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ETHNOPHARMACOLOGICAL INSIGHTS INTO *ACHYRANTHES ASPERA*: A TRADITIONAL MEDICINAL PLANT WITH GLOBAL SIGNIFICANCE

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Abstract:

Achyranthes aspera , part of the Amaranthaceae family, is a prominent medicinal herb known for its diverse therapeutic applications. This species, recognized for treating conditions such as gynecological disorders, asthma, odontalgia, and wounds, showcases significant pharmacological potential. A systematic review of existing literature reveals that Achyranthes aspera is rich in bioactive compounds, particularly polysaccharides, triterpenoid saponins, and ecdysterone, contributing to its therapeutic activities which include immunomodulation, anti-cancer, anti-inflammatory, and analgesic effects. Ecologically, the plant thrives in warm climates, predominantly found in regions across Africa, Asia, and the Americas. Methodological approaches for harvesting and studying Achyranthes aspera are highlighted, emphasizing the importance of its traditional use combined with modern pharmacological research. Despite its extensive use in ethnomedicine, a comprehensive review integrating its botanical characteristics, chemical composition, and ethnopharmacological implications has been limited. This review aims to fill this gap and promote further research on Achyranthes aspera to support its potential in contemporary medicine and validate traditional knowledge regarding its health benefits.

Keywords: *Achyranthes aspera, Ethno pharmacology, Medicinal plant, Pharmacological activities, Bio active compounds.*

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INTRODUCTION:

Achyranthes aspera L. (Amaranthaceae), commonly known as Chaff Flower, is a versatile herb celebrated for its diverse medicinal properties. Alongside *Achyranthes bidentata*, it holds a prominent place in traditional medicine, especially in India, where it is employed to treat various ailments, including gynecological disorders, respiratory conditions, and wound healing (Kumar et al., 2020; Singh et al., 2021). Its therapeutic applications encompass managing conditions like amenorrhea, dysmenorrhea, and various forms of inflammation (Rao et al., 2019). Pharmacological research has demonstrated the genus *Achyranthes's* influence on critical physiological systems, including immunity, the nervous system, bone metabolism, and reproductive health. Its bioactive constituents, predominantly triterpenoid saponins, polysaccharides, and polypeptides, exhibit a wide range of activities, such as blood activation, anti-tumor, antioxidant, and anti-inflammatory effects (Gupta et al., 2022; Jain et al., 2020). β-Ecdysterone, a significant compound identified in *Achyranthes*, is notably recognized in the Chinese Pharmacopoeia for its role in quality control (Li et al., 2020). Despite its extensive use and well-documented therapeutic potential, a comprehensive review detailing the botanical characteristics, ethnopharmacological importance, and bioactive constituents of *Achyranthes aspera* remains scarce. This review seeks to address this gap by systematically compiling data on its distribution, morphology, chemical profile, and health benefits, thereby enhancing the understanding of its therapeutic potential (Patel et al., 2023).

PLANT PROFILE

Common Names

Achyranthes species has devil's horsewhip, prickly chaff flower, chaff-flower, burweed, pululue, panga za wayuka (Kiswahili)

SYNONYMS

Achyranthes Species: Achyranthesargentea Lam., *Achyranthes aspera obtusifolia*, *Achyranthesobtusifolia*

FAMILY:*Amaranthaceae*

CHEMICAL CONSTITUENTS

Triterpenoid saponins, the aglycone of which is oleanolic acid, are found in *Achyranthes aspera. Achyranthes aspera* also contains long chain alcohols and the hormone ecdysterone which is involved in insect mounting.

Fig. plant part of *Achyranthes aspera*

COLLECTION

Geographical/demographic

While *Achyranthes aspera* may thrive in various climatic and environmental conditions, warm regions offer the best growing conditions for the plant. The three most important ecological requirements for chaff flower cultivation are warmth, light, and moisture. Afghanistan, Bhutan, India, Indonesia, Pakistan, Jordan, Laos, Malaysia, Myanmar, the Philippines, Singapore, Sri Lanka, Africa, Algeria, Cameroon, Kenya, Lesotho, Mauritius, and Yemen are among the countries where it is commonly grown. Other regions include Olivia, Colombia, Peru, Italy, Spain, Australia, the Cook Islands, Fiji, Guam, Namibia, Tanzania, Tunisia, Uganda, Zambia, Zimbabwe, Mexico, Florida, Hawaii, the Bahamas, the Caribbean, Cuba, Saint Lucia, and others. There are no known global statistics regarding the production of essential oil from chaff flowers. Since most global production is consumed domestically, a sizable portion is not sold internationally. However, Indonesia is the largest consumer, while India is the largest producer.

