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Achyranthes aspera- A panacea treatment: An overview

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Abstract –

Achyranthes aspera Linn. (Prickly Chaff Flower) is a significant or notable medicinal herb that is a member of the Amaranthaceae family. It has been adopted in traditional medical systems, including Ayurveda, Unani, Siddha, and folk medicine, for centuries. The plant is highly considered for its diverse therapeutic properties and is widely distributed in tropical and subtropical regions. This review provides a compact summary of the available data regarding the taxonomy, vernacular names, geographical distribution, botanical characteristics, ethnopharmacological significance, traditional uses, phytochemical constituents, and pharmacological activities of *A. aspera*. The presence of alkaloids, flavonoids, terpenoids, saponins, tannins, cardiac glycosides, phytosterols, phenolic compounds, carbohydrates, and amino acids has been identified through phytochemical investigations, all of which contribute to the plant's biological activities. Experimental research has revealed a variety of pharmacological effects, such as anti-inflammatory, antioxidant, antimicrobial, antifungal, hepatoprotective, hypoglycaemic, hypolipidaemic, bronchoprotective, wound healing, anti-allergic, diuretic, larvicidal, spermicidal, and anthelmintic properties. The traditional use of this substance is well-established by its Wide range of medicinal properties, which also highlight its potential as a valuable source for the development of new therapeutic agents. However, additional phytochemical investigations, toxicological evaluations, and well-designed clinical studies are essential to establish its safety, efficacy, and therapeutic applications in contemporary medicine.

Keywords - *Achyranthes aspera*, Prickly Chaff Flower, Ethnopharmacology, Phytochemical Constituents, Traditional Medicine, Pharmacological Activities, Medicinal Herb.

1. Introduction –

The knowledge of medicinal plants has been transmitted from generation to generation for thousands of years. Herbal medicines are an important part of traditional healthcare systems around the world. Plants have been used as medicine since ancient times because they are available, affordable, and effective. In recent times, there has been a significant global increase in the use of plant-based health products in both developing and developed countries, resulting in a rapid rise in research on herbal products. Herbal medicines have a strong foundation in traditional medicine and possess the potential for the safe and effective treatment of various diseases. ^[1]

Achyranthes aspera, known as the "Prickly Chaff Flower," is a medicinal plant highly valued by both traditional healers and modern researchers for its various therapeutic properties. This plant has a long history of use across various cultures and is an important part of indigenous (traditional) systems of medicine. It is an herbaceous perennial plant belonging to the Amaranthaceae family, native to the tropical and subtropical regions of Asia, Africa, and Europe. Its ability to adapt to diverse climatic conditions has led to its widespread distribution, making it readily available for medicinal use. ^[2]

Achyranthes aspera Linn. is widely recognized across various traditional and modern medical systems, including Ayurveda, Unani-Tibba, Siddha, Allopathy, Homeopathy, Naturopathy, and home remedies. It is widely distributed across tropical and subtropical regions, where it thrives under diverse ecological conditions. ^[3]



Figure 1 – *Achyranthes aspera*

Taxonomical classification of *Achyranthes aspera* – [4]

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>

Vernacular Names - [5]

Achyranthes aspera is known by various names across the world. In English, it is called "Chaff Flower," "Prickly Chaff Flower," and "Devil's Horsewhip." Other local and traditional names are also in use, such as -

African – Bohomane, Bohome-bo-bole, Mo-tswarak-gano; Belgian Congo: Denge, Gnegna, Kalambata, Lenge, Lenamo.

Arabic – Atkumah, Na'eem, No'eim, Mahout, Wazer (Yemen).

Ayurvedic names – Apamarga, Chirchita, Shikhari, Shaikharika.

Bengali – Apaang.

English – Prickly Chaff Flower, Hawai Chaff Flower, Devil's Horsewhip, Prickly Chaff Flower.

French – Achyranth à feuilles rudes, Collant, Gendarme.

Gujarati – Safad Aghedo, Anghadi, Andhedi, Agado.

Hindi – Latjira, Chirchira, Lamchichra, Sonpur, Onga.

Indonesian – Jarong.

Kannada – Uttarane, Uthane.

Latin – *Achyranthes aspera* (A. aspera).

Malayalam – Kadaladi, Vankadaladi, Katalati.

