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A SYSTEMATIC REVIEW ON ACHYRANTHES ASPERA L. (PRICKLY CHAFF FLOWER): PHYTOCHEMICAL PROFILE, ETHNOMEDICINE AND FUTURE PROSPECTS

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ABSTRACT

Achyranthes aspera L., belonging to the Amaranthaceae family, is a medicinal plant with a broad geographical distribution and is traditionally utilized in indigenous health practices like Ayurveda, Siddha and Unani. This plant is rich in various phytochemicals such as saponins, alkaloids, terpenoids, steroids, flavonoids, fatty acids and phenolic compounds, which are responsible for its diverse therapeutic properties, including anti-inflammatory, analgesic, antioxidant, antimicrobial, antidiabetic, hepatoprotective, wound healing, immunomodulatory, hypolipidemic and antifertility effects. Numerous traditional claims have been substantiated by scientific research through in-vitro and in-vivo studies. Nonetheless, the scarcity of clinical trials, ambiguous mechanisms and insufficient toxicity data hinder its integration into contemporary drug development. This systematic review offers a comprehensive update on the plant's taxonomy, ethnomedicinal uses, phytochemistry, pharmacology and safety profile as well as its potential for future pharmaceutical and cosmetic applications. Enhancing standardization, phytochemical analysis, reproductive toxicity assessment and clinical validation is crucial to establish A. aspera as a reliable and effective phytopharmaceutical product.

KEYWORDS: Achyranthes aspera L., Amaranthaceae, ethnomedicine, phytochemistry, antioxidant, wound healing, pharmacological activity.

1. INTRODUCTION

Fig. 01: Plant of *Achyranthes Aspera L.*[1]

Plants offer a vast array of therapeutic substances and are extensively utilized in both traditional and contemporary medicine.[1] Approximately 80% of the global population relies on herbal treatments for primary healthcare needs. *Achyranthes aspera L*., also known as Prickly Chaff Flower[2] or Latjeera, is a perennial herb frequently employed in addressing inflammatory conditions, wounds, digestive issues, respiratory ailments, and reproductive disorders.[3] The plant's significant biological activities are attributed to its rich content of phytochemicals such as flavonoids, saponins, steroidal compounds, triterpenoids, phenolics and alkaloids. Recent pharmacological research has confirmed its anti-inflammatory, antimicrobial, wound healing, antidiabetic, hepatoprotective, and anticancer properties.[4,5] Despite its widespread use in ethnomedicine, there is a lack of standardized clinical research and safety evaluations. Consequently, this review seeks to systematically gather verified information on its phytochemistry, pharmacology and therapeutic potential, while also emphasizing the need for future research directions in drug development.

Table 01: Major Traditional Uses.[17,18]

Condition / Purpose	Mode of Use
Inflammation, arthritis	Paste or decoction
Wound healing, burns	Leaf poultice
Fever	Root decoction
Respiratory diseases (asthma, cough)	Whole plant juice
Digestive problems (diarrhea, dysentery)	Leaf/alcoholic extracts
Snake bites	Root juice (folk use)
Reproductive issues\	Root and seed preparations
Skin diseases, acne	Topical application

Table 02: Taxonomical Classification of *Achyranthes aspera L.*[4]

Category	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta
Phylum / Division	Magnoliophyta (Angiosperms)
Class	Magnoliopsida (Dicotyledons)
Order	Caryophyllales
Family	Amaranthaceae
Genus	Achyranthes
Species	*Achyranthes aspera L.*

Table 03: Vernacular Names.[5,12]

Language	Name
Sanskrit	Apamarga
Hindi	Latjeera, Chirchira
Marathi	Aaghada
Gujarati	Safed Aghedo
Tamil	Siru-kadaladi
Telugu	Uttareni
Malayalam	Kadaladi
Punjabi	Kutri
Arabic	Atkumah
English	Prickly Chaff Flower

2. Botanical Description

Achyranthes aspera L. is a perennial herb belonging to the family Amaranthaceae. It thrives as a common weed in tropical and subtropical regions and is easily recognized by its rough-textured leaves and spiny inflorescences.[6]

Achyranthes aspera L. is a perennial herb belonging to the family Amaranthaceae. It thrives as a common weed in tropical and subtropical regions and is easily recognized by its rough-textured leaves and spiny inflorescences. *Achyranthes aspera L.* is characterized as a perennial or sometimes annual herbaceous plant, with a prostrate or erect habit.[7]

Morphology

Fig. 02: Inflorescence, Leaves & Roots of *Achyranthes Aspera Linn.*[12]