Achyranthes aspera is an upright herb that grows between 0.2 and 2.0 meters tall, with square stems and branches that frequently have a hint of purple color. Simple and oppositely placed, leaves are elliptic, ovate, or widely rhombate on the stem. They have dimensions of 5 cm x 22 cm, 2 cm x 5 cm, and are adpressed pubescent. The inflorescences are 8-30 cm long and have numerous single, white flowers.

Crimson blooms with a width of 3-7 mm. The petiole is 1.2 cm by 3 cm. Numerous oil glands on the leaves release volatile oil with a pungent smell. The terminal spikes of the inflorescence are typically much longer than the lateral ones, and it is typically long and upright. The bracts are sharp, ovate, stalked, and shorter than the calyx. Fruit causes the 4 mm long calyx to enlarge. The fruit's pedicel is short. The calyx lower lip is longer than the upper lip and bears two center teeth. Unlike teepals, *Achyranthes aspera* produces scale instead of corolla.Nutlets are ellipsoid in shape, black, pitted, and measure around 2 mm. The flower's five sepals continue to fuse to form a two-lipped calyx. There are four achenes in the fruit, and the ovary is superior. The leaves of *Achyranthes aspera* the circumstances needed by *Achyranthes aspera* are Mediterranean. 20°C is the ideal temperature for germination, and growth temperatures range from 10 to 30°C. The ideal growing conditions for the plant are lengthy days with full sun. *Achyranthes aspera* is tolerant to drought but prefers damp environments. Growing in disturbed areas with a high organic matter concentration is *Achyranthes aspera*. It thrives in soil that has a pH of between 4 and 8.2, with 6.2 being the ideal range. *Achyranthes aspera* requires a lot of water and has long, deep roots.

DESCRIPTION

Habit: An upright, perennial, wild herb. The stem is upright, branching, cylindrical, solid, angular, hairy, longitudinally striated, green with conspicuous internodes and nodes that become violet or pink at nodes. It is herbaceous above but woody below. Leaves: entire, ovate or obovate, simple, exstipulate, opposite decussate, petiolate, unicostate reticulate, hairy all over, acute or acuminate. The inflorescence is a spike that has lengthy peduncles holding flowers that are refluxed. Flowers: bracteolate, bracteoles two, shorter than the perianth, complete, sessile, actinomorphic, hypogynous, pentamerous, tiny, spinescent, green, dry, membranous, and persistent. Oval, persistent, owned bracts. Five tepals make up the polyphyllous, green, oval to oblong, quincuncial, imbricate, persistent perianth. An androecium consists of ten stamens, five of which are fertile and five of which are scale-like, fimbriated, sterile staminodes; these stamens alternate. Fertile stamens are dithecous, introrse, antiphyllous, monadelphous, and have filaments that are somewhat united at the base. The gynoecium has one ovule, is bicarpellary, syncarpous, superior, unilocular, has a single style, filiform stigma, and basal placentation.

Oblongutricle fruits. It is an endospermic seed. Oblong utricle fruits. Seeds: Endospermic, oblong, black, with a curved embryo measuring 2 mm in length. Australia is one of the nations where A. aspera has been utilized in traditional medicine.

This plant is said to be present in all the tropical and sub-tropical regions of the old world in the 1889 book The Useful Native Plants of Australia. In India, the herb is used to treat cases of dropsy. The seeds are administered for hydrophobia, snakebite patients, ophthalmia, and skin conditions. When the flowering spikes are ground into pills and applied topically to victims of crazy dogs, a small amount of sugar is added. When applied fresh and reduced to a pulp, the leaves are thought to be a beneficial treatment. externally to scorpion bites. The plant's ashes produce a significant amount of potash, which is used to wash garments. In India (Oude), the flowering spike is reputed to paralyze scorpions, thereby providing protection against them.

