and IgG3. Mice were subjected to immunomodulatory effects in order to monitor the ovalbumin-specific antibody response in several mouse groups. As a consequence, the study confirms *Achyranthes aspera*'s immunomodulatory properties since extracts from its various components show more activity. [55]

B. AZADIRACHTA-INDICA

TAXONOMICAL CLASSIFICATION^[15]

Table 3: Taxonomical Classification of *Azadirachta-Indica*

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Eudicot
Subclass	Rosidae
Order	Sapindales

Family	Meliaceae
Genus	<i>Azadirachta</i>
Species	<i>A. indica</i>

SYNONYMS

- *Azadirachta indica* var. *minor* Valetton
- *Azadirachta indica* var. *siamensis* Valetton
- *Azadirachta indica* subsp. *vartakii* Kothari, Londhe & N.P. Singh
- *Melia azadirachta* L.
- *Melia indica* (A. Juss.) Brandis

GEOGRAPHICAL DESCRIPTION

The study of locations and the relationships between people and their environment is known as geographical description. The physical characteristics of the Earth's surface as well as the many human social structures that exist there are both studied by geographers. The study of how vegetation spreads over the earth, with a focus on the environmental elements that determine this appropriation. At least thirty Asian nations, including India, Burma, Thailand, Bangladesh, Cambodia, Indonesia, Iran, Malaysia, Nepal, Pakistan, Sri Lanka, and Vietnam, as well as Africa, Australia, and Central and South America, have neem trees. Neem is believed to be native to arid regions of South Asia and the Indian subcontinent. It has expanded to several South and Central American nations, the Caribbean, and portions of Africa. [56,57]

MORPHOLOGICAL DESCRIPTION^[58-62]

The tree is thought to reach a height of 15 to 20 meters and live for about 200 years. The tree's branches are widely dispersed and create an oval-shaped crown due to its powerful roots. The neem tree's bark has a brownish hue. The leaves are green, but when the plant is young, they are purple-red. *Azadirachta indica* has tiny, fragrant white blooms that are around 25 centimeters long. The



little, delicious golden fruit. This tree is located in Egypt and is evergreen. With widely spread branches, a small, straight trunk with a diameter of 0.8–1.2 m, rough bark, and blossoms in May that may develop to a height of 5–15 m, this tree is the quickest growing.

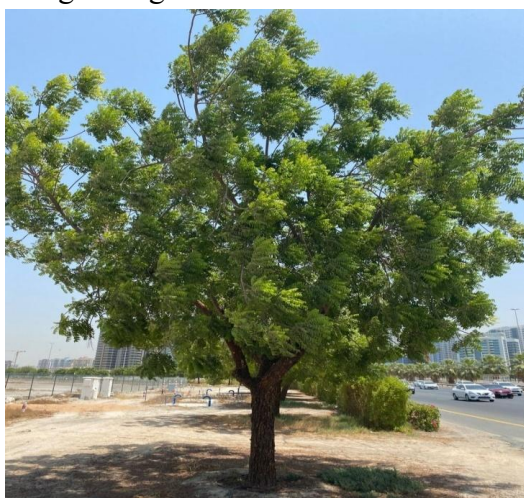


Fig. 7: Plant of Azadirachta-Indica

Leaf: The alternate, petiolate, compound imparipinnate leaf contains seven to nineteen leaflets and is 38 to 45 cm long. The green petiole has an expanded, swelling center and is long and cylindrical. It is 6–9 cm in length and 0.1–0.3 cm in breadth. The rachis is a green-colored, long, cylindrical structure that is 15–20 cm long and 0.15–0.3 cm in diameter.



Fig. 7: Leaf of Azadirachta-Indica

Stem: Neem branches are firm, cylindrical, brown in color, with rough surfaces coated in somewhat thick brown bark. They range in length from 1.5 to

3.5 meters and are regarded as ancient branches. The immature branches have fibrous fractures and are green in color. The stem tastes harsh and has a distinctive smell.

Bark: Neem has dark, rigid, relatively thick, curved, quill-shaped bark with a silvery brown inside. There are longitudinal and transverse wrinkles and cracks in the outer bark. The bark has a harsh, astringent taste and no smell.