Height: Typically, it attains a height ranging from 0.2 to 2 m, often supported by a woody base.[20] *Achyranthes aspera L.* (Latjeera) is an erect or procumbent, annual or perennial herb of about 1- 2 meter in height, often with a woody base.[8,9]

Leaf: The leaves are arranged oppositely bearing a velvety, tomentose texture.[8] They take on an obovate form, with undulating margins and a white hairy surface.[8] The leaf petiole has a crescent-shaped outline and consists of a single-layer cuticle with a thick cuticle.[8,10] The midrib has a single-layer epidermis, surrounded by 4 to 5 layers of parenchyma on the upper surface and 2 to 3 layers of parenchyma on the lower surface.[10] Leaf dimensions vary, with an average length of 5.22 cm and a width of 2.5 cm. They can be found in assorted sizes, featuring anomocytic stomata on the lower epidermis[7] ovate – elliptic or obovate – rounded[11], finely and softly pubescent on both sides, entire, petiolate, petiole 6 – 20 mm long.[9]

Branch: The branches are either terete or quadrangular, marked by striations and a pubescent surface. They support thick leaves.[7] Stems are 4-sided and covered in short hairs.[4] Stems angular, ribbed, simple or branched from the base, often with a tinged purple colour, branches terete or absolutely quadrangular, striate, pubescent.[8,9]

Roots: The root system comprises secondary and tertiary roots. These roots are cylindrical in shape, exhibiting a diameter ranging from 0.1 to 1 cm. They possess a somewhat ribbed texture, gradually tapering towards the ends, and are tinted yellowish-brown.[8,9,7]

Fruits: Dry, indehiscent fruit known as utricle is bladder-like and covered by loose, papery tissue. Each egg-shaped fruit (2.5-3 mm long) contains 1 brown, egg-shaped seed (2 mm long).[7,8]

Flower: flowers with a greenish-white hue, numerous in axillary or terminal spikes up to 75 cm long.[9] Arranged in spikes, the flowers vary in length from 8 to 30 cm, with a width of 3 to 7mm. They are bisexual, presenting a greenish-white hue and occur in numerous quantities.[7] Flowers are sessile and bracteate and have two bracts, one of which has a spiny lip.[7] They exhibit optical symmetry and subcellular arrangement. The perianth comprises five membranous segments, while there are five stamens with short filaments and a two-celled anther.[9,7]

Seeds: The seeds possess a brown hue, featuring a truncated apex and a rounded base. They are endospermic and sub-cylindrical in shape.[7]

2.3 Microscopic Evaluation of *Achyranthes aspera L.*

Sample Preparation

Fresh leaves of *Achyranthes aspera L.* were sectioned crosswise, mounted in glycerin, and stained with phloroglucinol-HCl to facilitate microscopic observation.

Fruit

The fruit is a dry utricle characterized by a thin, bladder-like pericarp that does not dehisce. It remains enclosed within a persistent perianth and bracteoles.[8,14]

Leaf

1. **Petiole:** The petiole exhibits a single-layered epidermis covered by a thick cuticle.[8] The ground tissue is composed of thin-walled parenchymatous cells containing rosette crystals of calcium oxalate In the central region, 4–5 vascular bundles are present.[14]

2. **Midrib**

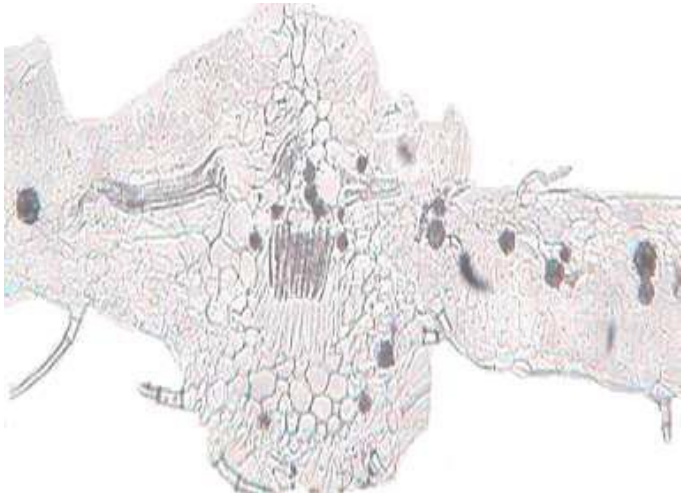


Fig 03: T. S. of *Achyranthes aspera* Linn. (Apamarga) leaf through midrib.[30]