PLANT EXTRACTION

A powder of *A. aspera* was macerated in 300 ml of distilled water in an Erlenmeyer flask (1 L) for 72 h. The extraction was facilitated by using orbital shaker (Gallenhamp, England) at 120 rpm. The mixture was first filtered with gauze and then Whatman filter paper No. 1.The marc was macerated for another 72 h twice and filtered. The combined aqueous filtrates were then concentrated in an oven at a temperature of 40 ˚C. After drying, the extract was stored in tightly closed bottle container in refrigerator at -20 ˚C.

QUALITATIVE AND QUANTITATIVE ANALYSIS

Triterpenoid saponins, ketosteroids, and polysaccharides are the major three classes of bioactive compounds in *Achyranthes* plants, and there are a multitude of studies concerning their qualitative and quantitative analysis. For example, RRLC method coupled with electrospray ionization Q-TOF MS/MS has been developed by Li and colleagues for the characterization and identification of twenty-two triterpenoid saponins from *A. bidentata*. Through the developed method, the losses of monosaccharide

PHARMACOLOGICAL ACTIVITIES

Pharmacological Applications Strong antioxidant capabilities are known to be present in chaff flower. Numerous studies have demonstrated the oil's strong spermicidal, anti-fertility, and anti-cancer effects. A balanced and healthful lifestyle depends in large part on antioxidants, and chaff flower is a great provider of these vital substances. [12]

Still, in spite of Despite its purported benefits, it's crucial to remember that basil includes certain carcinogenic components that, if consumed in excess, could be harmful to one's health. For this reason, it is not advised for youngsters or pregnant women to use chaff flower.[24]

The phytochemical components of chaff flower are highly diverse and change dramatically with time, growing method, and storage. The entire herb's nutritional and pharmacological qualities in its natural state, as it has been traditionally used, are derived from the interactions of several active phytochemicals; as a result, a single isolated constituent cannot fully replicate the health benefits of chaff flower.[25]

Chemists and pharmacists face difficulties since traditional practitioners have relatively little data regarding standardized dosages. It brings up the point that improved knowledge of the constituents of phytochemicals and their interactions requires increased communication between conventional and traditional medicine.[26]

Studies on the effects and medicinal qualities of chaff flower have been carried out on a variety of levels. The analgesic effect of *Achyranthes aspera* methanolic extract was evaluated in mice. When the plant's extract was taken orally at doses of 300, 600, and 900 mg/kg of body weight, it significantly reduced pain compared to the usual dosage of 10 mg/kg of piroxicam. The ethanolic extract of *Achyranthes aspera* root has post-coital antifertility effect in female albino rats, according to research by N. Vasudeva and S.K. Sharma (2006). At 200 mg/kg body weight, the aforementioned extract showed 83.3% anti-implantation effectiveness when taken orally. The oil of *Achyranthes aspera* was discovered to have strong anti-ulcer properties. [27]

Plant-based nutrition research has focused a lot of attention on the health benefits of phytochemicals found in fruits, vegetables, herbs, and spices in recent years. While the study of plant components is not new, the characterization of bioactive compounds to investigate their effects on human health and illness is a relatively recent development for scientists. Research on animals and in cell cultures has revealed that chaff flower possesses anti-inflammatory, anti-oxidant, and anti-microbial qualities. [28]

Chewing on fresh chaff flower leaves is a remedy for Herpes zoster. It aids with blood clotting as well. [29]

