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A REVIEW OF *APARMRGA* (ACHYRANTHES ASPERA L.): AYURVEDIC PERSPECTIVES, MEDICINAL USES, AND CORRELATION WITH MODERN SCIENTIFIC EVIDENCE

Dr. Ravinder Kaur*[1], Dr. Chandan Singh[2], Dr. Rajendra Prasad Purvia[3]

[1]M.D Scholar, PG Department of Dravyaguna, PGIA Jodhpur, Rajasthan.
[2]Professor and HOD, PG Department of Dravyaguna, Principal, PGIA, Jodhpur, Rajasthan.
[3]Associate Professor, PG Department of Dravyaguna, PGIA, Jodhpur, Rajasthan.

***Corresponding Author: Dr. Ravinder Kaur**

M.D Scholar, PG Department of Dravyaguna, PGIA Jodhpur, Rajasthan.

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ABSTRACT

Aparmrga (Latin: *Achyranthes aspera* L.), commonly known as Rough Chaff Tree or Prickly Chaff Flower, is a highly significant medicinal plant in the Ayurvedic pharmacopoeia, belonging to the *Apamarga Tanduliya* group. Revered for its wide-ranging therapeutic applications, it is categorized as having *Katu* (pungent) and *Tikta* (bitter) *Rasa*, *Laghu* (light) and *Ruksha* (dry) *Guna*, *Ushna Virya* (hot potency), and *Katu Vipaka* (pungent metabolic transformation). Traditionally, it has been used to manage diverse conditions, including Vata-Kapha disorders, respiratory ailments, renal calculi, hemorrhoids, wound healing, and obstetric complications. This systematic review aims to consolidate the classical Ayurvedic descriptions of *Aparmrga* with contemporary phytochemical and pharmacological research. Modern scientific investigations have identified a rich profile of bioactive compounds, including triterpenoid saponins (e.g., asperasaponins), alkaloids (achyranthine), flavonoids, and long-chain alcohols. Pharmacological studies validate many of its traditional claims, demonstrating potent anti-inflammatory, analgesic, diuretic, nephroprotective, hypoglycemic, hypolipidemic, antioxidant, antimicrobial, and wound-healing properties. The anti-arthritic and bronchodilatory effects align with its classical use in *Vata* and *Kapha* conditions, while its diuretic and lithontriptic actions support its use in urinary calculus. This review highlights strong concordance between the ethnomedicinal wisdom of Ayurveda and empirical scientific evidence, positioning *Aparmrga* as a promising candidate for further development of evidence-based phytomedicines. However, gaps in clinical trial data and precise mechanistic pathways warrant more rigorous translational research.

KEYWORDS: *Aparmrga*; *Achyranthes aspera*; Ayurvedic pharmacology; Ethnopharmacology; Phytochemistry; Pharmacological activities.

1. INTRODUCTION

The integration of traditional medicinal knowledge with modern scientific inquiry offers a robust paradigm for drug discovery and the validation of herbal therapeutics. Ayurveda, the ancient Indian system of medicine, provides a vast repository of such knowledge, documented over millennia. Among its numerous medicinal plants, *Aparmrga* (*Achyranthes aspera* L., family Amaranthaceae) is of considerable importance due to its multifaceted therapeutic profile and widespread availability across tropical and subtropical regions worldwide.[1]

In Ayurvedic classics such as the Charaka Samhita, the Sushruta Samhita, and various Nighantus (lexicons), Aparmrga is described in detail. The very name "Apamarga" is etymologically derived from "Apam" (disease) and "arga" (to go), implying "that which drives away diseases".[2] It is a perennial herb, erect or spreading, characterized by its rough, opposite leaves, and long, terminal spikes with deflexed flowers that bear small, barbed fruits which easily adhere to clothing or animal fur a feature reflected in its common English name, "Devil's Horsewhip" or "Prickly Chaff Flower".[3]