The midrib shows a thin, single-layered epidermis.[10] Beneath the upper epidermis are 4–5 layers of collenchyma, while the lower epidermis contains 2–3 layers.[10,14] The ground tissue consists of thin-walled parenchymatous cells with several vascular bundles, each accompanied by thin layers of cambium located below the xylem vessels.[14]

3. Lamina

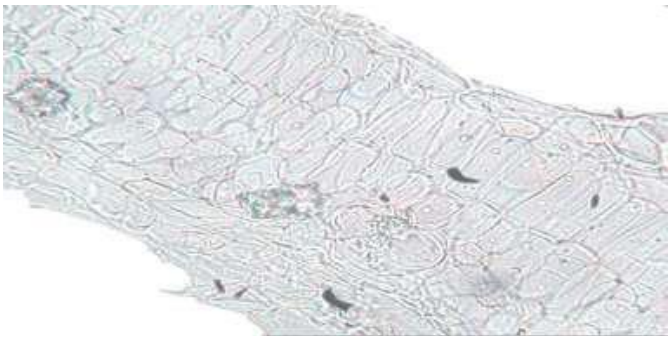


Fig. 04: T. S. of *Achyranthes aspera* Linn. (Apamarga) leaf through lamina.[30]

The lamina has a single-layered, tangentially elongated epidermis covered with a thick cuticle. Trichomes are both uni- and multicellular and occur on both surfaces.[10] Idioblasts containing large rosette crystals of calcium oxalate are found within both palisade and spongy parenchyma cells.[14]

4. Stomata

Stomata are anisocytic and anomocytic, present on both leaf surfaces.

- **Stomatal index:** 4.5–9.0 (upper surface) and 9.0–20.0 (lower surface)
- **Palisade ratio:** 7.0–11
- **Vein density:** 7–13 veins per sq. mm[14]

Flower

The flowers are arranged in perennial, elongated spikes and display a greenish-white colour.[8] They are abundant, sessile, and accompanied by two bracteoles, one of which is spine-lipped. The flower is bisexual, actinomorphic, and hypogynous.[8,14]

The perianth consists of five free, membranous segments, which may be twisted or arranged quincuncially. There are five stamens, positioned opposite the perianth lobes. The filaments are short, and the anthers are two-celled and dorsifixed. Staminodes are present, alternating with the fertile stamens, and are truncate and fringed. The gynoecium is bicarpellary and syncarpous, with a superior, unilocular ovary containing a single ovule. The style is single, terminating in a capitate stigma.[1,14]

Root

Fig. 05: T. S. of *Achyranthes aspera* Linn. (Apamarga) root.[30]

The root of *Achyranthes aspera* is a taproot, cylindrical in shape, and slightly ribbed, measuring 0.1–1.0 cm in thickness. It tapers gradually and appears rough due to root scars. The mature root is yellowish-brown, with no distinct odour.[7]

- The corkcomprises 3–8 layers of rectangular, tangentially elongated, thin-walled cells.
- The secondary cortexconsists of 6–9 layersof oval to rectangular parenchymatous cells, containing scattered stone cells.
- 4–6 discontinuous ringsof secondary thickeningmade up of vascular tissuesare present.
- Sieve tube patchesare found in the phloem parenchyma, separating the xylem rings.
- The xylem consists of typical elements with simplypittedvessels.
- Medullary rays are 1–3 cells wide, and prismatic calcium oxalate crystals are abundant in the cortical region, especially within the medullary rays.[14]

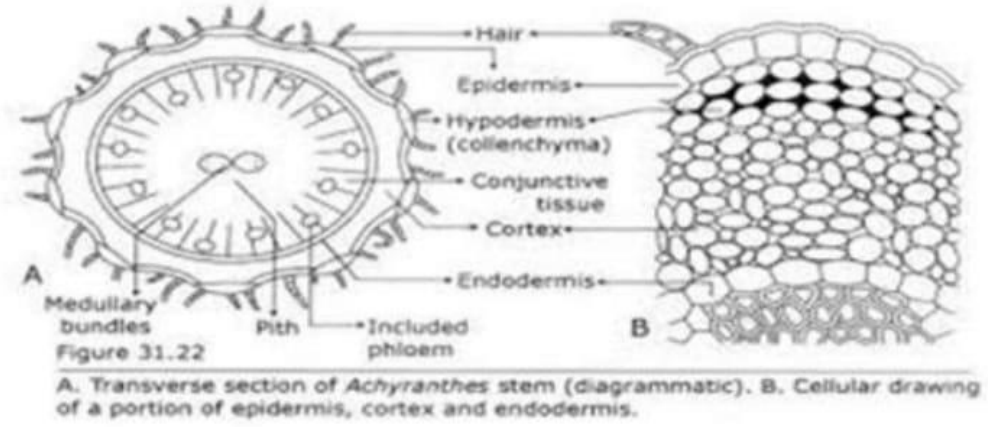


Fig 06: Transverse section of *Achyranthes Aspera* plant stem.[11]