Varieties and Cultivars –

Many varieties and cultivars of *Achyranthes aspera* exist, differing in taste, form, and uses. The major ones including -

Achyranthes aspera aspera

Achyranthes aspera borbonica

Achyranthes aspera pubescens

Achyranthes aspera rubrofusca

Achyranthes aspera velutina

Achyranthes aspera late ovata

The most common variety of these is often known as "Chaff Flower". [6]

Geographical Distribution –

Achyranthes aspera is broadly found in India, where it flourishes as a weed along road verges, field margins, and on wasteland. This species grows at altitudes reaching approximately 2,100 meters above mean sea level, and is also widely present throughout the South Andaman Islands. [7]

It is broadly distributed in tropical – subtropical zones of the world. Apart from its distribution in India, the species is also distributed in Baluchistan, Sri Lanka, various parts of tropical Asia, Africa, Australia, and America. Due to its rapid growth and adaptability, it has been reported as an alien invasive plant in northern Bangladesh. [8]

It is considered one of the major herbaceous species in Shivbari Sacred Grove of Himachal Pradesh, India. It is also known as an important medicinal plant in the Lalitpur district of Uttar Pradesh, India. [9]

This plant is commonly found in tropical and subtropical regions including India, Afghanistan, Africa, Algeria, Australia, Bahamas, Bolivia, Bhutan, Cameroon, Caribbean, Colombia, Cook Islands, Cuba, Fiji, Florida, Hawaii, Guam, Indonesia, Italy, Jordan, Laos, Lesotho, Malaysia, Mauritius, Myanmar, Mexico, Namibia, Pakistan, Philippines, Saint Lucia, Singapore, Sri Lanka, Spain, Syria, Tunisia, Tanzania, Uganda, and Zimbabwe. Nearly all plant parts, including leaves, seeds, and roots, possess medicinal value. [10]

Botanical Description of *Achyranthes aspera* Linn. (Macroscopic Information) -

Achyranthes aspera is a long lived, straight growing herb that can grow up to 2 meters tall. Its stem is branched, hairy, yellowish-brown, and usually four angled. The leaves are oval shaped to broad diamond shaped, about 5–22 cm long, with a soft surface. It produces extended terminal spikes (8–30 cm) bearing many small flowers ranging from white to reddish, mainly flowering in summer. The root system has a thick cylindrical taproot with Second- and third-level roots that are slightly ribbed and yellowish-brown, emitting a faint odour and having a mildly sweet, mucilaginous taste. Seeds are black, smooth, shiny, sub-cylindrical, with a rounded base and truncated apex. This species is widely distributed across India, thriving up to altitudes of around 3000 ft above sea level. [11]

Height: The plant is a stiff, erect herb growing from 0.2 to 2.0 meters high. The base is woody, angular or ribbed, either simple or branched, with bulged nodes often tinged with pink.

Root: Cylindrical root, measuring 0.1 to 1.0 cm in thickness, slightly ribbed, gradually tapering, yellowish-brown in color. Secondary and tertiary roots are present.

Stem: Square in cross-section, yellowish-brown, branched, hairy, erect, cylindrical, solid when fresh, and hollow when dry.

Flower: Flowers are arranged in long spikes forming inflorescences, 8 to 30 cm in length and 3 to 7 mm wide. They are bisexual, greenish-white, numerous, sessile, and bracteate with two bracteoles (one spine-lipped). Flowers are actinomorphic, hypogynous, with five membranous perianth segments, five

stamens with short filaments, two-celled anthers, and a bicarpellary, syncarpous gynoecium. The ovary is superior with a single ovule, a single style, and a single stigma. Flowers are producing during summer.

Fruit: An indehiscent dry utricle is a small, dry fruit that doesn't open at maturity, enclosed by persistent bracteoles and the flower's outer parts (perianth).

Seed: Seeds are rounded basally. ^[12]

Leaf: Leaves are opposite, densely hairy, obovate, and have wavy margins. The surface is Surrounded by white hairs. The petiole is Moon-shaped with a single-layer thick cuticle. The midrib has a single-layer epidermis, covered by 4–5 layers of parenchyma on the upper side and 2–3 layers on the lower side. Leaves average 5.22 cm in length and 2.5 cm in width, varying in size. The lower epidermis consists of anomocytic stomata. ^[13]

The plant features a woody, ribbed base with pink nodes. Its roots are cylindrical, yellowish-brown, and have secondary roots. The yellow-brown stem is branched, hairy, solid when fresh, and hollow when dry. Flowers are bisexual and sessile with five perianth segments and stamens. The ovary is superior with one ovule. The fruit is a dry, indehiscent utricle, and seeds are rounded at the base. ^[14]

Ethnopharmacological Significance –

The ethnopharmacological significance of *Achyranthes aspera* stems from its long-standing traditional use as a medicinal plant in many cultures worldwide. Indigenous communities and traditional healers have valued its therapeutic potential over centuries, using it to treat a variety of health conditions. ^[15]

Ethnopharmacological uses of *Achyranthes aspera*:

Anti-inflammatory and Analgesic Properties - Traditionally used in Ayurveda and Traditional Chinese Medicine (TCM) to relieve joint pain, arthritis, and other inflammatory conditions.