Prophylactic agent

Chaff flower leaf decoction is used to prevent microbiological infections such as fever, diarrhea, and malaria. Root decoction with Within a month after conception, honey is consumed as an abortifacient. [30] The essential oil of chaff flowers exhibits larvicidal qualities. Another treatment for diabetes is chaff flower leaf decoction.[20] Because of the presence of alkaloids, chaff flower exhibits antiplasmodial activity. It also possesses anti-malarial qualities, and its primary ingredient, eugenol, is what gives it its ability to repel mosquitoes [31]. The paste made from chaff flower leaves works well for clearing facial scars and treating ringworm [32]. Chaff flower is very helpful in treating skin conditions, getting rid of worms and parasites, and mending cuts, wounds, and ulcers. [33] Chaff flower is rich in antioxidants and provides strong protection against damage caused by free radicals. Free radicals of oxygen are naturally occurring physiological products that include a single unpaired electron or several. Reactive oxygen species have the potential to damage proteins, carbohydrates, DNA, and vital membrane lipids. Numerous illnesses, including diabetes, cancer, and atherosclerosis, are brought on by this damage. Such illnesses can be effectively treated using chaff flower. [34] Since bio generative disorders are characterized by stress, chaff flower antioxidants aid in preserving health and lowering the risk of developing such diseases.[35] Numerous research carried out in different regions of the world have provided the majority of the information now accessible regarding the chemical characteristics of chaff flower leaves and seeds. Consequently, it is anticipated that regional impacts will cause variations in the chemical composition of chaff flower Sudhir Patil *et al.*, 2021, NavjeetSingh*et al.*, 2019, Saba Hasan and coworkers 2014 were investigated the anti-inflammatory, Heart-related diseases, Antioxidants, Hepatoprotective intent, Diuretic intensity, Antidiabetic action, Antimicrobial properties, Anticancer, Prophylactic agent against *A. aspera* species. [30]

A

nti-cancer effort

Researcher after researcher has confirmed and documented chaff flower's anti-cancer properties. After being treated with mineral oil, Swiss albino mice were used to investigate the anti-tumor potential of chaff flower. A variety of chaff flower leaf extracts were investigated for potential anti-tumor properties. Mice were given varying amounts of ether extract (3 mg/ml and 1.5 mg/ml), and the results indicated that at a concentration of 3 mg/ml, the ether extract of chaff flower leaves had the highest ability to prevent cancer among all extracts. The higher anti-cancerous

activity seen in chaff flower leaves is attributed to non-alkaloid components. [36]

Shivsharan Singh *et al.,* 2017 were published the In-vitro anticancer activity of *Achyranthes aspera* root extractagainst different human cancer cell lines, he reported that anticancer potentialactivities exhibited due to the presence of phytoconstituents, like alkaloid, phenolics, flavonoids, terpenoids etc; that have been demonstrated to act as cytotoxic agents. [34]

NafisehsadatOmidiani*etal*., 2020 were revealed theAnticancer potentials of leaf, stem, and root extracts of Achyranthes aspera L. she reported that anticancer properties attributed to *Achyranthes aspera L*. The LC-MS analysis of the acetone extract of its roots has revealed the presence of a few anticancer compounds reported in the literature.[45]. Sudhir **Patil *et al.,* 2021**, NavjeetSingh*et al.,* 2019, Saba Hasan and coworkers 2014 were investigated the anti-inflammatory, Heart-related diseases, Antioxidants, Hepatoprotective intent, Diuretic intensity, Antidiabetic action, Antimicrobial properties, Anticancer, Prophylactic agent against *A. aspera* species. [34]

Antimicrobial properties

Essential oils, also referred to as volatile oils, possess hydrophobic Herbs and spices get their biological activity from nature. Petroleum, ether, and methanol extracts of chaff flower oil were produced in dimethyl sulfoxide (DMSO, W/V) at varying doses (50-200 µg/100µl) in order to assess the antibacterial activity of the flower. The well plat assay method was used for the test. Methanol and chloroform root extracts exhibited weak antimicrobial action against Escherichia coli and Shigella sp., but stronger antimicrobial activity against Gram-negative Klebsiella sp. When applied to Fusarium species, all of the root and shoot extracts had antifungal properties. Methanol extract, however, shown activity against Alternaria species. The chloroform extract of the chaff flower's roots demonstrated the strongest anti-microbial and anti-fungal activity against the examined microorganisms, however all the extracts displayed anti-microbial activity that differed noticeably from one another. antibacterial properties were as a result of the tannins, alkaloids, and saponins present.[37]

The various extracts of dried leavesusing solvents like petroleum ether, chloroform and methanol have reported antibacterial andantifungal activity. The extracts were tested against 3 gram-negative bacteria Sudhir Patil *et al.,* 2021, NavjeetSingh*et al.,* 2019, Saba Hasan and coworkers 2014 were investigated the anti-inflammatory, Heart-related diseases, Antioxidants, Hepatoprotective intent, Diuretic intensity, Antidiabetic action, Antimicrobial properties, Anticancer, Prophylactic agent against *A. aspera* species. [38]