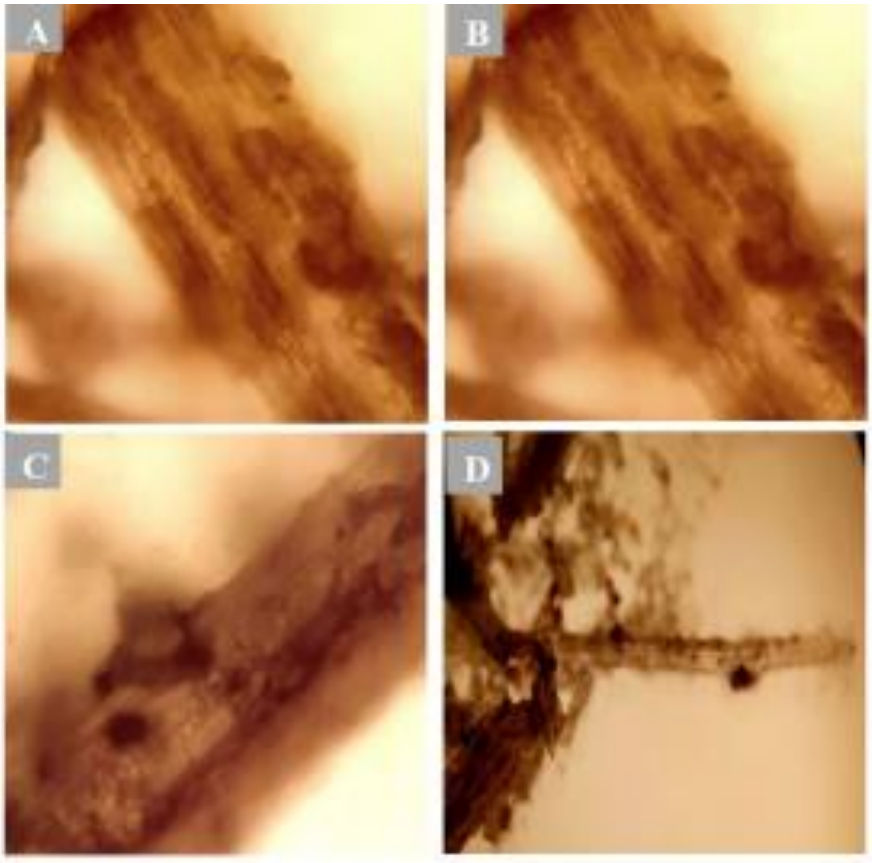


Fig. 07: Microscopic studies of *A. aspera* (A) Xylem (B) Phloem (C) calcium oxalate crystals (D) pitted fibers.[15]

2.4 Geographical Distribution[7,9,16,18]

Achyranthes aspera L. is widely distributed across:

- India, Nepal, Bangladesh, Pakistan
- Sri Lanka, China, Southeast Asia
- Africa, Australia, and the Americas

It commonly grows in

- Roadsides, farmland margins, wastelands
- Up to 2,100 m altitude

This easy availability increases its importance as a low-cost medicinal resource.

3. Traditional and Ethnomedicinal Relevance

Achyranthes aspera L. has been used extensively in Ayurveda, Siddha, Unani, and tribal medicine.

4. EXTRACTION TECHNIQUES

The extraction of *Achyranthes aspera* phytoconstituents has been performed using different solvents, depending on polarity.

4.1 Sample Preparation

- Plant parts (leaves, roots, seeds, stems) are shade-dried at room temperature (25–30°C)
- Pulverized to coarse powder using a grinder
- Stored in airtight containers at 4°C until extraction

Table 04: Solvent Extraction Approaches.