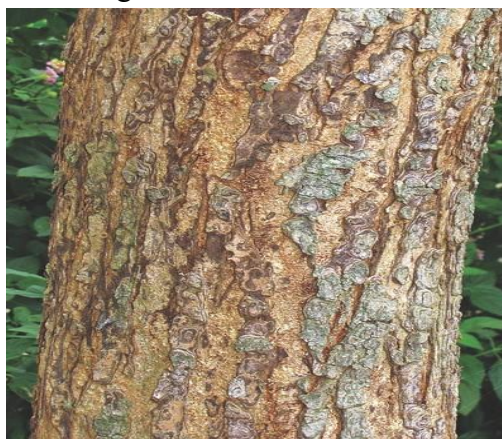


Fig. 8: Bark of Azadirachta-Indica

Fruit: A. indica is a plant that grows largely throughout India. The smooth, edible fruits have a length of [1.2 to 2.0] cm. Neem starts to bear fruit around three to five years of age. The epidermis of the brown epicarp is thin. The pulp of the mesocarp is [0.3–0.5] cm thick, fragrant, yellowish, and fibrous. The endocarp is the white, oblong, firm seed with a brown seed coat that is part of the fruit.



Fig. 8: Seeds of Azadirachta-Indica

PHYTOCHEMICALS^[63]

Many of *Azadirachta indica*'s biological and medicinal properties are attributed to its rich phytochemical profile, which is well known. Many secondary metabolites, including limonoids, flavonoids, phenolic chemicals, terpenoids, alkaloids, tannins, saponins, and steroids, may be found in the plant's leaves, bark, seeds, flowers, and roots. The most distinctive and pharmacologically significant components of neem are limonoids, also known as tetranortriterpenoids. Azadirachtin, nimbin, nimbidin, nimbolide, salannin, gedunin, meliantriol, azadiradione, deacetylnimbin, deacetylnimbidin, nimbinene, epoxyazadiradione, margolone, and margolonone are among the limonoids that have been separated and identified from the plant. These substances, which have potent insecticidal, antibacterial, anti-inflammatory, and anticancer effects, are mostly found in seeds and seed oil.

Neem leaves and flowers are rich in limonoids as well as flavonoids that are known to have anti-inflammatory and antioxidant properties, including quercetin, kaempferol, myricetin, rutin, catechin, and epicatechin. Additionally, the plant has a range of phenolic chemicals, including gallic acid, caffeic acid, ferulic acid, chlorogenic acid, and protocatechuic acid, which help it scavenge free radicals and protect against oxidative stress. Additionally, neem includes a number of terpenoids with antibacterial and insect-repelling qualities, including β -caryophyllene, α -humulene, limonene, β -elemene, and β -selinene. Important phytosterols, including β -sitosterol, stigmasterol, and campesterol, which are known to have anti-inflammatory and cholesterol-lowering properties, are also found in the plant. Other secondary metabolites have also been identified in other plant sections, including alkaloids, saponins, tannins, glycosides, and polysaccharides. A

number of fatty acids, such as oleic acid, stearic acid, palmitic acid, and linoleic acid, are also present in neem seed oil and contribute to its industrial and medical uses. *Azadirachta indica* is a significant medicinal plant with a variety of pharmacological properties, including antibacterial, antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, and anticancer effects, thanks to the presence of these varied phytochemical ingredients.

TRADITIONAL USES

Antifungal and Antibacterial Paste: Neem leaves can be used to treat bacterial and fungal illnesses. To relieve the infection, make a paste out of tree leaves and apply it. Neem leaf paste is also used to cure boils caused by chickenpox. [64]

Neem Oil: Neem leaves have a very high calcium and other mineral content. For stronger bones, neem oil can be administered to the hands and legs in particular. Additionally, neem oil helps those with arthritis by reducing inflammation and relieving pain. [64]

Natural Insecticide: Neem leaves work wonders for keeping insects and mosquitoes away. To keep mosquitoes away from your house and surrounding area, burn neem leaves. Cattle rearers mostly employ this technique to keep various insects away from their animals. [65]

Oral Health: Chewing neem leaves might help you keep your mouth healthy. It prevents gum infections, improves breath, reduces tooth decay, eliminates harmful oral bacteria, and keeps saliva's pH level stable. [65]

Boost Immunity with Neem Tea: Neem tea increases the body's resistance to illnesses like fever and the common cold. Research has shown that neem tea can heal malaria-affected cells in the body just as well as quinine. [66]



Homemade Toothbrush: You may clean your teeth with little branches or twigs. Neem toothpaste has been used for decades, and it still offers the same advantages today. [67]

Hair Mask: Your hair will benefit from a neem hair mask in a long-lasting and healthy way. It gives your hair strength and luster. For greater effects, make a paste out of neem leaves and apply it to your hair. Dandruff and fungal infections of the scalp can also be treated using the same method.