Wound Healing - Applied topically as poultices or ointments to promote healing of cuts, wounds, and burns.

Gastrointestinal Disorders - Used to treat diarrhoea, dysentery, and stomach ache, with believed antidiarrheal and anti-dysenteric effects.

Antimicrobial Activity - Employed as a natural remedy against bacterial, fungal, and viral infections.

Antipyretic Properties - Traditionally used to reduce fever and manage associated symptoms.

Respiratory Ailments - Used to alleviate coughs, bronchitis, and asthma.

Blood Sugar Regulation - Incorporated in traditional treatments to help manage diabetes and regulate blood sugar levels.

Reproductive Health - Used in some cultures for menstrual disorders and postpartum complications.

Immune System Support - Known to boost the immune system and enhance resistance to infections.

Achyranthes aspera has a long history of traditional use, but more scientific research and clinical trials are needed to confirm its medicinal benefits. Integrating traditional knowledge with modern science could unlock its potential for new drugs or natural health products. ^[16]

Traditional Uses - *Achyranthes aspera* is used for the manage asthma, cough, pneumonia, digestive disorders, and skin diseases. Herbal extracts prepared from the crushed plant and Plant extracts of the roots are commonly used in traditional medicine. In addition, a paste made from the seeds or flowering spikes is applied externally for snake bites and certain eye and skin ailments. ^[17]

For snake bites, the ground root is given with water until the patient vomits and regains consciousness. Inhalation of fumes from a mixture of *Achyranthes aspera* and *Smilax ovalifolia* roots is believed to enhance appetite and alleviate gastric ailments. ^[18]

The plant is useful for haemorrhoids (Piles), its leaves and seeds act as an emetic, hydrophobia treatment, carminative, reduce swelling, aid digestion, and expel phlegm. Residue of the plant is applied externally to treat ulcers and warts. Crushed leaves rubbed on the back help cure strained or aching backs. A fresh piece of root is used as a toothbrush. A paste of the roots in water is used to treat ophthalmia (Ocular inflammation) and corneal opacities. Paste of fresh leaves is used to relieve pain from wasp stings. The plant also helps with liver complaints, rheumatism, scabies, and numerous skin diseases. It exerts a sedative effect. ^[19]

1. Respiratory Disorders - Asthma, Bronchitis, Common Cold, Cough, Pneumonia
2. Gastrointestinal Disorders - Colic, Dysentery
3. Dermatological Disorders - Boils, Leucoderma, Various Skin Diseases
4. Reproductive Uses - Facilitation of Childbirth (Delivery)

Traditional herbal claim enhances the therapeutic efficacy of other plant-based medicines in herbal formulations. ^[20]

History and Origin –

Achyranthes aspera is naturally occurring to South-east Asia and has been cultivated since ancient times. The name *Achyranthes* comes from Greek words: "*Achyro*" meaning "chaff or husk" and "*anthas*" meaning "flower." The exact origin of the herb's name is uncertain; some suggest it refers to its symmetry above the plane. According to ancient accounts, Alexander the Great brought the plant to Greece. It was introduced to France and the USA in the 1700s from South Asia. ^[21]

Herbal medicines are extensively used in both developed and developing nations, including India, due to their different therapeutic properties, relatively better safety profile, and cost-effectiveness compared to many synthetic drugs. The sustained interest in *Achyranthes aspera* is largely linked to its wide range of biological activities and its significance in herbal medicine. ^[22]

2. Phytochemical Screening of *Achyranthes aspera* –

Phytochemical screening of *Achyranthes aspera* was conducted to identify the major bioactive constituents present in its crude extract. The ethyl acetate extract was subjected to qualitative analysis to detect various phytochemical classes such as alkaloids, flavonoids, cardiac glycosides, terpenoids, phytosterols, tannins, saponins, phenolic compounds, carbohydrates, and amino acids. Standard qualitative tests, with minor modifications, were employed to reliably determine the presence of these constituents. This screening provides foundational insight into the chemical composition of the plant, which may underlie its diverse pharmacological activities.