Method	Solvent Used	Major Constituents Extracted	Purpose	References
Soxhlet extraction	Methanol, ethanol, chloroform, n-hexane	Terpenoids, steroids, fatty acid	Complete phytoconstituent extraction	[19,20]
Cold maceration	Hydroalcoholic solvents (50–80% ethanol)	Heat-sensitive compounds	Traditional relevance	[13,21]
Aqueous extraction	Distilled water	Polar Compounds	Used in herbal medicines	[22]

Post-extraction, solvents are evaporated using a rotary evaporator at ≤40°C and extracts stored under refrigeration to preserve stability.

Achyranthes aspera L. contains>50 identified phytochemical compounds across plant parts.

5. Phytochemistry

Achyranthes aspera L. contains diverse secondary metabolites contributing to its pharmacological effects.

5.1 Physicochemical Parameters

Table No 05: Parameters.

Sr. no	Parameter	Procedure	Reference
1	Loss on Drying (Moisture Content)	Weigh about 5 g of the powdered drug in a pre-weighed porcelain dish. Heat at	[14,15]
2	Ash Value	Place the dried plant powder in a silica crucible. Ignite gradually until the residue becomes	[14,15]
3	Acid-Insoluble Ash	Boil the ash with	[14,15]
4	Water-Soluble Ash	Accurately weigh the total ash and mix it with	[14,15]
5	Swelling Index	Accurately weigh	[15]

5.2. Phytochemical Evaluation

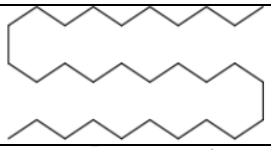
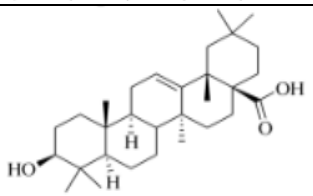
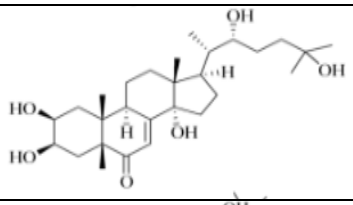
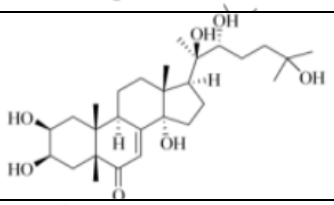
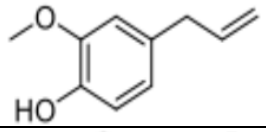
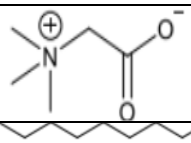
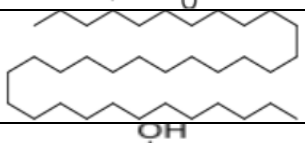
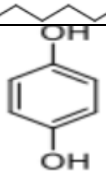
Preliminary Phytochemical Screening

Qualitative phytochemical analysis of *Achyranthes aspera L.* extracts (petroleum ether, benzene, chloroform, ethyl acetate, ethanol, and aqueous) was carried out using standard methods.[19]

Table 06: Phytochemical Test For Evaluation Phytoconstituent of *Achyaranthes aspera L.*

Constituent	Test Name	Procedure	Observation	Inference	Reference
Alkaloids	Mayer's Test	Add a few drops of Mayer's reagent to 1 mL of test solution.	Buff-colored precipitate	Alkaloids present	[14,19,23]
	Dragendorff's Test	Add 1–2 mL of Dragendorff's reagent to 2 mL of filtrate	Red precipitate	Alkaloids present	[14,19,25]
	Tannic Acid Test	Add 10% tannic acid solution to the test sample	Buff-colored precipitate	Alkaloids present	[14,19,24]
Tannins	Ferric Chloride Test	Add 2 mL of 10% $FeCl_3$ to filtrate.	Blue-black or green color	Tannins present	[14,19,24]
	Gelatin Test	Add 1 mL of 1% gelatin and 1 mL of 10% NaCl to test solution.	White precipitate	Tannins present	[11,14,24]
	Vanillin Hydrochloride Test	Add 1 mL of vanillin hydrochloride reagent.	Purple-red color	Tannins present	[4,14,19,24]
Cardiac Glycosides	Keller-Killiani Test	Add 2 mL conc. H_2SO_4, 4 mL glacial acetic acid, and a few drops of $FeCl_3$ to extract.	Brown ring at interface	Cardiac glycosides present	[14,19]
	Salkowski Test	Add 2 mL chloroform and 1 mL conc. H_2SO_4 to test solution.	Reddish-brown interface	Cardiac glycosides present	[14,24]
Proteins	Ninhydrin Test	Add 1 mL of 0.2% ninhydrin solution to extract and heat gently.	Violet color	Proteins present	[19]
Reducing Sugars	Fehling's Test	Heat 1 mL filtrate with 1 mL each of Fehling's solutions A and B.	Brick-red precipitate	Reducing sugars present	[14,19]
Saponins	Foam Test	Add 2 mL distilled water to 0.5 mL test solution and shake vigorously.	Persistent foam for 10 min	Saponins present	[14,19]

Table 07: Phytoconstituents.

