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

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Review Article

A Review On The Species: Achyranthes aspera L.

Dr.N.Astalakshmi[1], Deena Dhayalan[2], Dhinagaran P.[3], Muthumani V[4], Sugandhan G.[5], Suguna V.[6], Dr.M.Surendra Kumar[7]

[1]M.Pharm., Ph.D, Department of Pharmaceutical Chemistry, Senghundhar College of Pharmacy, Kumaramangalam, Tiruchengode, Tamil Nadu, India. Orcid ID: 0000-0003-4980-5283.

[2,3,4,5,6] B.Pharm Final Year, Senghundhar College of Pharmacy, Kumaramangalam, Tiruchengode, Tamil Nadu, India.

[7]M.Pharm.,Ph.D., Principal, Senghundhar College of Pharmacy, Kumaramangalam, Tiruchengode, Tamil Nadu, India.

ARTICLE INFO

Published: 13 Aug. 2026

Keywords:
Achyranthes aspera, Amaranthaceae, Phytochemistry, Antimicrobial activity, Oral pathogens, Herbal formulation..

DOI:
10.5281/zenodo.21908808

ABSTRACT

Achyranthes aspera Linn. (Prickly Chaff Flower), a member of the family Amaranthaceae, is a widely distributed medicinal herb with extensive traditional and ethnopharmacological significance in the management of inflammation, wounds, gastrointestinal disorders, respiratory ailments, and oral health conditions. The plant is a rich source of bioactive secondary metabolites, including alkaloids, flavonoids, saponins, terpenoids, steroids, and phenolic compounds, distributed across its bark, leaves, stem, root, and whole-plant preparations, each contributing distinct pharmacological properties. This literature review compiles and critically examines recent studies on the phytochemical composition and biological activities of different parts of A. aspera, with particular emphasis on its antimicrobial, antibiofilm, anti-inflammatory, antioxidant, and periodontal therapeutic potential. Reported investigations demonstrate significant efficacy of A. aspera extracts and formulations such as buccal patches, herbal tooth powders, mouthwashes, and root gels against key oral pathogens including Streptococcus mutans, Porphyromonas gingivalis, and Enterococcus faecalis, often comparable to standard agents like chlorhexidine. Additionally, its traditional use as a natural chewing stick is supported by scientific evidence of antibiofilm, quorum-sensing inhibitory, and antibacterial activity. Collectively, the reviewed literature underscores the therapeutic versatility of A. aspera and its strong potential as a natural candidate for the development of standardized herbal formulations, particularly in the field of oral healthcare and periodontal disease management.

***Corresponding Author:** Dr.N.Astalakshmi
Address: *M.Pharm., Ph.D, Department of Pharmaceutical Chemistry, Senghundhar College of Pharmacy, Kumaramangalam, Tiruchengode, Tamil Nadu, India. Orcid ID: 0000-0003-4980-5283.*
Email ✉: astalakshmisurendar@gmail.com

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

Further mechanistic and clinical investigations are warranted to validate its efficacy and facilitate integration into modern pharmaceutical applications.

INTRODUCTION

Achyranthes aspera Linn., commonly known as "Prickly Chaff Flower," is a well-recognized medicinal herb belonging to the family Amaranthaceae, valued extensively across traditional healing systems for its broad ethnopharmacological relevance. The plant has been traditionally employed for the management of inflammation, wounds, gastrointestinal disorders, respiratory ailments, and pain, reflecting its longstanding cultural and therapeutic significance **[1]**. Phytochemical investigations have revealed that *A. aspera* is a rich reservoir of secondary metabolites, including alkaloids, flavonoids, saponins, terpenoids, steroids, phenolic compounds, and fatty acids, distributed across its leaves, roots, seeds, and stem **[2]**. These diverse constituents are reported to underlie the plant's wide-ranging bioactivities, encompassing anti-inflammatory, antioxidant, and antimicrobial properties, thereby reinforcing its potential as a candidate for the development of standardized herbal formulations and novel therapeutic agents **[1,2]**. Given this extensive pharmacological promise, a systematic review of the existing literature on *A. aspera* is essential to consolidate current knowledge and support its rational application in modern drug delivery and formulation research.

TAXONOMICAL CLASSIFICAION

Kingdom: Plantae

Division: Angiospermae

Class: Dicotyledonae

Order: Caryophyllales

Family: Amaranthaceae

Genus: *Achyranthes*

Species: *Achyranthes aspera* (L.)

A weed distributed throughout tropical and subtropical regions, with distinct root, stem, leaf, inflorescence, and seed parts, each used individually or as a whole-plant preparation in traditional. Its fibrous root and slender stem are traditionally used as a natural chewing stick **[3,4]**.

