

Achyranthes Aspera: An assessment of medical validation for its dietary and phyto-pharmacological potentials

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ABSTRACT

Food and drugs plays a quite noteworthy responsibility in public healthcare system globally. Nutraceuticals have evolved from the recognition of the link between food and health. Nutraceuticals contain health promoting ingredients or natural components that have a potential health benefit for the body. Consumer interest in the relationship between diet and health has increased the demand for information on nutraceuticals. Rapid advances in science and technology, increasing health care costs, an aging population and rising interest in attaining wellness through diet are among the factors fueling interest in nutraceuticals. Nutraceuticals currently on the market represent a small fraction of the possible products. The vast potential for functional foods will not be achieved without extensive scientific research to ensure the safety and efficacy of these products. Plants are superior foundation for vital macro and micronutrients. *Achyranthes aspera* (Amaranthaceae) is a noteworthy medicinal herb widely distributed in Indian subcontinent in form of weed. It has rich content like alkaloids, saponins, flavonoids, steroids and terpenoids. The whole plant is said to used for health issues but the most common part used are roots, seeds and shoots. The present review explored various medicinal properties of *Achyranthes aspera*.

KEYWORDS: *Achyranthes aspera*, Nutraceuticals, Nutrients, Medicinal herb.

Introduction

Medicinal plants have enormous implication in the health status of communities. India is well known to be as the “Emporium of Medicinal Plants”. Due to great magnitude, demand of medicinal plants has increased several folds [1]. Especially in developing countries herbal drugs play an important role in health care programs. Ancient Indian literature i.e. “Ayurveda” comprise of a tremendously broad definition of medicinal plants to be a potential source of medicinal substances [2]. *Achyranthes aspera* L. belongs to the Family Amaranthaceae commonly recognized as Chirchita and Latjeera in confined languages. It is a renowned plant in Ayurvedic, Siddha, Unani-Tibbi, Homeopathic and Naturopathic & Home Remedies [3]. The plant and its parts are assessed for various pharmacological potentials like anti-allergic, anti-parasitic, analgesic, cardiovascular, nephroprotective, hypoglyceamic, and antipyretic. The traditional healing assets of the plant is highly admired and is used in curing of, cold, cough, headache, dog bite and in treatment of asthma, bleeding, pneumonia, boils, bronchitis, colic, debility,

dropsy, dysentery, ear complications, leucoderma, renal complications, scorpion bite, snake bite and skin diseases etc [4]. It is reported to possess alkaloids, flavonoids, saponins, steroids and terpenoids. Flavonoids of this plant have reported for anticancer property as it prevents or slows the development of some cancers [5].

Plant Description

Achyranthes aspera L. (Latjeera) is about 1- 2 meter in height, found annually or in perennial time. It is an herb which is erect and prostrate often with a woody base. Stems are simple or branched from the base angular, ribbed and often with tinged purple color [6]. In summer, it bears gorgeous flowers. The stem are of square, leaves elliptic ovate or in general rhombate The inflorescences observed as 8 - 30 cm long with 3 – 7 mm wide white or red flowers [7] as shown in figure 1.



Figure 1: Image of *Achyranthes aspera*

The plant is widespread in nature in form of weed, in Ceylon, Baluchistan, Australia, Tropical Asia, Africa and America. In India, it can be found easily anywhere on roadsides or on the edges of field and waste place up to an altitude of 2100 m. The morphological description of plants is depicted in table 1.

Table 1. Morphological description of *Achyranthes aspera*

Root	Stem	Leaf	Seed
 <p>Cylindrical tap root of thickness 0.1-1.0 cm regularly tapering. Rough due to presence of some root scars. Root seemed yellowish</p>	 <p>Thickness is about 0.3 - 0.5 cm with yellowish-brown, erect, branched, cylindrical, hairy, and solid.</p>	 <p>Leaves are opposite, oblong-obviate to elliptic or obviate from an acute or obtuse, wavy margin, obviate, slightly</p>	 <p>At the apex, it is sub-cylindrical, truncate, round at the base and endospermic.</p>

- brown in color.		acuminate	and	
		pubescent.		

Phytochemistry of *Achyranthes Aspera*

The major constituents of plants is present in seeds such as Betaine, Exdysterone, Achyranthine, Hentriacontane, Achyranthes and saponins A, B, C, D. While the Leaves of plant possesses Benzoquinone, Hydroquinone, Spathulenol, Nerol, α -ionone, Asarone, Eugenol. The structures of these components are shown in figure 2.