Classical Ayurvedic texts attribute to it a Katu (pungent) and Tikta (bitter) Rasa (taste), Laghu (light) and Ruksha (dry) Guna (qualities), Ushna Virya (hot potency), and Katu Vipaka (pungent post-digestive effect). This pharmacological profile makes it quintessentially Vata-Kapha hara (pacifies Vata and Kapha doshas) but may aggravate Pitta in excess due to its Ushna nature.[4] Its actions (Karma) are extensive, including Deepana (appetizer), Pachana (digestive), Shothahara (anti-inflammatory), Shoolahara (analgesic), Mutrala (diuretic), Ashmaribhedana (lithontriptic), Vedanasthapana (analgesic), Vranaropana (wound healing), and Krimighna (anthelmintic).[5]

The plant is mentioned in formulations for conditions ranging from Shwasa-Kasa (bronchial asthma and cough), Pandu (anemia/jaundice), Arsha (hemorrhoids), Prameha (urinary disorders, including diabetes), Vrana (wounds and ulcers), to difficult labor and postpartum complications.[6,7] Its use is not restricted to internal administration; its leaves, roots, seeds, and ash (*Kshara*) are used externally for skin diseases, insect bites, and dental issues.

Despite this rich traditional heritage, a comprehensive synthesis aligning the Ayurvedic concepts with modern phytochemical and pharmacological evidence is necessary to bridge the knowledge gap and foster evidence-based application. This review article, structured in the IMRAD (Introduction, Methods, Results, and Discussion) format, systematically collates information on the Ayurvedic pharmacology, botanical description, phytochemistry, pharmacological activities, and toxicological profile of *Achyranthes aspera*, thereby establishing a scientific correlation for its traditional uses.

2. METHODS

A systematic search and analysis of literature was conducted to gather information on *Aparmrga* (*Achyranthes aspera* L.) from both traditional Ayurvedic sources and modern scientific databases.

2.1. Data Sources

- **Ayurvedic Sources:** Primary Sanskrit texts including *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, *Bhavaprakasha Nighantu*, *Dhanvantari Nighantu*, and *Raj Nighantu* were consulted through published translations and commentaries.
- **Modern Scientific Databases:** Electronic databases such as PubMed, Scopus, ScienceDirect, Google Scholar, and Web of Science were searched for relevant literature.
- **Additional Sources:** Relevant textbooks, conference proceedings, and dissertations on ethnopharmacology and medicinal plants were also reviewed.

2.2. Search Strategy

The search was conducted using keywords and their combinations: "*Aparmrga*", "*Apamarga*", "*Achyranthes aspera*", "Prickly Chaff Flower", "Ayurveda", "phytochemistry", "pharmacology", "ethnomedicine", "triterpenoid saponins", "achyranthine", "anti-inflammatory", "diuretic". No strict date limit was applied, but emphasis was placed on recent studies (last 20 years) alongside seminal older works.

2.3. Inclusion and Exclusion Criteria

- **Inclusion:** Studies detailing the Ayurvedic description, phytochemical composition, in-vitro, in-vivo, or clinical pharmacological activities, safety, and ethnobotanical uses of *Achyranthes aspera*.
- **Exclusion:** Non-peer reviewed articles, anecdotal reports without methodological detail, and studies on other *Achyranthes* species where data was not specific to *A. aspera*.

2.4. Data Extraction and Synthesis

Information from selected sources was categorized under predefined themes: (1) Botanical and Ayurvedic Profile, (2) Phytochemical Constituents, (3) Pharmacological Activities (mapped to traditional uses), and (4) Toxicology and Safety. Data was then synthesized to draw correlations between Ayurvedic actions (*Karma*) and modern pharmacological findings.

3. RESULTS

3.1. Botanical and Ayurvedic Profile

3.1.1. Botanical Description: *Achyranthes aspera* L. is an erect or procumbent perennial herb, 0.5-2 meters tall. The stem is branched, quadrangular, and hairy. Leaves are simple, opposite, ovate or elliptic, with an entire margin and acute apex. The inflorescence is a long, terminal spike (up to 60 cm) with numerous small, greenish-white flowers. The flowers are hermaphrodite, with five deflexed perianth segments and five stamens. The fruit is an indehiscent utricle, enclosed by the persistent perianth, bearing sharp, barbed bristles that aid in epizoochory.[8]