REVIEW OF LITERATURE ON: *Achyranthes aspera* Linn.

BARK:

❖ **Lakshmi et al., 2020** investigated the in vitro antibacterial activity of A. aspera bark extract against the oral pathogens Streptococcus mutans and Lactobacillus acidophilus using the micro broth dilution method across a concentration range of 0.8-50 µg/mL. The extract exhibited significant inhibitory activity against Lactobacillus acidophilus, with a minimum inhibitory concentration of 6.25 µg/mL, though no antibacterial effect was observed against Streptococcus mutans, with the activity attributed to beta-ecdysone, a phytoecdysteroid present in the bark extract **[5]**.

LEAVES:

❖ **Kumar et al., 2024** formulated mucoadhesive buccal patches containing Achyranthes aspera leaf extract for toothache management using the solvent casting method. The ethanolic and petroleum ether extracts contained phytochemicals including alkaloids, flavonoids, amino acids, and carbohydrates, with quercetin quantified by HPLC. The optimized formulation (F1) showed >85% drug release within 8 hours and remained stable under accelerated ICH conditions,

indicating its potential for sustained buccal drug delivery **[6]**.

❖ **Asnotikar et al., 2022** developed an herbal tooth powder containing Achyranthes aspera leaves with clove, Triphala, Pacha Karpoora, Ritha, and Mulethi. The formulation showed acceptable physicochemical properties and contained phytochemicals such as carbohydrates, glycosides, alkaloids, flavonoids, and saponins. Antimicrobial activity evaluated by the agar well diffusion method showed a 15 mm zone of inhibition against *Streptococcus aureus*, indicating promising antibacterial potential **[7]**.

❖ **Maurya, 2017** investigated the phytochemical and pharmacological properties of the methanolic extract of A. aspera leaves, confirming the presence of flavonoids, tannins, saponins, and alkaloids while reducing sugars were absent. The extract exhibited significant cytotoxic activity in a brine shrimp lethality bioassay (LC50 values of 2.18-3.80 µg/mL across exposure times) and moderate thrombolytic activity, producing 37.51% clot lysis compared to 78.04% for the streptokinase standard, suggesting mild fibrinolytic potential linked to its alkaloid and flavonoid content **[8]**.

❖ **Ndhlala et al., 2015** evaluated the antimicrobial, anthelmintic, and wound-healing potential of Achyranthes aspera leaf extracts prepared using aqueous acetone, water, and aqueous methanol. The extracts showed good activity against bacteria, fungi, and *Caenorhabditis elegans*, particularly those collected from Ciaat (Eritrea), which also contained higher levels of phenolic compounds and exhibited superior wound-healing potential **[4]**.

STEM AND ROOT:

❖ **Yadav et al., 2016** evaluated the antibacterial activity of aqueous stem and root extracts of *Achyranthes aspera* against *Streptococcus mutans*. Both extracts showed significant concentration-dependent antibacterial activity, with the root extract (21 mm) exhibiting greater inhibition than the stem extract (16 mm) at 10% concentration. The minimum effective concentration was 2.5%. Although less effective than 0.2% chlorhexidine, the activity was attributed to alkaloids and tannins, indicating the plant's potential as a natural anticariogenic agent **[9]**.

WHOLE PLANT:

❖ **Shukla et al., 2025** conducted phytochemical screening, isolation, and antioxidant/antimicrobial evaluation of the methanolic extract of whole-plant A. aspera collected at the flowering stage, identifying ferulic acid, caffeic acid, oleanolic acid, ursolic acid, and quercetin derivatives via TLC and FTIR analysis. The extract exhibited significant DPPH radical-scavenging antioxidant activity (IC50 135.8 µg/mL) and concentration-dependent antibacterial activity against S. aureus, B. subtilis, E. coli, and P. aeruginosa comparable to the standard antibiotic ofloxacin, underscoring its potential as a natural antioxidant and antimicrobial agent **[10]**.

❖ **Murugan et al., 2013** investigated the antibiofilm and quorum-sensing inhibitory activity of sequentially extracted A. aspera whole-plant fractions against cariogenic Streptococcus mutans. The methanol extract demonstrated the strongest effect, achieving 94% biofilm inhibition at its MIC of 125 µg/mL and a 23mm growth inhibition zone, while GC-MS and molecular docking analyses identified betulin and 3,12-oleandione as key contributors binding strongly to S. mutans glycosyltransferase and the OmpR quorum-sensing regulator, respectively, supporting the

plant's traditional use as a chewing stick for oral care **[11]**.

