

A Comprehensive and Phytochemical Review on Achyranthesaspera

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ABSTRACT:

Achyranthesaspera which originates from the Amaranthaceae family is a most important medicinal herb found throughout India. It mainly grows as a weed on the roadsides, at forest borders, open grasslands, and in sand dunes. It is also called by common names such as chaff flower and prickly chaff flower. A wide range of chemical constituents were isolated and identified from the plant which possess activities like anti-periodic, diuretic, purgative, laxative, anti-asthmatic, hepatoprotective, anti-allergic and various other important medicinal properties. Traditionally, the plant is used to treat various types of ailments, such as, pneumonia, dropsy, snakebites, ulcers, piles, diarrhea, dysentery, scabies and other skin diseases. Achyranthesaspera is a bitter plant that consists of several secondary metabolites such as alkaloids, tannins, saponins, flavonoids, glycosides, steroids, essential fatty acids that play a prominent role in the exhibition of increased bioactivity against the vast variety of diseases.

Key words: Amaranthaceae, chaff flower, prickly chaff flower, pneumonia,

used worldwide, the World Health Organization has identified over 20,000 species. More than 80% of people worldwide receive their primary medical treatment from traditional herbal medicine, according to the WHO.

Secondary metabolites of plants, such as terpenoids, quinones, flavonoids, and tannins, are typically the medicinally active plant components and are in charge of shielding the plants from insects, microbes, and other natural pests. Herbal products have grown exponentially worldwide in recent years due to the massive surge in the usage of plant-based health products in both developed and developing nations. Of the many plants used in the herbal medicine, Achyranthesaspera is one of them.

Achyranthesaspera belongs to the family Amaranthaceae. It is a flowering plant species in the genus Achyranthes that is native to India, tropical Asia, Africa, Australia and America. It is also referred to by the common names prickly chaff flower and chaff flower. It can be found at the heights of up to 2000-3000 m in open, dry areas. The plant can grow up to an altitude of 2100 meters height above the sea level. It flourishes in sandy soils, particularly under the protection of trees and bushes. It is a slow to moderate growing plant. It grows as a weed along the field borders, waste areas, and roadsides in India. It is an annual or perennial herb growing to a height of 12 meters, often with a woody base. This wild plant is known by the different names such as Agharo in Gujarati, Chirchira in Hindi, Katalaati in Malayalam, Kini in Marathi, Naaiyuruvi in Tamil, Ulti hot in Assamese, Uttarene in Telugu, Apang in Bengali, and Churchura in Urdu, in India.

The plant is used in indigenous system of medicine as anti-periodic, diuretic, laxative, anti-asthmatic, hepatoprotective, anti-arthritis, anti-helminthic, anti-inflammatory, nephroprotective, anti-oxidant and anti-tumor. It is also used to treat pneumonia, venomous snake and reptile bites, gastro-intestinal issues, liver issues, rheumatism

I. INTRODUCTION:

Any chemical compound or material that is created by a living thing and found in nature is referred to as a natural product. In a broad sense, natural products can also be created chemically—both partially and completely—and since they present difficult synthetic targets, they have been essential to the growth of the study of organic chemistry. Natural materials have pharmacological activity, which makes them useful for treating a wide range of illnesses. These could function as active ingredients in both conventional and contemporary medicine. These natural products are frequently utilized as beginning points in the chemical process of drug discovery, enabling the preparation of synthetic analogs with enhanced potency, safety, efficacy and purity.^[1]In an endeavor to catalog every species of medical plant

and skin conditions, wounds and ulcers, constipation, piles and fistula/fissures, relieve cough and eliminates excess mucus from the body. The plant's juice is applied to wounds and ulcers to speed up healing since it has astringent and anti-inflammatory properties. It is reported to contain carbohydrates, proteins, glycosides, alkaloids, tannins, saponins, flavonoids and lignin. Flavonoids generally function as antioxidants and anti-inflammatory agents and have been demonstrated to prevent or reduce the development of several malignancies.