Removes Acne: When administered topically, neem oil relieves and eliminates acne. Neem oil's anti-inflammatory qualities make it a highly efficient remedy for dry skin, pimples, and itching. [68]

PHARMACOLOGICAL ACTIVITIES

Antifungal activity: Research was done to see how well a number of neem leaf extracts worked against the seed-borne fungus *Rhizopus* and *Aspergillus*. The results demonstrated that the alcoholic and water extracts significantly inhibited and controlled the growth of both fungal species. Additionally, alcoholic neem leaf extract inhibited the development of both fungal species more successfully than aqueous extract. In a different study, neem cake aqueous extracts were found to have antibacterial action against three sporulating fungi: *Helminthosporium penniseti*, *Curvularia lunata*, and *Colletotrichum gloeosporioides* f. sp. *Mangiferae*. The results of the study showed that *Azadirachta indica* methanol and ethanol extracts inhibited the development of *Cladosporium* sp., *Alternaria solani*, and *Aspergillus flavus*. *Azadirachta indica* L.'s antifungal activity was investigated in a research against *Alternaria solani* Sorauer. The ethyl acetate fraction was shown to be the most successful in stopping fungal growth, with a minimum inhibitory concentration (MIC) of

0.19 mg. It also worked better than the fungicide (metalaxyl + mancozeb), which has a minimum inhibitory concentration (MIC) of 0.78 mg. [69,70]

Anti-bacterial activity: Another research looked at the antibacterial activity of extracts from *Azadirachta indica*'s bark, leaves, seeds, and fruit against bacteria that were isolated from adult mouths. The results demonstrated that bark and leaf extracts had bactericidal properties on all of the test bacteria. Furthermore, only at higher doses did fruit and seed extracts exhibit bactericidal action. The antibacterial effectiveness of herbal substitutes as endodontic irrigants was evaluated in a research that used sodium hypochlorite as the standard irrigant. According to the results, leaf extracts displayed zones of inhibition, which are indicative of antibacterial properties. Furthermore, leaf extracts blocked much more zones than 3% sodium hypochlorite. Extracts from neem leaves, seeds, and bark show antibacterial activity against a range of Gram-positive and Gram-negative pathogens, including *Klebsiella pneumoniae*, *Mycobacterium*, and *Vibrio cholera*. [71,72]

Antiviral activity: At doses ranging from 50 to 100 g ml⁻¹, neem bark extract (NBE) dramatically decreased HSV-1 penetration into cells. Additionally, it was demonstrated that the NBE extract's inhibitory action had a direct anti-HSV-1 impact when preincubated with the virus rather than the target cells. Neem leaf extract has demonstrated virucidal effect against the coxsackievirus virus B-4, as demonstrated by virus inactivation and yield reduction studies, in addition to interfering early in the virus's reproductive cycle. [73]

Anti-inflammatory activity: Neem leaf extract dramatically decreases inflammation, although not as much as dexamethasone, according to a research. Dexamethasone is a well-known and



extremely effective steroid that reduces inflammation [57]. One study found that nimbidin suppresses the inflammatory reactions of neutrophils and macrophages. When taken orally, nimbidin inhibited chemotaxis, phagocytosis, and respiratory burst in macrophages in response to thioglycollate [58]. Numerous researchers reached similar conclusions. The water-soluble component of an alcoholic neem leaf extract at a dosage of 200 mg kg⁻¹ orally showed a considerable anti-inflammatory effect and effectively blocked the biochemical mode of action on inflammation in a cotton pellet granuloma test. The ability of neem leaf extract to stabilize lysosomal membranes and its anti-proliferative qualities may be linked to its anti-inflammatory effects. [74]

Anti-cancer activity: Changes in molecular and genetic pathways impact the onset and progression of cancer. An oncogene, also known as a cancer-causing gene, is a mutated gene that is essential to the growth and metastasis of malignancies. The 500 mg kg⁻¹ neem leaf extract (C500) group dramatically reduced c-Myc oncogene expression in comparison to the cancer control group, according to a study that used 4T1 breast cancer BALB/c mice to investigate the impact of leaf extract on the expression of the cMyc oncogene. [75]