❖ **Naidu et al., 2006** evaluated the antimicrobial activity of successive solvent extracts from various parts of *A. aspera* (whole plant, root, stem, leaves, inflorescence) against several bacterial pathogens using the disc diffusion method. The methanol extract of the whole plant showed the strongest activity against *S. aureus* and *B. subtilis* (MIC 200 - 400 µg/mL), while the n-hexane extract of the inflorescence was most effective against *E. coli*, indicating that antimicrobial potency varied considerably with both plant part and solvent polarity **[12]**.

REVIEW WORKS:

❖ **Pal et al., 2023** reviewed the phyto-pharmacological aspects of Apamarga (*A. aspera*), an important Ayurvedic medicinal plant, characterizing hydro-alcoholic seed extracts for physicochemical parameters and confirming the presence of flavonoids, alkaloids, tannins, phenolics, and saponins. The review compiled major bioactive constituents, including achyranthine, ecdysterone, oleanolic acid, saponins A and B, and betaine, and consolidated extensive pharmacological evidence spanning anti-inflammatory, antidiabetic, hepatoprotective, wound-healing, and antibacterial activities, notably against *S. aureus*, *E. coli*, and dental pathogens **[13]**.

❖ **Raju et al., 2022** conducted a comprehensive updated review compiling pharmacological data on *A. aspera* from 2011-2021, covering antioxidant, antibacterial, antifungal, anticancer, and antidiabetic activities across various plant parts and solvent systems. Antibacterial assays demonstrated strong activity against *S. aureus*, *E. coli*, *K. pneumoniae*, and *S. mutans*, primarily attributed to tannins and alkaloids, while key bioactive compounds such as achyranthine, ecdysterone, and oleanolic acid were highlighted for their significance in antidiabetic, antituberculosis, and antiviral applications, along with reported toxicological safety at standard doses **[14]**.

❖ **Jawanjal and Patgiri, 2021** reviewed the therapeutic applications of Apamarga Kshara, a herbomineral preparation derived from the alkaline ash of *A. aspera*, widely used in Ayurvedic anorectal and clinical therapeutics. The formulation, rich in potassium, sodium, calcium, and magnesium, was shown to possess debridement, incision, purification, and healing properties, with compiled clinical evidence demonstrating strong efficacy in hemorrhoids, fistula-in-ano, bleeding piles, and diabetic/venous wound debridement, attributable to its corrosive and penetrating characteristics **[15]**.

ROOT:

❖ **Kumar et al., 2025** evaluated a polyherbal gel combining *A. aspera* and *T. ammi* ethanolic extracts as an intracanal medicament against *Enterococcus faecalis*, benchmarked against chlorhexidine and calcium hydroxide. The gel exhibited additive antibacterial interaction with an intermediate zone of inhibition (12.0mm) and notably superior biocompatibility (95.1% viable periodontal ligament cells) compared to both standard medicaments, supporting its potential as a safer alternative for root canal therapy **[16]**.

❖ **Soorgani et al., 2023** evaluated the clinical and microbiological effects of a subgingivally delivered *A. aspera* root gel as an adjunct to scaling and root planing (SRP) in chronic periodontitis patients using a split-mouth design. At the 3-month follow-up, the test group receiving SRP plus the herbal gel showed significantly greater reductions in probing depth and clinical

attachment level gain, along with a notable reduction in subgingival *Porphyromonas gingivalis* counts, supporting its efficacy as a nonsurgical local drug delivery adjunct **[17]**.

❖ **Boyapati et al., 2017** assessed the efficacy of an *A. aspera* root gel formulation as a local drug delivery adjunct to SRP in chronic periodontitis patients, delivered subgingivally via blunt cannula syringe. After 3 months, the combined SRP-plus-gel group exhibited significantly greater improvements in gingival index, probing depth, and clinical attachment level compared to SRP alone, with the therapeutic benefit attributed to the plant's antimicrobial, antioxidant, and anti-inflammatory properties and no reported adverse effects **[18]**.

❖ **Owk et al., 2014** examined the antimicrobial activity of *A. aspera* root extracts prepared in hexane, chloroform, methanol, ethanol, and water against a panel of bacterial and fungal human pathogens using agar well diffusion and MIC assays. Ethanol and methanol extracts exhibited the highest antimicrobial potency, with *Klebsiella pneumoniae* proving most susceptible (MIC as low as 62.5 µg/mL), and phytochemical screening attributed the broad-spectrum activity to the synergistic action of alkaloids, flavonoids, saponins, and terpenoids present in the extracts **[19]**.

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HOW TO CITE: Dr.N.Astalakshmi1, Deena Dhayalan2, Dhinagaran P., Muthumani V, Sugandhan G., Suguna V.,Dr.M.Surendra Kumar, A Review On The Species: Achyranthes aspera L., Int. J. of Pharm. Sci., 2026, Vol 4, Issue 8, 2115-2120. https://doi.org/10.5281/zenodo.21908808