Plant Profile:

Synonyms: Achyranthesacuminata,
Achyranthesaustralis, Achyranthesfruticosa,
Achyranthesobovata, Achyranthessicula,
Achyranthescanescens^[2]

Biological Source:

It is obtained from the plant called as Achyranthesaspera belonging to the family Amaranthaceae.^[3]



Figure 1: Achyranthesaspera

Taxonomic Classification:^[4]

Kingdom – Plantae
Subkingdom – Tracheobionta
Super Division – Spermatophyta
Division – Mangoliophyta
Class – Magnoliopsida
Subclass – Caryophyllidae
Order – Caryophyllales
Family – Amaranthaceae
Genus – Achyranthes
Species – aspera

Vernacular names of Achyranthesaspera:^[5]

Assamese: Ulti hot
Gujarati : Agharo
Hindi: Chirchira, Pratyakpushpi
Kannada: Uttara ani
Malayalam: Katalaati
Marathi: Aghada, Kini
Sanskrit: Pratyanchapushpa, Vashir

Tamil: Naaiyuruvi, Akatam
Telugu: Uttarene, dubbinachettu
Urdu: Aghara, Churchura

Geographical Distribution:

Achyranthes aspera is widespread in the tropics and subtropics of Europe, Africa, Asia, Australia, and the Americas. It can be found at heights of up to 2000-3000 m in open, dry areas. At forest borders, in thickets, open grassland, along forest trails, in sand dunes, in seasonal wetlands, and in dried-up watercourses, it is frequently seen in secondary re-growth. Achyranthes aspera is one of the most common species of Acacia nilotica's understory in East Java. It grows as a weed along field borders, waste areas, and roadsides in India. It is also found in the South Andaman Islands.^[6]

Botanical Description:

Cultivation:

The plant can grow up to an altitude of 2100 meters height above the sea level.^[7] At forest borders, in thickets, open grassland, along forest trails, in sand dunes, in seasonal wetlands, and in dried-up watercourses, it is frequently seen in secondary re-growth.^[6] The plant mainly grows on moist and well drained soils. The plant needs between 700 and 1300 milliliters of mean annual rainfall to grow.^[8] The plant requires moderate light for their growth. Irrigation is also less required for the growth of the plant. The propagation of the plant can be mainly done through the seeds. The flowering and fruiting time of the plant is from September to April.^[9]

Plant Description (Morphology):

Achyranthesaspera is an annual or perennial herb growing to a height of 1-2 meters, often with a woody base. It can be erect or procumbent. The base is simple or branched, woody, angular or ribbed, and the nodes are bulging and often pink in color.^{[10],[11]}

Roots- Cylindrical roots with secondary and tertiary roots present, 0.1-1.0 cm thick, somewhat ribbed, and progressively tapering in shape.^[12]

Stem- The plant is hairy, longitudinally striated, erect, branched, cylindrical, firm, angular and herbaceous above, with noticeable green internodes and nodes that are colored pink or violet below. It appears hollow when it is dried.^[13]

Leaf- A dense covering of long, simple hairs make the plant simple, sub-sessile, somewhat acuminate, wavy edge, obovate or broadly rhombate, opposite, decussate, and pubescent. They come in a range of

sizes, measuring 5-22 cm long and 2-5 cm wide. On the lower epidermis, there are anomocytic stomata.^[11]

Flowers- Two bracteoles, one lipped spine, actinomorphic, hypogynous, five segments of the membranous perianth, five stamens, one short filament, one two-celled anther, seven bicarpellary, syncarpous, superior ovary, one ovule, style, one

stigma, and a white or red flower characterize this bisexual, numerous, sessile, 830 cm long, 3-6 mm wide plant. The blooming season is summer.