Anti diabetic action

Although chaff flower has been used to treat diabetes mellitus since ancient times, its anti-diabetic properties have not been supported by science. [38]. Therefore, ethanol extract was made and tested against diabetic Swiss albino mice that had been treated with alloxan in order to assess the effectiveness of chaff flower against diabetes mellitus. On the fifteenth and thirteenth day of exposure, the blood glucose level was observed to have grown by 123% and 128%, respectively. The results clearly showed that chaff flower ethanol extract has strong anti-diabetic properties.[37]

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Diuretic intensity

Using albino rats of both sexes, the acute toxicological profile and diuretic efficacy of chaff flower were investigated. the crude aqueous extract by intraperitoneal route at various doses of 10, 30, and 50 mg/kg, respectively. The experiments' findings demonstrated the notable diuretic effects of chaff flower. Results also showed that chaff flower aqueous extract increased urine volume in a dose-dependent way [35]. Sudhir Patil *et al.,* 2021, NavjeetSingh*et al.,* 2019, Saba Hasan and coworkers 2014 were investigated the anti-inflammatory, Heart-related diseases, Antioxidants, Hepatoprotective intent, Diuretic intensity, Antidiabetic action, Antimicrobial properties, Anticancer, Prophylactic agent against *A. aspera* species. [35]

Hepatoprotective intent

The potential hepatoprotective effects of an ethanolic extract from *Achyranthes aspera* seeds were investigated in rats using a model of liver injury produced by carbon tetrachloride. The rats treated with an ethanolic extract of chaff flower (100 mg/kg p.o.) showed a significant inhibition in serum levels, and the similar results were obtained with standard medication silymarin (100 mg/kg). This demonstrated

chaff flower's effectiveness in protecting the liver [30].

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Antioxidants

The distinct health the primary cause of chaff flower's health advantages is its extremely high antioxidant content. Antioxidants, such as vitamins and phytochemicals, help to prevent disease in the case of chaff flower. The antioxidant capacity of chaff flower was assessed in numerous tests, along with that of many other herbal plants. The results showed that chaff flower had substantial antioxidant potential. Using an in vitro 1, 1-diphenyl-2-picrylhydrazyl (DPPH) scavenging assay, the antioxidant capacity of a methanolic extract of the roots and leaves of chaff flower was assessed in an experiment. The results demonstrated the antioxidant properties of chaff flower, with flavonoids being the phytochemicals accountable for this activity [31].

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Heart-related conditions

The impact of chaff flower saponin on rat heart phosphorylase activity was observed in order to assess the potential of chaff flower against heart diseases. *Achyranthine* is a water-soluble alkaloid that in dogs under anesthesia caused blood pressure to drop, the heart to slow down, and breathing to speed up. Research revealed that chaff flower significantly activates the cardiovascular system. [30]. Sudhir Patil *et al.,* 2021, Navjeet Singh*et al.,* 2019, Saba Hasan and coworkers 2014 were investigated the anti-inflammatory, Heart-related diseases, Antioxidants, Hepatoprotective intent, Diuretic intensity, Antidiabetic action, Antimicrobial properties, Anticancer, Prophylactic agent against *A. aspera* species.

Anti-inflammatory action

Numerous studies have revealed that the chaff flower possesses immune-modulatory properties. A trial revealed that chaff flower extract enhances the dose-dependent development of an OVA-specific antibody response. It has been observed that the chaff flower hydro-alcoholic extract stimulates the cell-mediated immune system by enhancing phagocytic function. Higher levels of immunomodulatory activity have been found in extracts from seeds and roots.[28]

Shreya Talreja et *al.,* 2023 were published a comprehensive review of *Achyranthes aspera* ethnopharmacology, phytochemistry, and therapeutic potential. She reported that the plant's diverse pharmacological activities, including anti-inflammatory, antioxidant, antimicrobial, and analgesic effects.[36]

Sudhir Patil *et al.,* 2021, NavjeetSingh*et al.,* 2019, Saba Hasan and coworkers 2014 were investigated the anti-inflammatory, Heart-related diseases, Antioxidants, Hepatoprotective intent, Diuretic intensity, Antidiabetic action, Antimicrobial properties, Anticancer, Prophylactic agent against *A. aspera* species.