Neem leaves contain a variety of potent antioxidants and anticarcinogens, including ascorbic acid, limonoids, flavonoids, terpenoids, and carotenes. Neem leaves include beta-carotene and vitamin C, which have a significant preventive impact on tumor growth due to their ability to scavenge free radicals. Limonin 17b-D-glucopyranoside, a limonoid found in neem, has been demonstrated to prevent DMBA-induced oral carcinogenesis. Azadirone 1, the limonoid component of *A. indica*, has been shown to have cytotoxic effect against prostate, melanoma, and breast cancer cell lines. The cytotoxicity of

azadirachtin A has been investigated in human glioblastoma cell lines. Nimbolide and 28-deoxonimbolide have been shown to be cytotoxic components of neem leaves. Neem leaves include the flavonoids quercetin and kaemferol, which have been demonstrated to inhibit carcinogenesis at both the initiation and promotion phases due to their capacity to scavenge radicals. As an anticancer drug, quercetin, a neem bioflavonoid, has received the greatest scientific interest. Quercetin has been shown to decrease tumor cell development in a variety of cancerous cell lines. Quercetin has been shown to have antiproliferative properties in both humans and experimental animal models. Furthermore, it has been shown that quercetin improves the therapeutic effectiveness of radiation and chemotherapy drugs. [76]

Anti-Diabetes: Neem is offered as a herbal combination supplement in North America. HbA1c levels and glucose control improved in type 2 diabetic patients (ages 18 to 70) who received treatment with this dietary supplement for three months. The Kochhar research looked at the antidiabetic efficacy of neem in ninety diabetic males between the ages of forty and sixty. The participants received two grams of neem leaf powder daily for three months. The results of the study indicate that neem relieves headaches, perspiration, and itching in diabetics. [77]

In Obesity: Obesity and overweight are serious health problems that are becoming more prevalent worldwide. A significant increase in mortality and a decrease in life expectancy are associated with obesity. Obesity risk factors include a poor diet, age, heredity, stress, sleep deprivation, alcohol consumption, and inactivity. Diabetes, heart disease, hypertension, hyperlipidemia, and atherosclerosis are among the consequences of obesity. Lipase and α -glucosidase inhibitors are

two types of obesity medications that may be used as the most effective treatment to reduce obesity. Pancreatic lipase and α -glucosidase were suppressed in an in vitro system by 520 μ g/ml of an aqueous and methanolic extract of neem stem bark and roots. However, following 28 days of therapy, rats administered 500 mg/kg of neem leaf extract orally did not show a reduction in body weight. [78-80]

Antimalarial Activity: The ethanolic extract of *A. indica* has notable antiplasmodial qualities, according to a study examining the antiplasmodial activity of *A. indica* in albino mice infected with *Plasmodium berghei*. These results demonstrate its promise as a natural remedy for malaria. [81]

CONCLUSION

Achyranthes aspera and *Azadirachta indica* are two significant medicinal plants that are frequently utilized in traditional healthcare systems. This review focuses on their pharmacognostic traits, phytochemical makeup, and pharmacological potential. In order to properly identify, authenticate, and maintain the quality of herbal medicines, pharmacognostic assessment is essential. Reliable diagnostic criteria are provided by the macroscopic and microscopic characteristics of various plant sections, which aid in differentiating these plants from potential adulterants or replacements in herbal formulations. Both plants contain a wide variety of secondary metabolites, such as alkaloids, flavonoids, saponins, tannins, glycosides, terpenoids, steroids, and phenolic chemicals, according to phytochemical analyses. Azadirachtin, nimbin, nimbolide, salannin, and gedunin in *Azadirachta indica* and ecdysterone, achyranthine, and oleanolic acid in *Achyranthes aspera* have all been found to be significant bioactive components that contribute to their therapeutic qualities. Numerous

biological and medicinal actions are caused by these phytoconstituents.

These plants have a broad range of biological properties, including antibacterial, antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, anticancer, and immunomodulatory actions, according to several pharmacological research. These results demonstrate their potential as useful sources of natural medicinal substances and justify their widespread usage in traditional medicine. Even with the wealth of information already accessible, more research is still needed to identify and describe more active chemicals, comprehend how they work, and assess their safety and effectiveness through carefully planned clinical trials. Thus, more research on *Achyranthes aspera* and *Azadirachta indica* may greatly aid in the creation of novel plant-based medications and encourage the incorporation of ancient medical knowledge into contemporary healthcare systems.

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HOW TO CITE: Akhilesh Kumar, Shailesh Pathak, Anurag Singh, Dr. A.K. Srivastava, Abhash Singh, A Comprehensive Review on the Pharmacognostic Characteristics, Phytochemical Profile and Pharmacological Activities of *Achyranthes Aspera* and *Azadirachta Indica*, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 4, 473-490 <https://doi.org/10.5281/zenodo.19398065>