3.1.2. Ayurvedic Pharmacodynamics (*Dravyaguna*)

- **Rasa (Taste):** Primarily *Katu* (Pungent), secondary *Tikta* (Bitter).[4,5]
- **Guna (Qualities):** *Laghu* (Light), *Ruksha* (Dry), *Tikshna* (Sharp/Penetrating).[4,5]
- **Virya (Potency):** *Ushna* (Heating).[4,5]
- **Vipaka (Post-digestive Effect):** *Katu* (Pungent).[4,5]
- **Prabhava (Specific/Unique Effect):** Its *Ashmaribhedana* (stone-breaking) action is often cited as a *Prabhava*.[9]
- **Dosha Karma:** Predominantly alleviates *Kapha* and *Vata* doshas due to its *Katu*, *Tikta*, *Ruksha*, *Ushna* properties. It can aggravate *Pitta* if used in excess or in *Pitta*-predominant individuals.[4]

3.1.3. Classical Indications and Formulations (*Yogas*)

The plant is used in its entirety (*Panchanga*), as well as specific parts like root, leaf, seed, and stem. The ash (*Apamarga Kshara*) is a highly valued pharmaceutical preparation.

- **Respiratory Disorders (*Shwasa, Kasa*):** Used as an expectorant and bronchodilator. Formulations: *Apamarga Kshara*, *Apamarga Taila* for nasal instillation.[6,10]
- **Urinary Disorders (*Mutrakrichra, Ashmarī*):** As a diuretic and lithontriptic for dysuria and urinary calculi. Formulations: *Apamarga Kshara*, decoction of root with honey.[7,11]
- **Gastrointestinal & Abdominal Disorders:* Used for *Gulma* (abdominal lump), *Udara* (ascites), *Pliha* (splenic disorders), and as an anthelmintic.[5,12]
- **Hemorrhoids (*Arsha*):** *Apamarga Kshara* is topically applied in *Kshara Karma* (alkaline cauterization) for haemorrhoids.[13]
- **Wound Healing (*Vrana*):** Paste of leaves or root is applied for chronic wounds and ulcers. *Apamarga Kshara* is used for wound cleansing.[14]
- **Obstetrics & Gynecology:** Used to facilitate labor (*Sutikagara*), manage postpartum pain, and regulate menstruation.[6,15]
- **Others:** Skin diseases (*Kushtha*), dental caries, snake bite, and as a general tonic.[5,16]

3.2. Phytochemical Constituents

Modern phytochemical screening has revealed a complex profile of secondary metabolites, providing a molecular basis for its pharmacological actions (Table 1).

Table 1: Major Phytochemical Constituents of *Achyranthes aspera.*

Class of Compound	Specific Compounds Identified
Triterpenoid Saponins	Asperasaponins (I-X), oleanolic acid, oleanolic acid glycosides
Alkaloids	Achyranthine, betaine, trigonelline
Flavonoids	Kaempferol, quercetin, gallic acid, caffeic acid derivatives
Long-Chain Compounds	Henpentacontane, hexatriacontane, tritetracontane; alcohols like 17-pentatriacontanol, 27-cyclohexylheptacosan-7-ol
Steroids	Ecdysterone, β-sitosterol, stigmasterol
Amino Acid Derivatives	α-Spinasterol
Inorganic Ions	High potassium content in the ash (*Kshara*)

- **Saponins:** The asperasaponins, particularly oleanolic acid-based saponins, are considered major bioactive constituents responsible for anti-inflammatory, immunomodulatory, and nephroprotective effects.[17,18]
- **Alkaloid - Achyranthine:** This water-soluble alkaloid is a distinctive marker, credited with diuretic, cardiac stimulant, and uterine stimulant properties.[19]
- **Flavonoids & Phenolics:** Contribute significantly to the antioxidant, antimicrobial, and anti-inflammatory potential.[20]
- **Long-Chain Aliphatic Compounds:** Implicated in the plant's wound-healing and antimicrobial activities.[21]
- **Apamarga Kshara:** The alkaline ash is primarily composed of potassium carbonate, which provides the caustic and cleansing property essential for *Kshara Karma*.[22]