Fruit- Bracteoles, persistent, and perianth surround an indehiscent dry utricle.^[11]

Seeds- These have a brown color, and are endospermic, sub cylindrical, and truncate at the apex.^[14]



Figure 2: Roots of Achyranthesaspera Figure 3: Achyranthesaspera stem



Figure 4: Achyranthesaspera leaves Figure 5: Achyranthes aspera flowers



Figure 6: Achyranthesaspera fruit Figure 7: Achyranthesaspera seeds

Traditional Uses:

Wasp bite pain can be relieved with a paste made from fresh leaves. As a toothbrush, a fresh piece of root can be utilized. When combined with a little bit of salt and mustard oil, the ash from the burned plant is used as a tooth powder to clean the teeth. It also has a calming influence. Back pain can be relieved by massaging the crushed leaves on it. The blossoming spikes or seeds are ground and mixed with water to make a paste that is applied topically to treat cutaneous diseases and venomous

snake and reptile bites. The plant debris is cooked in water and is used to treat pneumonia. The root's infusion acts as a mild astringent for intestinal issues. It is said that combining the vapors of the plant with the roots of *Smilax ovalifolia* to inhale may help with a number of gastrointestinal issues including increasing appetite. Warts and ulcers can be treated externally with the plant ash. For ophthalmic and corneal opacities, root paste diluted in water is administered.^{[15], [5]}

Pharmacological Uses:

Achyranthesaspera is used to treat a variety of conditions due to its expectorant, stomach tonic, laxative, anthelmintic, diuretic, lithotriptic, sudorific, demulcent, anti-inflammatory, anti-cataract, antifungal, antibacterial, hypoglycemic, anti-hyperlipidemic, antiperiodic, anti-asthmatic, hepatoprotective, and anti-allergic properties. Digestion is improved when the supplement powder is regularly taken with honey. Excellent digestive and palatable qualities are found in the plant, which aid in good digestion. The primary usage of oil is to relieve cough and to eliminate excessive mucus from the body. The purgative properties of the plant assist to soften stools and reduce the risk of constipation, piles, and fistula/fissures. When used topically, its root paste and juice can aid with earaches by reducing pain, itching, skin rashes from the bug bites, and urticaria. By limiting the buildup in the belly, supplements made from the plant helps reduce excess body fat; the gluteal areas regulate the weight.^{[16],[17]}

Phytochemical Investigation:

Achyranthesaspera is traditionally having a value as a potential medicinal plant. The chemical constituents has been isolated and identified from the different parts of the plant by different research scholars. Some of them have been listed below:

V. Hariharan & S. Rangaswami (1970) and M. Ali (1993) stated that Saponins A and B had been isolated and identified. D-glucuronic acid was found to be saponin A, and β -D galacto pyranosyl ester of D-glucuronic acid was shown to be saponin B. A few more components, such as hentriacontane, amino acids, and oleanolic acid, were also extracted in addition to these components. Chemical components such as 4-tritriacontanone, 10-tricosanone, and 10-octacosanone are also present in the seeds.

R.D. Rameshwar & N. Akito (2007) reported three oleanolic acid glycosides from the seeds of the plant which were identified as α -L-rhamnopyranosyl-(1 \rightarrow 4)-(β -D glucopyranosyl uronic acid)-(1 \rightarrow 3)-oleanolic acid, α -L-rhamnopyranosyl-(1 \rightarrow 4)-(β -D glucopyranosyl uronic acid)-(1 \rightarrow 3)-oleanolic acid-28-O- β -D-glucopyranoside and α -L rhamnopyranosyl-(1 \rightarrow 4)-(β -D- glucopyranosyl uronic acid)-(1 \rightarrow 3)-oleanolic

acid-28-O- β -D glucopyranosyl-(1 \rightarrow 4)- β -D-glucopyranoside.

A. Banerji et al. (1970) have isolated and reported ecdysterone from the roots of Achyranthes aspera.

H.N. Khastgir et al. (1958) have isolated and reported oleanolic acid from the glycosidic fraction of the roots.

A.K. Batta & S. Rangaswami (1973) also have reported dihydroxy ketones from the shoots as 36, 37- dihydroxyhenpentacontan-4-one and Triacontanol.

Y. Gariballa et al. (1983) have identified and isolated an aliphatic alcohol, 17-pentatriacontanol from the shoots of the plant.

N. C. Neogi et al. (1970) reported Water-soluble alkaloid achyranthine has pharmacological effects that include dilatation of the blood vessels, reduction of blood pressure, cardiac depression, and elevation of the rate and amplitude of breathing.