Chemical Constituents	Molecular Formula	Chemical Structure	IUPAC Name	References
Triacontanol	C30H62O		Triacontan-1-ol.	[10,25]
Oleano	C30H48O		3β-hydroxyolean-12-en-28-oic acid.	[10,25,26]
Ecdysone	C27H44O6		(22R)-2β,3β,14α,22,25-Pentahydroxy-5β-cholest-7-en-6-one	[10,25]
Ecdysterone	C27H44O7		(22R)-2β,3β,14α,20,22,25-hexahydroxy-5β-cholest-7-en-6-one	[25,27]
Eugenol	C10H12O2		4-Allyl-2-methoxyphenol	[1,10,25]
Betaine	C5H11NO2		2-(trimethylazaniumyl)acetate	[25,26]
Pentatricontane	C35H72		pentatriacontane.	[1,25]
Hydroquinone	C6H6O2		Benzene-1,4-diol	[1,25]

6. Pharmacological Activities

Based on the variety of phytochemicals identified in *Achyranthes aspera L.*, multiple biological pathways may be influenced, leading to diverse therapeutic responses. Therefore, it is critical to connect each phytochemical group with corresponding experimentally validated pharmacological outcomes. The following section provides a logical and coherent organ-system–based overview of these activities, followed by a mechanistic interpretation that links specific constituents such as saponins, flavonoids, and alkaloids to the plant's therapeutic potential.

1.Anti-inflammatory Activity

Achyranthes aspera L. has been traditionally used to manage inflammation. Its bioactive compounds—flavonoids, alkaloids, and saponins—suppress pro-inflammatory mediators and cytokines.[3] T. Vetrichelvan and M. Jagadeesans (2003) evaluated the alcoholic extract of *A. aspera* on cotton pellet granuloma and carrageenan-induced hind paw oedema in albino rats. The extract (375–500 mg/kg) inhibited oedema by 65.38% and 72.37% at 3 hours and reduced granuloma weight by up to 45.32%, comparable to diclofenac sodium.[4,28]

System: Musculoskeletal.

Mechanism: Inhibition of COX-2, TNF-α, nitric oxide (NO)&prostaglandins.

Table 08.[4,12]

Extract	Model	Findings	Inference
Ethanol extract	Carrageenan-induced paw edema	In albino male rats72.37% edema inhibition at 500 mg/kg	Strong anti-inflammatory activity
Alcohol extract	Cotton pellet granuloma	40–45% reduction in granuloma weight	Anti-proliferative effect in chronic inflammation

Conclusion: Plant saponins and flavonoids show Diclofenac-comparable anti-inflammatory action.

2. Analgesic and Antinociceptive Activity

Methanolic and hydroalcoholic extracts of *A. aspera L.* leaves, roots, and seeds have demonstrated both central and peripheral analgesic effects. Studies using hot plate, tail flick, and acetic acid-induced writhing tests showed significant pain reduction at doses of 200–400 mg/kg, comparable to aspirin.[5]

System: Central and peripheral nervous system

Mechanism: Modulation of nociceptive pathways

Table 09.[3,5]

Extract	Assay	Result
Methanolic leaves	Hot plate&tail flick methods	↑ Pain threshold
Hydroalcoholic leaves&roots	Acetic acid writhing	60% inhibition of writhing at 400 mg/kg

3. Antioxidant Activity

The ethanolic extract of *A. aspera L.* leaves exhibits concentration-dependent free radical scavenging effects. Pandey et al. reported IC_{50} values of 62.24 µg/ml (DPPH) and 68.32 µg/ml (hydroxyl radicals), indicating strong antioxidant capacity due to phenolic and flavonoid constituents.[23]

Mechanism: Reactive oxygen species (ROS) scavenging
Phenolics and flavonoids are major contributors.

Table 10:[3,23]

Assay	IC_{50} Value	Interpretation
DPPH	62.24 µg/mL	Strong radical scavenging
Hydroxyl radical	68.32 µg/mL	Prevents oxidative stress

4. Antimicrobial Activity

Extracts of *A. aspera L.* display inhibitory effects against several bacterial and fungal pathogens, including *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, *Micrococcus luteus*, and *Candida* spp. These properties support its traditional use in treating skin infections.[23,28]

Mechanism : Supports its traditional use in skin infections.