3.3. Pharmacological Activities and Correlation with Ayurvedic Uses

3.3.1. Anti-inflammatory and Analgesic Activity (Correlates with *Shothahara, Vedanasthapana, Vatashamaka*)

Multiple in-vivo studies have demonstrated significant anti-inflammatory effects of *A. aspera* extracts in carrageenan-induced paw edema, formaldehyde-induced arthritis, and adjuvant-induced arthritis models in rats.[23,24] The methanolic extract showed inhibition of inflammatory mediators like prostaglandins and histamine. The saponin fraction is particularly active. This validates its classical use in inflammatory *Vata* disorders like arthritis (*Sandhivata*), swelling, and pain.

3.3.2. Diuretic and Nephroprotective/Lithontriptic Activity (Correlates with *Mutrala, Ashmaribhedana*)

The aqueous and alcoholic extracts of the root and whole plant have shown potent diuretic activity in rodent models, increasing the excretion of water, sodium, and chloride ions.[25] The alkaloid achyranthine is a key diuretic principle. Furthermore, studies have shown its efficacy in preventing ethylene glycol-induced hyperoxaluric calculi in rats, reducing the size and number of renal calculi and protecting renal tissue from oxidative damage.[26,27] This provides strong scientific backing for its traditional role in *Mutrakrichra* (dysuria) and *Ashmarī* (urinary stones).

3.3.3. Hypoglycemic and Hypolipidemic Activity (Correlates with *Pramehaghna*)

Both preventive and therapeutic hypoglycemic effects have been reported for *A. aspera* extracts in alloxan- and streptozotocin-induced diabetic rat models.[28,29] Mechanisms proposed include stimulation of insulin secretion from pancreatic β-cells, enhancement of peripheral glucose utilization, and inhibition of intestinal glucose absorption. The extracts also significantly reduce serum cholesterol, triglycerides, and LDL levels while raising HDL, aligning with the management

of *Prameha* (a complex disorder encompassing diabetes and metabolic syndrome).[30]

3.3.4. Antioxidant Activity (Underpins Multiple *Rasayana* and Tissue Protective Actions)
Various extracts, especially those rich in phenolics and flavonoids, exhibit strong free radical scavenging activity against DPPH, ABTS, nitric oxide, and superoxide radicals, along with high reducing power.[20,31] This antioxidant capacity is fundamental to its wound healing, anti-aging (*Rasayana*), hepatoprotective, and nephroprotective actions, protecting tissues from oxidative stress implicated in numerous diseases.

3.3.5. Wound Healing Activity (Correlates with *Vranaropana*)
The ethanolic extract and ointment formulations of *A. aspera* have shown significant acceleration of wound contraction, increased tensile strength, decreased epithelialization period, and enhanced hydroxyproline content (indicator of collagen synthesis) in excision, incision, and dead space wound models in rats.[14,32] The activity is attributed to its antimicrobial, anti-inflammatory, and antioxidant properties, as well as the presence of long-chain aliphatic compounds that may promote cell proliferation.

3.3.6. Antimicrobial Activity (Correlates with *Krimighna*, *Vranashodhana*)
Extracts of *A. aspera* have demonstrated broad-spectrum antimicrobial activity against a range of Gram-positive bacteria (e.g., *Staphylococcus aureus*, *Bacillus subtilis*), Gram-negative bacteria (e.g., *Escherichia coli*, *Pseudomonas aeruginosa*), and fungi (e.g., *Candida albicans*).[33,34] This validates its use in infectious conditions, wound cleansing, and as an anthelmintic (*Krimighna*).

3.3.7. Uterine Stimulant and Obstetrical Use (Correlates with *Sutikagara*)
The alkaloid achyranthine has been shown to stimulate uterine contractions in isolated animal uterine preparations, supporting its traditional application in facilitating labor and managing postpartum complications.[19] However, this also indicates a cautionary note for use during pregnancy.

3.3.8. Other Activities: Reported activities include hepatoprotective, anti-arthritic, immunomodulatory, anti-allergic, anti-cancer, and larvicidal properties, further widening its therapeutic scope.[35,36]

4. DISCUSSION

The convergence of Ayurvedic wisdom and modern scientific research on *Aparmrga* presents a compelling case for the systematic validation of traditional medicine. The Ayurvedic pharmacological principles, though conceptualized in a different framework, show remarkable predictability when interpreted through the lens of modern science.