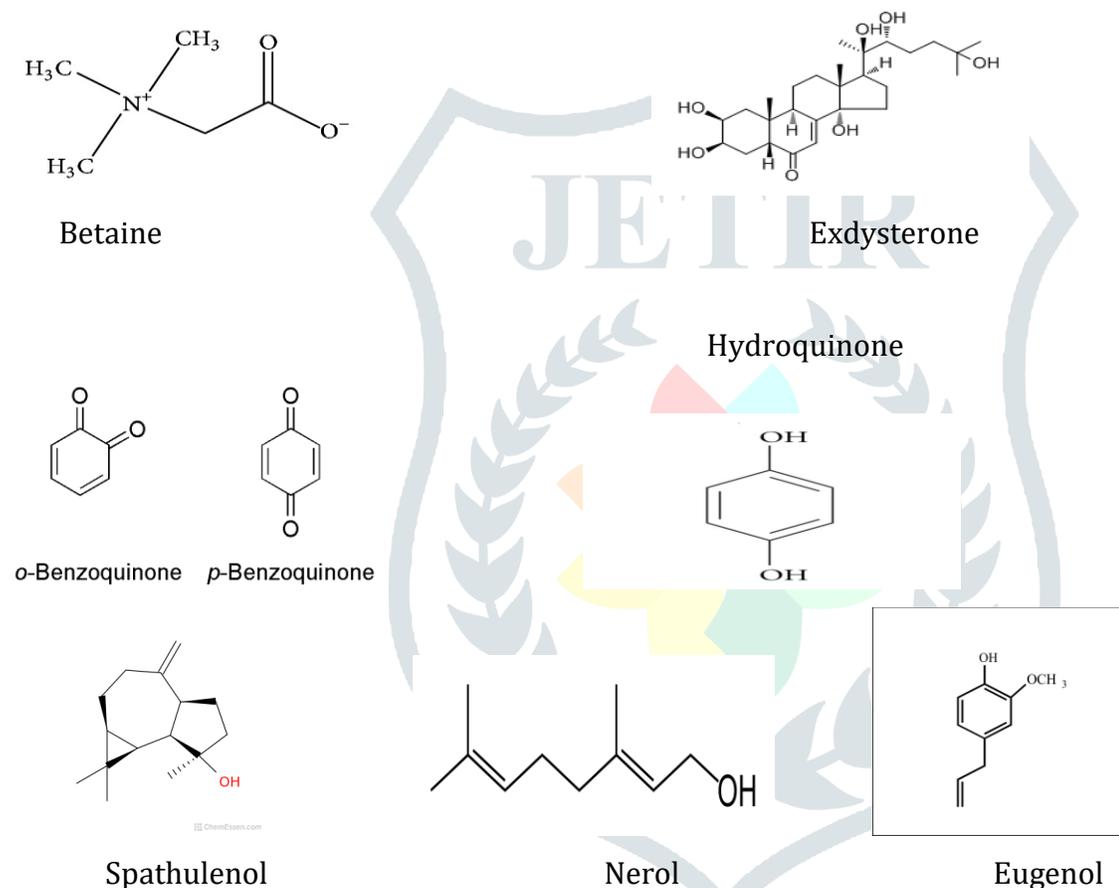
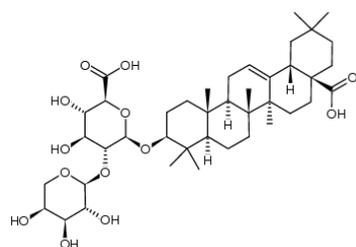
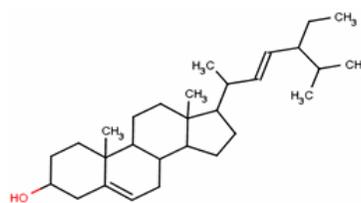


Figure 2: Structures of phytoconstituents isolated from seeds and leaves of the plant

The Aerial Part of plant contains β -D-glucopyranosyl 3 β -[O- α -L-rhamnopyranosyl-(1 \rightarrow 3)-O- β -D-glucopyranuronosyloxy] machaerinate, β -D-glucopyranosyl3 β -[O- β -Dgalactopyranosyl-(1 \rightarrow 2)-O- α -Dglucopyranuronosyloxy] machaerinate (figure 3)



β -D-glucopyranosyl3 β -



β -D-glucopyranosyl3 β -[O- β -

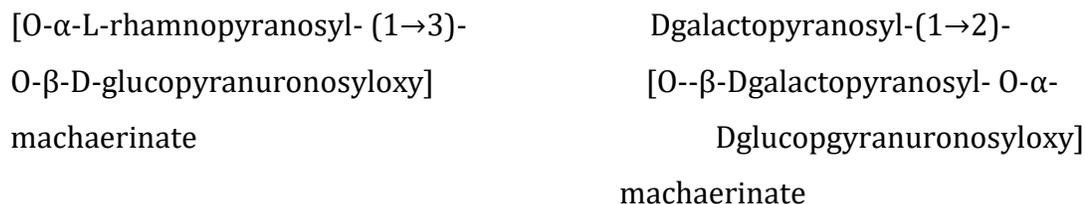


Figure 3: Structures of phytoconstituents isolated from aerial parts of the plant

Ethnomedical claims

The whole plant is commonly used for abdominal troubles and mostly used for treatment of piles. The roots are used to clean mouth as brushing purpose as well as to cure halitosis. The twig is used to stop the toothache. It important use to be noted is that, it can be used for treatment of night blindness when taken as eye drop during bedtime. [9]. Also, used for dropsy, dermatitis, gynecological disorders. The paste of root is used to induce labor pain. It is also useful to treat cough, renal dropsy, fistula, scrofula, skin rash, nasal infection, chronic malaria, impotence, fever, asthma, piles and snake bites. When mixed with honey, its dried leaves are used to stop diarrhea. Leaves have great potential as it claims to heal from prutitis and scabies. Adding to it, paste of leaves used to relieve toxic bites. [10,11].