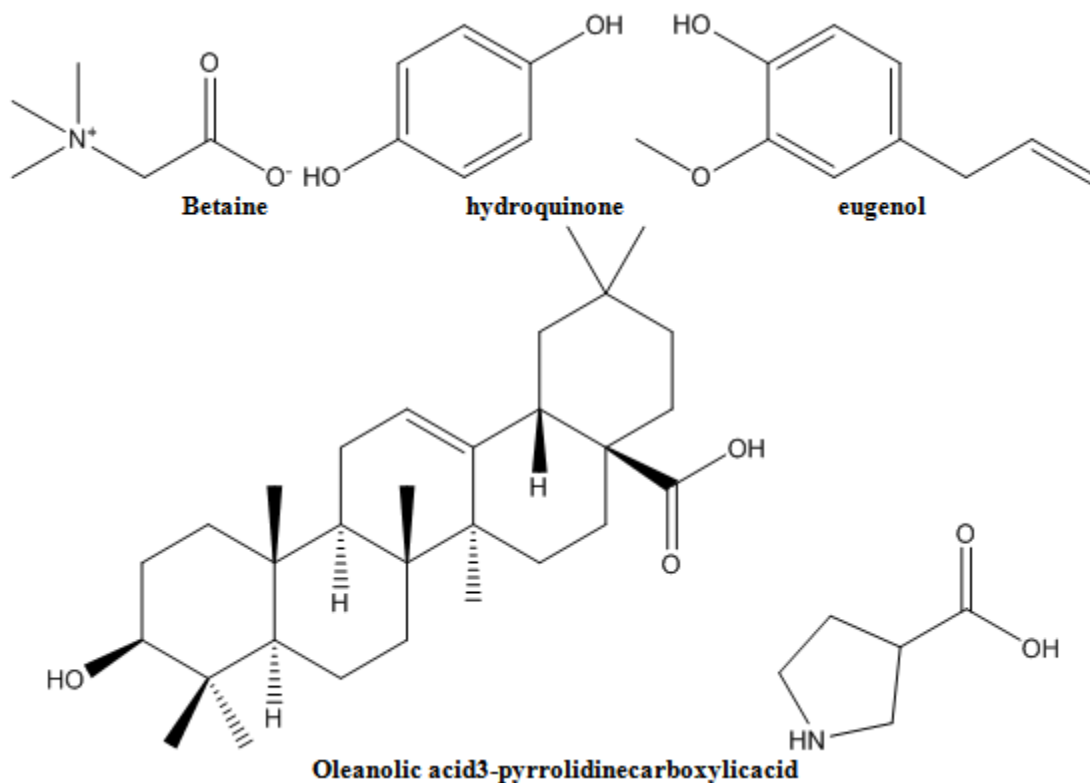
V. Seshadri et al. (1981) have isolated and reported two constituents from the fruits and these were identified as saponins C and D.

O. Kunert et al. (2000) have reported three bisdesmosidic saponins (I-III), 20-hydroxyecdysone, and quercetin-3-O- β -D-galactoside, were identified and isolated from the methanol extract of the aerial parts of the plant. Their structures were determined via NMR spectroscopic analysis; 2D NMR studies were used to determine the compounds' full ^1H and ^{13}C assignments.

R.D. Rameshwar (2007) have reported the isolated chemical compounds from the leaves of Achyranthes aspera, and were analyzed by using the technique called GC-MS. Seven compounds were identified in the volatile oil isolated from the leaves, namely p-benzoquinone, hydroquinone, spathulenol, nerol, α -ionone, asarone and eugenol, constitutes 63.05% of the oil. Of them, Hydroquinone which constitutes to about 57.7% was found to be the chief chemical constituent of the oil.

Aziz.et. al. (2005) have isolated and identified 3-Acetoxy-6-benzoyloxyapangamide from the ethyl acetate extract of the stem of Achyranthes aspera, and the structure of the identified compound was established by the modern spectroscopic techniques.