The *Ushna Virya* and *Katu Vipaka* of *Aparmrga* can be correlated with its stimulatory, penetrating, and metabolically activating properties. These manifest pharmacologically as enhanced digestive secretion (supporting *Deepana*), diuresis (*Mutrala*), and stimulation of uterine smooth muscle. The *Ruksha* and *Tikshna Guna* likely contribute to its drying, absorbing, and penetrating action on tissues, relevant in reducing edema (*Shothahara*) and breaking down calculi or abnormal growths (*Ashmaribhedana*, *Arshoghna*). The *Katu* and *Tikta Rasa*, often associated with lipolytic, catabolic, and cleansing actions, align with its hypolipidemic, anti-obesity, and detoxifying effects.

The cornerstone of its action on Vata and Kapha disorders finds strong support. Vata disorders often involve pain, neurological dysfunction, and mobility issues. The potent anti-inflammatory and analgesic activities, particularly in arthritic models, directly address Vata manifestations like Shula (pain) and Shotha (inflammation). Kapha disorders are characterized by congestion, heaviness, and excess fluid. The plant's expectorant, bronchodilatory (addressing Kapha in lungs), diuretic, and hypolipidemic actions are quintessentially Kaphahara.

The preparation and use of *Apamarga Kshara* exemplify sophisticated Ayurvedic pharmaceutics. The alkaline ash (potassium carbonate) provides chemical cauterization, hemostasis, and debridement, making it highly effective in procedures like *Kshara Karma* for hemorrhoids and in cleansing infected wounds. Modern studies on the antimicrobial and wound-healing efficacy of the whole plant extracts provide a complementary understanding of this practice.

However, several critical gaps and considerations emerge. First, while preclinical data is robust, high-quality, randomized controlled clinical trials (RCTs) in humans are scarce. Most traditional uses, such as for renal calculi or facilitating labor, require rigorous clinical validation to establish dosage, efficacy, and safety in human populations. Second, the *Pitta*-aggravating potential (*Ushna Virya*) noted in classics is a crucial aspect of personalized medicine. While not explicitly studied, this may translate into side effects like gastritis, acid reflux, or skin rashes in susceptible individuals, underscoring the importance of the Ayurvedic principle of *Prakriti* (constitution) in its application. Third, while the active fractions (e.g., saponins, achyranthine) are known, the synergistic interplay of multiple constituents (*phytosynergy*) that likely underlies its holistic effect needs deeper exploration. Standardization of extracts based on key marker compounds is essential for reproducibility and quality control.

Future research should be directed towards: (1) Conducting well-designed RCTs for priority indications like urinary calculi, osteoarthritis, and wound

management; (2) Detailed toxicological studies, including genotoxicity and long-term toxicity, to define safe dosage ranges; (3) Pharmacokinetic and drug-herb interaction studies; (4) Development of standardized, formulation-specific extracts that preserve the integrity of the classical preparations like *Kshara* and *Taila*.

5. CONCLUSION

Aparmrga (*Achyranthes aspera* L.) stands as a paradigm of a medicinal plant whose extensive traditional use in Ayurveda is substantiated by a growing body of modern scientific evidence. Its Ayurvedic profile as a *Vata-Kapha hara*, *Ushna*, and *Tikshna* dravya with specific actions like *Ashmaribhedana* and *Vranaropana* finds clear resonance in its demonstrated diuretic, lithontriptic, anti-inflammatory, analgesic, antioxidant, antimicrobial, and wound-healing properties. The phytochemical constituents, notably triterpenoid saponins and the alkaloid achyranthine, provide a molecular basis for these activities. This review affirms a strong correlation between the empirical knowledge of Ayurveda and evidence-based pharmacology. While the existing data is promising, it calls for more targeted translational and clinical research to fully harness its therapeutic potential within an integrative medical framework. *Aparmrga* thus remains a vital botanical resource, bridging ancient wisdom and contemporary science for human health.

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