Activity of Prothyrods

Chaff flower leaf extracts have been shown to possess prothyroidic and anti-peroxidative qualities. The plant extracts reduced hepatic lipid peroxidation and altered thyroid hormone concentrations in rats. The tannins and saponins found in the seeds of the chaff flower may be the cause of this plant action. [33]

Spermicidal activity

Extracts from roots of *Achyranthes aspera* have been reported to possess spermicidal activity in human andrat sperm, as studied by. is covered that the most successful methods for sperm immobilization, sperm viability, acrosome status, 5'-nucleotidase activity, and nuclear chromatin decompensation were hydroethanolic, n-hexane, and chloroform extracts**.** 2016 were found the plant of *achyranthus aspera* having spermicidal activity.

Antiparasitic activity

Zahir et al**.,** have demonstrated the presence of anti-parasitic activity in ethyl acetate extracts of A. aspera. Research has shown that *A. aspera's* dried leaf, flower, and seed extracts are effective against the internal parasite Paramphistomumcervi in sheep and the larvae of the bovine tick Rhipicephalus (Boophilus) microplus (Acari:lxodidae) in cattle [23].

Anti-allergic

Datir*et al.,* found that the plant's petroleum ether extract (200 mg/kg, i.p.) significantly inhibits the

effects of milk on mice's leukocytosis and eosinophilia. Thus, the presence of steroids may be the cause of *A. aspera's* antiallergic activity. Therefore, the antiallergic action of the herb may be attributed to these steroids [24].

Wound healing property

S. Edwin et al., examined the potential of ethanolic and aqueous extracts of *Achyranthes aspera* leaves for wound healing. Two wound models the incision wound model and the excision wound model were used to study the wound healing activities.[25]

Hypolipidemic activity

In rats given triton injection to induce hyperlipidemia, A. K. Khanna *et al.,* found that an alcoholic extract of *A. aspera* at a dose of 100 mg/kg reduced serum levels of total lipids (TL), phospholipids (PL), triglycerides (TG), and cholesterol (TC) by 60, 51, 33, and 53%, respectively. After 30 days of chronic dosing at the same doses, normal rats' serum levels of TC, PL, TG, and TL decreased by 56, 62, 68, and 67%, respectively. This was followed by a significant decrease in hepatic lipid levels. This medication caused a 24 and 40% rise in the excretion of cholic acid and deoxycholic acid in the feces, respectively. The quick excretion of bile acids, which results in reduced cholesterol absorption, may be the mechanism of action for *A. aspera's* cholesterol-lowering function.[27]

Sudhir Patil *et al.,* 2021, Navjeet Singh*et al.,* 2019, Saba Hasan and coworkers 2014 were investigated the anti-inflammatory, Heart-related diseases, Antioxidants, Hepatoprotective intent, Diuretic intensity, Antidiabetic action, Antimicrobial properties, Anticancer, Prophylactic agent against *A. aspera* species.

Toxicity

According to the available knowledge, the toxicity of *Achyranthes* plants is low and safe enough for herb prescription uses. Acute toxicity study performed in rabbits showed that the oral administration of *A. aspera* powder did not cause any poisoning symptoms in the perspective of behavior patterns although the dosage was as high as 8 g/kg (Akhtar and Iqbal, 1991). Another similar study demonstrated that the oral administration of healthy adult male albino mice with a methanol extract of *A. aspera*

CONCLUSIONS:

Achyranthes aspera stands out as a significant medicinal plant with a rich history of traditional use and a promising future in pharmacological research. Its diverse therapeutic applications, coupled with a wealth of bioactive compounds, underline the potential for this herb to contribute meaningfully to modern medicine. Through a comprehensive exploration of its botanical characteristics, chemical composition, and ethnopharmacological practices, it becomes apparent that *Achyranthes aspera* is not just a relic of traditional knowledge, but a vital source of remedies that warrant further investigation. The plant's ability to thrive in various ecological contexts enhances its viability as a global resource, particularly in regions that have relied on its medicinal properties for generations. Encouragement of sustained research efforts could lead to a deeper understanding of its mechanisms of action and broader acceptance in the integrative medical community. Ultimately, recognizing and validating the cultural significance and health benefits of *Achyranthes aspera* can promote its conservation and utilization, ensuring that this valuable herb remains accessible for future generations.

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