Table 11.[4]

Pathogen	Extract	Activity
Staphylococcus aureus	Methanolic leaves	Strong antibacterial
Candida albicans	Ethyl acetate	Antifungal
Drug-resistant bacteria	Crude extract + Ciprofloxacin	Synergistic effect

5. Wound Healing Activity

Ethanolic and aqueous extracts of *A. aspera L.* leaves promote wound healing through enhanced angiogenesis, collagen synthesis, and cell proliferation. S. Edwin et al. (2008) demonstrated significant wound contraction and tensile strength improvements in excision and incision wound models.[9,5]

System: Skin & connective tissues
Mechanism: ↑ Collagen synthesis, angiogenesis, epithelialization

Table 12.[3,5]

Model	Findings
Excision wound in rats	98% closure by day 14
Incision wound	↑ Tensile strength of tissue

6. Antidiabetic Activity

Extracts from *A. aspera L.* exhibit hypoglycemic effects by regulating blood glucose levels, suggesting potential in diabetes management.[3]

System: Endocrine

Mechanism: Enhances glucose metabolism, insulin response Helps manage diabetic conditions.

Table 13.[23]

Model	Result
Alloxan-induced diabetic rats	29–43% reduction in fasting blood glucose

7. Hepatoprotective Activity

Methanolic extracts of the aerial parts protect against rifampicin-induced hepatotoxicity in rats by normalizing serum SGOT, SGPT, ALKP, and bilirubin levels (Bafna&Mishra, 2004).[16,28]

System: Liver

Mechanism: ↓ SGOT, SGPT, ALP — protects hepatocytes

Useful in liver disorders including jaundice.

Table 14.[16]

Toxin	Outcome
Rifampicin-induced liver injury	Significant restoration of liver enzymes

8. Anticancer Activity

Methanolic leaf extracts inhibited Epstein–Barr virus early antigen activation in Raji cells, indicating potential chemopreventive activity (Chakraborty et al., 2002).[9]

9. Antihypertensive Activity

Preliminary research indicates vasodilatory and blood pressure–lowering effects of *A. aspera L.* extracts, supporting its potential use in hypertension management.[3]

10. Antidepressant Activity

C.C. Barua et al. (2009) showed that methanolic extracts of *A. aspera L.* (200–600 mg/kg)

significantly reduced immobility time in forced swim and tail suspension tests, indicating antidepressant-like effects.[5,9,16]

CNS Activity — Antidepressant

Mechanism: Serotonergic & adrenergic interaction

Table 15.[5,9,16]

Test	Observation
Forced swim&tail suspension	↓ Immobility time — antidepressant-like effect

11. Diuretic Activity

Ethanolic and aqueous leaf extracts increased urine output and electrolyte excretion in rats, similar to furosemide. A saponin (achyranthine) isolated from seeds also showed significant diuretic effects (Gupta et al., 1972).[4,9,23]

Increases urinary excretion of Na^+, K^+ and Cl^-

Similar to Furosemide

12. Gastroprotective Activity

Ethanolic extracts (600 mg/kg) reduced gastric acidity and ulcer index while increasing pH and mucosal protection in pylorus-ligated and ethanol-induced ulcer models, likely due to flavonoids, saponins, and tannins.[23]

13. Antiparasitic Activity

Ethyl acetate and dried extracts of leaves, flowers, and seeds showed larvicidal and antiparasitic activity against *Rhipicephalus microplus* (cattle tick) and *Paramphistomum cervi* (sheep parasite).[7,16]

14. Bronchoprotective Activity

Ethanolic extracts demonstrated protective effects in toluene diisocyanate–induced asthma in rats by reducing airway inflammation and oxidative stress (B.R. Goyal et al., 2007).[4]

Drug : Toluene Di-isocynate [TDI]

Table 16.[4]

Extract	Model	Observation
Ethanolic extract	Wistar rat	Did not show any airways abnormalities.