Alkaloids, Flavonoids, Cardiac glycosides, Terpenoids, Phytosterols, Tannins, Saponins, Phenolic compounds, Carbohydrates, Amino acids. ^[23]

1. Test for Flavonoids –

A. Shinoda Test - The extract was dissolved in alcohol, and a few magnesium turnings were added, followed by the dropwise addition of concentrated hydrochloric acid. The appearance of a pink to reddish coloration indicated the presence of flavonoids in the extract. ^[24]

B. Alkaline reagent test - The alkaline reagent test was performed by dissolving a small portion of the plant extract in alcohol, followed by the addition of a few drops of sodium hydroxide solution. The appearance of an intense yellow colour indicated the presence of flavonoids. This yellow coloration disappeared upon the subsequent addition of dilute hydrochloric acid. ^[25]

2. Tests for Cardiac Glycosides –

A. Legal's test – The extract was treated with pyridine followed by alkaline sodium nitroprusside solution. The reaction resulted in the development of a characteristic blood-red coloration, which was considered a positive indication for the presence of cardiac glycosides. This colour change occurs due to the interaction of the reagent with the glycosidic constituents present in the extract.

3. Test for Terpenoids –

A. Salkowski test - The Salkowski test was conducted by dissolving the extract in chloroform, followed by the gradual addition of a few drops of concentrated sulfuric acid to form a distinct layer. The appearance of a reddish-brown colour at the interface indicated the presence of terpenoids in the extract. [26]

4. Test for Phytosterols –

A. Liebermann -Burchard test - The extract was dissolved in chloroform, to which a few drops of acetic acid and concentrated sulfuric acid were added. The development of a deep green colour upon mixing indicated the presence of steroids in the extract. [27]

5. Test for Tannins –

A. Gelatin test - The extract was treated with a 1% gelatin solution containing 10% sodium chloride. The appearance of a white precipitate was considered a positive result, indicating the presence of tannins in the extract. The precipitate is formed due to the interaction between tannins and gelatin proteins. [28]

6. Test for Saponins –

A. Foam tests - A small amount of the extracted sample was shaken vigorously with water. The formation and persistence of a stable froth or foam on the surface for several minutes indicated the presence of saponins in the extract.

7. Test for Carbohydrates –

A. Molisch's test - Two hundred milligrams of the extract were dissolved in 5 mL of distilled water and filtered. To the filtrate, a few drops of alcoholic alpha-naphthol were added, followed by the careful addition of concentrated sulfuric acid along the sides of the test tube. The appearance of a violet ring at the interface indicated the presence of carbohydrates in the extract. [29]

3. Pharmacological Studies –

1. Hypolipidemic Activity - The administration of its alcoholic extract at a dose of 100 mg/kg has been shown to markedly reduce serum lipid profiles including total cholesterol, phospholipids, triglycerides, and total lipids in both hyper lipidemic and normal rat models. Specifically, in triton-induced hyper lipidemic rats, reductions of 60%, 51%, 33%, and 53% were observed in total cholesterol, phospholipids, triglycerides, and total lipids respectively. Chronic administration to normal rats over a period of 30 days further resulted in substantial decreases in these lipid parameters, accompanied by a significant reduction in hepatic lipid content.

The mechanism underlying the hypolipidemic effect of *Achyranthes aspera* is hypothesized to involve enhanced faecal excretion of bile acids, notably cholic acid and deoxycholic acid, which increased by 24% and 40% respectively upon treatment. This increased bile acid excretion likely leads to decreased intestinal absorption of cholesterol, thereby lowering serum cholesterol levels. Thus, *Achyranthes aspera* may exert its lipid-lowering effects through modulation of bile acid metabolism, offering potential therapeutic benefits in the management of hyperlipidaemia. [30]

2. Antimicrobial & Antifungal Activity - Various extracts, including seed extracts, ethyl acetate extract of the stem, ethanol and methanol extracts of leaves and stems, as well as aqueous flower extracts, have demonstrated significant antibacterial effects. Additionally, the essential oil derived from the plant has

shown notable antifungal activity, highlighting its potential as a natural antimicrobial and antifungal agent. [31]

3. Larvicidal Activity - The ethanol crude extract demonstrated strong larvicidal effects against tick larvae, specifically *Boophilus micro plus*. Larvicidal saponins isolated from leaf extracts showed efficacy against mosquito larvae, including *Aedes aegypti* and *Culex quinquefasciatus*. Additionally, the ethyl acetate leaf extract was active against *Aedes subpictus* mosquito larvae. The plant is recognized for its potential in controlling mosquito larvae populations. Essential oils obtained from the leaf and stem through steam distillation exhibited larvicidal activity against *Aedes aegypti* and *Culex quinquefasciatus*. [32]

4. Hepatoprotective Activity – The ethanolic seed extract of *Achyranthes aspera* was tested in rats with carbon tetrachloride-induced liver damage. Serum levels were measured to assess liver function. When the extract was administered alongside the standard drug silymarin, it showed significant hepatoprotective effects. [33]