The seeds also contain many aliphatic fatty acids such as palmitic acid, myristic acid, oleic acid, behenic acid, linoleic acid, linolenic acid as the aliphatic fatty acid composition.



Pharmacological Review of *Achyranthes aspera*:

Different parts of *Achyranthes aspera* contain different phytochemicals which show different pharmacological activities. Some of them are described as follows:

Anti-inflammatory activity:

In albino male rats, an alcohol extract of *Achyranthes aspera* demonstrated anti-inflammatory effects on models of carrageenan-induced hind paw edema and cotton pellet granuloma. Additionally, it has been claimed that *A. aspera*'s ethanol extract has anti-inflammatory and anti-arthritic properties at doses of 100–200 mg/kg. Rats with carrageenan-induced paw edema, granuloma pouch, formalin-induced arthritis, and adjuvant arthritis were used to test the anti-inflammatory and anti-arthritic properties of achyranthine, a water-soluble alkaloid derived from *A. aspera*.^[18]

Anti-cancer activity:

Numerous studies on *Achyranthes aspera* demonstrate its ability to inhibit malignant activity. Swiss albino mice that have been given mineral oils may be used in this investigation's tests. Antitumor properties were investigated on parts of the flowers and foliage. The mice may be

administered varying concentrations of the plant's crude extract. More than other extracts, the ether extract might have beneficial benefits on malignancies.^[19]

Cardiovascular activity:

Water-soluble alkaloid Achyranthine, isolated from *Achyranthes aspera* L., dilated blood vessels, raised the rate and amplitude of breathing in frogs and dogs, and lowered heart rate and blood pressure. Tubocurarine did not inhibit the alkaloid's spasmogenic activity, and its contractile effect on frog rectus abdominal muscle at 0.5 mg/ml was less than that of acetylcholine (0.1 mg/ml). Another study have revealed the study of the heart contraction force of the isolated frog, guinea pig, and rabbit was enhanced by a blend of saponins that were extracted from the seeds of *Achyranthes aspera* L. Prosthilol and mepyramine partially inhibited the stimulating impact of the lower dosages (1-50 µg). Prosthilol did not prevent the impact at greater doses of saponin. The hypodynamic heart's tone and the failing papillary muscle's contraction force were both raised by the saponins.^[20]

Anti-diabetic activity:

When oral administration of 250 and 500 mg of *Achyranthes aspera* was used in a rat model of alloxan-induced diabetes and normal glucose, a unique dose-related hypoglycaemic response was seen. A group of albino rats without glucose was starved for 12 hours in order to establish diabetes mellitus in them. Intraperitoneally (IP) 150 mg/kg body weight of alloxan monohydrate was injected after it had been dissolved in physiological saline. After four days, this dosage of alloxan resulted in persistent hyperglycemia, as evidenced by the examination of blood and urine samples used to determine glucose levels. The HbA1C level and blood glucose were significantly lower in the *A. aspera* aqueous extract group (500 mg/kg) than in the control group.

Anti-oxidant activity:

Through a number of in vitro tests, including 1, 1-diphenyl-2-picrylhydrazyl (DPPH) and the Hydroxyl Radical Scavenging technique, the antioxidant activity of *A. aspera* crude root extract was assessed.^[21]

Hypolipidemic activity:

In rats with triton-induced hyperlipidemia, the alcoholic extract of *A. aspera* was observed to reduce blood cholesterol (TC), phospholipid (PL), triglyceride (TG), and total lipids (TL) at 100 mg/kg. The hypolipidemic effectiveness of the plant was evaluated in rats fed sesame oil. There have been reports on the plant's ability to inhibit lipid peroxidation induced by sesame oil.^[21]

After giving this medication to normal rats at the same doses for 30 days, the treatment significantly reduced the levels of hepatic lipids and decreased serum TC, PL, TG, and TL by 56, 62, 68, and 67%, respectively. Under the influence of this medication, the excretion of deoxycholic acid and cholic acid in the feces rose by 40% and 24%, respectively. *A. aspera*'s potential mode of action for its cholesterol-lowering activity could be the quick excretion of bile acids, which results in less cholesterol being absorbed.