15. Cardiovascular Activity

The alkaloid achyranthine lowered blood pressure and heart rate and caused vasodilation in animal studies. Saponins increased cardiac contractility and improved hypodynamic heart function (Gupta et al., 1972).[4,9]

System: Cardiac & vascular

Mechanism: Vasodilation, ↓ heart rate, blood pressure

Active compound: Achyranthine

Table 17.[4,9]

Effect	Impact
Hypotensive	↓ Blood pressure
Bradycardic	↓ Heart rate

16. Spermicidal Activity

Root extracts (hydroethanolic, n-hexane, chloroform) showed potent spermicidal activity in human and rat sperm, affecting viability, motility, and acrosome integrity (Paul et al., 2010).[5]

17. Antifertility Activity

Whole-plant, leaf, root, and seed extracts exhibited antifertility and abortifacient effects in rats and mice. Benzene and ethanol extracts were particularly effective in preventing implantation and pregnancy.[5]

Scientific studies validate many traditional claims of *Achyranthes aspera L*. Pharmacological effects are demonstrated through both in-vitro and in-vivo experimental models.

Table 18.[4]

Extract	Result
Root extract	Sperm immobilization — reversible antifertility effect

7. Toxicity and Safety Profile

Although *Achyranthes aspera L.* is used traditionally, scientific toxicology studies are still limited and must be expanded for safe therapeutic applications.

Table 19: Acute and Sub-acute Toxicity.

Extract	Animal Model	Dose	Findings	Safety Level	References
Methanolic whole plant	Rats	Up to 2000 mg/kg orally	No mortality or behavioral changes	Safe	[30]
Ethanolic root extract	Mice	1000 mg/kg	Mild gastrointestinal irritation	Dose-dependent	[30]
Seed saponins	Rats	50–200 mg/kg	Strong antifertility action	Risk	[30]

- LD_{50}>2000 mg/kg → Generally safe at low doses
- Reproductive toxicity warning
- Strong spermicidal effects → Not recommended during pregnancy
- Possible abortifacient action (traditional reports)

7.1Cytotoxicity

Some extracts show cell-specific cytotoxic potential, particularly against:

- Tumor cell lines
- Lymphocyte transformation test

Table 20: Contraindications.[3]

Category	Risk
Pregnant women	Abortifacient effect reported
Lactating women	Unknown excretion in milk
Reproductive age users	Contraceptive effect risk
Chronic long-term use	Lack of toxicity trials

Overall Safety Evaluation

Achyranthes aspera L. is safe at therapeutic ranges but reproductive effects demand caution in:

- Women of child-bearing age
- Individuals attempting conception

8. Research Gaps, Future Prospects and Current Clinical Research Status,

Despite promising results, several limitations restrict its transition into regulated medicine.

8.1 Major Research Gaps[3]

Although a large number of preclinical studies validate the traditional claims of *A. aspera L*., the majority of these experiments are limited to animal models and in-vitro assays. There is a clear lack of standardized dosing, validated biomarkers for clinical translation, and human-based pharmacokinetic profiling. Moreover, reproductive toxicity findings in animals have

not been investigated clinically, creating a critical ethical gap before recommending internal use.

Table 21: Future Research Opportunities.[3]

Area	Suggested Investigation
Drug development	Isolation of active compounds&nano-formulations
Dermatology	Clinical trials for wound-healing&anti-acne creams
Antimicrobial resistance	Synergy studies with antibiotics
Male contraception	Standardized spermicidal products
Hepatoprotection	Advanced biochemical mechanism research

A. Aspera is an under-utilized medicinal herb with commercial potential for:

- Herbal cosmetics
- Dermatological drugs
- Sustainable&low-cost pharmaceuticals

8.3 Current Clinical Research Status

Despite strong laboratory success of *A. aspera L.*, its real-world therapeutic relevance depends on well-designed clinical studies. Therefore, it is essential to evaluate to what extent its benefits have been investigated in human populations and to identify the limitations that prevent clinical translation. To bridge these gaps, collaborations between Phyto chemists, clinicians, and regulatory scientists are essential.

Considering the promising pharmacological outcomes and simultaneous lack of comprehensive clinical validation, *A. aspera L.* remains a scientifically valuable plant. Bridging the gap between laboratory evidence and standardized therapeutic use must now be prioritized through ethically approved human studies.

9. CONCLUSION

Achyranthes aspera L. is a widely available medicinal herb with validated pharmacological activities including anti-inflammatory, antimicrobial, antioxidant, wound healing, antidiabetic, and antifertility properties. The presence of saponins, alkaloids, terpenoids, steroids, and phenolic compounds provides a strong basis for therapeutic applications.

However, its clinical utilization is currently limited due to insufficient standardization, reproductive toxicity concerns, and absence of clinical trials. By prioritizing phytochemical characterization, toxicity evaluation, dosage standardization, and well-designed human

studies, A. aspera can become a valuable modern phytopharmaceutical resource.

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