5. Cardiovascular Activity - Achyranthine, a water-soluble alkaloid from *Achyranthes aspera*, decreases blood pressure and heart rate, dilates blood vessels, and increases the rate and amplitude of respiration in dogs and frogs. At 0.5 mg/ml, its contractile effect on frog rectus abdominal muscle is less than acetylcholine (0.1 mg/ml), and its spasmogenic effect is not blocked by tubocurarine. [34]

6. Bronchoprotective Activity - The ethanolic extract of *Achyranthes aspera* shows a bronchoprotective effect in toluene diisocyanate (TDI)-induced occupational asthma in Wistar rats. Total and differential leukocytes were measured in blood and bronchoalveolar lavage (BAL) fluid. Liver homogenate was used to assess oxidative stress, and lung histology examined airway inflammation. [35]

7. Anti-allergic Activity - The petroleum ether extract (200 mg/kg, i.p.) of *Achyranthes aspera* shows significant antiallergic activity in milk-induced leukocytosis and eosinophilia in mice. This activity may be due to its nonpolar constituents, particularly steroids. Phytochemical screening revealed steroids like β -sitosterol, ecdysone, and ecdysterone, which may be responsible for the antiallergic effects. [36]

8. Wound Healing Activity- The ethanolic and aqueous leaf extracts of *Achyranthes aspera* have been reported to exhibit wound healing activity, supporting their traditional use in the management of wounds. [37]

9. Antioxidant Activity - Antioxidant activity has been reported in both the leaves and roots of *Achyranthes aspera*, suggesting its potential role in scavenging free radicals and reducing oxidative stress. [38]

10. Anti-Inflammatory Activity - The anti-inflammatory activity of *Achyranthes aspera* has been extensively studied. Alcoholic extracts of the plant demonstrated significant anti-inflammatory effects in Wistar rats using the carrageenan-induced paw oedema and cotton pellet granuloma models. Specifically, the alcoholic extracts of leaves and seeds showed notable activity in both the induced paw oedema and formalin tests. [39]

In studies on albino male rats, the alcohol extract (at doses of 375 and 500 mg/kg) was evaluated using the carrageenan-induced hind paw oedema and cotton pellet granuloma models. Paw volume was measured plethysmometrically (using a plethysmometer) at intervals of 0 to 5 hours, with diclofenac sodium serving as the standard drug. The extract exhibited maximum inhibition of paw oedema by 65.38% and 72.37% respectively at 3 hours post-carrageenan injection. In the chronic granuloma test, the extract reduced granuloma weight by 40.03% and 45.32%, indicating significant anti-inflammatory efficacy. [40]

11. Spermicidal activity - Root extracts of *Achyranthes aspera* have been reported to exhibit significant spermicidal activity against both human and rat spermatozoa, indicating its potential use as a natural antifertility agent. [41]

Further investigations evaluated the hydroethanolic, n-hexane, and chloroform root extracts of *Achyranthes aspera*, which demonstrated marked spermicidal effects by reducing sperm motility and viability. In addition, the ethanolic root extract exhibited significant post-coital antifertility activity in female albino rats. [42]

12. Hypoglycaemic Activity - Oral administration of 2, 3, and 4 g/kg of *Achyranthes aspera* whole plant powder produced a significant, dose-related hypoglycaemic effect in normal and alloxan diabetic rabbits. Both water and methanol extracts also lowered blood glucose levels. A 7-day toxicity study showed no adverse effects up to 8 g/kg orally. The plant may work by supplying essential elements like calcium, zinc, magnesium, manganese, and copper to beta-cells. [43]

13. Anti-Helminthic Activity – The anthelmintic activity of *Achyranthes aspera* was tested on adult Indian earthworms (*Pheretima posthuma*). Aqueous stem extracts were prepared at 2.5, 5, 10, and 20 mg/mL using 1% Tween 20 in normal saline. Six earthworms (8–10 cm) were placed in petri dishes with 30 mL of each solution. Albendazole at the same concentrations was the reference, and normal saline with 1% Tween 20 was the negative control. Paralysis time (no movement even in saline) and death time (no response to shaking, warm water, and color fading) were recorded. All solutions were freshly prepared. [44]

14. Diuretic Activity - A saponin isolated from the seeds of *Achyranthes aspera* has demonstrated significant diuretic activity in adult male albino rats. The optimum oral dose of the saponin was found to be 10 mg/kg, which produced an increase in urine output comparable to that observed with a 10 mg/kg oral dose of the standard diuretic drug, acetazolamide. This suggests the potential of the saponin as an effective natural diuretic agent. [45]

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