Anti-microbial and Anti-fungal activity:

Numerous studies have been conducted to assess the antibacterial and antifungal properties of the plant. There have been reports of the plant having strong antibacterial properties. Seeds stem leaf extract in ethyl acetate, leaf and stem extracts in ethanol and methanol, leaf and stem extract in ethanol, and aqueous flower extract all exhibit

antibacterial properties. There have been reports of the antibacterial and antifungal properties of dried leaf extracts in petroleum ether, chloroform, and methanol. The plant was discovered to possess antibacterial properties against gram-positive bacteria that originated in hospitals. The plant's antibacterial properties may be attributed to its tannins, saponins, flavonoids, and alkaloids.

Achyranthes aspera extracts were tested using disk diffusion and well plate method for their antibacterial effectiveness against a variety of pathogenic pathogens, including *Escherichia coli*, *Pseudomonas aeruginosa*, *Citrobacter* species, *Bacillus subtilis*, and *Micrococcus* species. The highest inhibition of *E. coli* was observed in extracts from *Achyranthes aspera* (17 mm), which was followed by *Pseudomonas* species (14 mm), *Citrobacter* species (12 mm), *Bacillus* species (12 mm), and *Micrococcus* species (12 mm).^[22]

Larvicidal activity:

It was discovered that root extract had strong hormonal effects on insect molting. When applied to tick larvae, ethanol crude extract exhibited strong larvicidal action against *Boophilismicroplus*. Tests against *Culex quinquefasciatus* and *Aedes aegypti* have been conducted on larvicidal saponins derived from leaf extracts. It was discovered that ethyl acetate leaf extract was effective against *Aedes subpictus* mosquito larvae. It was mentioned that the plant has the ability to suppress mosquito larvae. The bioactivity of steam-distilled leaf and stem essential oils was found to be highly effective in killing mosquitoes, specifically *Aedes aegypti* and *Culex quinquefasciatus*. There have been reports that the plant's leaf extracts are effective against *Aedes aegypti*.^[22]

Diuretic activity:

As rats were given 10–20 mg/kg i.m. dosages of the saponin extracted from *A. aspera* seeds, their urine production increased significantly after 2, 6, and 24 hours as compared to rats that were not given any treatment. The diuretic impact was similar to what was seen with a dosage of 3 mg/kg of mersalyl. The saponin's ideal dosage was 10 mg/kg. Rats who received oral saponin (5–10 mg/kg) showed a substantial increase in urine production that was equivalent to an oral acetazolamide dose of 10 mg/kg. Similar to acetazolamide, saponin's diuretic impact has been linked to increased potassium and sodium excretion in the urine.^[23]

Immuno-stimulant activity:

It was discovered that mice's Ovalbumin (OVA)-specific humoral antibody response was induced by *Achyranthes aspera* extract. There was a notable rise in IgM, IgG, and IgG3 antibodies. For IgE and other classes of antibodies, the antibody response was assessed with ELISA and passive cutaneous anaphylaxis (PCA), respectively. It was discovered that injecting *Achyranthes aspera* Linn extract intraperitoneally increased the generation of particular primary, secondary, and tertiary IgG antibodies. The extract was administered at 10, 50, 100, and 200 µg dosages, respectively, to stimulate *Achyranthes aspera*'s stimulatory action. Further investigation was conducted on haplotype mice (H-2d, H-2b, and H-2q) that demonstrated stimulatory activity across the genetic variance. Mice were subjected to an immunomodulatory effect in order to observe the ovalbumin-specific antibody response in various mouse groups.^[24]

II. CONCLUSION:

Now-a-days the people are becoming aware of potential uses and the side effects of the synthetic drugs, and there is the growing interest in the people towards the natural remedies with a basic approach towards the nature. *Achyranthes aspera* constitutes a number of phytochemical constituents, which further shows its uses for various pharmacological purposes. Thus, by considering all the scientific reports from the previous researchers, the present review gives a perception about *Achyranthes aspera* because of its many pharmacological actions like analgesic, anti-diabetic, wound healing, anti-oxidant activity and many more.

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