9. Pharmacological uses

Antiparasitic activity-

Zahir et al (2009) observed the potential of this plant as antiparasitic using ethyl acetate extract [12]. *A.aspera* dried leaf, flower and seed extract was observed to have activity against the larvae of cattle tick *Rhipicephalus* (*Boophilus*) *microplus* (*Acarilxodidae*), sheep internal parasite *Paramphistomum cervi*.

Hepatoprotective Activity-

The methanolic extract of this plant reported to have hepatoprotective potential. It altered the SGPT, SGOT, SALP, total and direct bilirubin parameters dose dependently in experimental animals when exposed to rifampicin which is used as hepatotoxicant. [13].

Anti-inflammatory Activity

The potential of plant was assessed in wistar rats using alcoholic extract. The alcoholic extract significantly suppressed granuloma formation. Collectively, these data demonstrated promising anti-inflammatory activity against both acute and chronic inflammation. In addition, inhibition of prostaglandins and bradykinins played a vital role in cure. [14].

Nephroprotective Activity-

The nephroprotective role of methanolic extract of *Achyranthes aspera* (*A.aspera*) studied against lead acetate-induced nephrotoxicity in rats. Toxicity was induced in Wistar strain by administering lead acetate (0.2%) in drinking water for 6 weeks, followed by extract of *A. aspera* (200 mg/kg body weight). Changes in kidney weights encountered upon lead administration improved after extract with *A. aspera*.

Lead damage to the urine was evident from increase in the activity of γ -glutamyltranspeptidase (γ -GT), Cathespin D, alkaline phosphatase (ALP), acid phosphatase (ACP), β -glucuronidase lactate dehydrogenase (LDH) and N-acetyl- β -D-glucosaminidase (NAG) in urine along with some urinary constituents (urea, uric acid, creatinine, protein and phosphorous). Increased activities of urinary enzymes were accompanied by increase in the urinary constituents. Treatment with methanolic extract of *A. aspera* after lead induction completely ameliorated the lead-induced renal damage.[15].

Anti-depressant Activity-

The antidepressant activity of methanolic extract of the leaves of was studied using forced swimming test in mice and rats and tail suspension test in mice. Here, the immobility time in forced swimming test in mice was decreased significantly in *A. aspera* (300 and 600 mg/kg) treated group as compared to the control group. But in case of rat, administration of the plant extract significantly decreased the duration of the immobility time in forced swimming test in a dose dependant manner from 100 to 600 mg/ kg body weight p.o. In the tail suspension test, there was significant decreased in the duration of immobility time in the treated as well as the standard group compared to the control group in a dose dependant manner. [16].

Cardiovascular Activity-

The water soluble alkaloid of *Achyranthes aspera* was assessed for cardiovascular activity and it was found that, there was decrease in the heart rate, BP, along with increased the rate and amplitude of respiration in experimental dogs and frogs. [17].

Bronchoprotective Activity –

Goyal et al (2015) studied the bronchoprotective effect using ethanolic extract in toluene diisocyanate (TDI) induced occupational asthma in wistar rats. At the end of the study, after provocation with 5% TDI the symptoms were observed in all animals. The total and differential leucocytes were counted in blood and bronchoalveolar (BAL) fluid. Here, liver homogenate was utilized for assessment of oxidative stress and lung histological examination was performed to investigate the inflammatory status in the airway. The TDI sensitized rats exhibited asthmatic symptoms while *A. aspera* and dexamethasone treated rats did not show any airway abnormality. The neutrophils and eosinophils in blood were decreased significantly; the total cells and each different cell in particular eosinophils in BAL fluid were markedly decreased in treatment groups as compared to TDI sensitized rats. Their findings concluded that *A. aspera* has beneficial role in occupational asthma. [18].

Anti-allergic Activity-

Datir et al (2009) observed the petroleum ether extract (200 mg/kg, i.p.) of the aerial parts of *A.aspera* plant have significant antiallergic activity in both milk induced leukocytosis and eosinophilia in mice. It was concluded that due to presence of steroids, *A.aspera* possess antiallergic activity [19].

Anticancer activity-

Chakraborty A, et al (2002) studied the leaves of *A. aspera* for chemopreventive activity. In MeOH extract, the presence of alkaloid, non-alkaloid and saponin fractions exhibited significant inhibitory effects (100 µg) on the Epstein-Barr virus early antigen activation induced by the tumor promoter 12-O-tetradecanoylphorbol-13-acetate in Raji cells. In this in vitro assay the non-alkaloid fraction containing mainly non-polar compounds showed the most significant inhibitory activity (96.9%; 60% viability). Also, in the *in-vivo* study, two-stage mouse skin carcinogenesis test, the methanolic extract possessed a pronounced anticarcinogenic effect (76%) which indicated that there are valuable antitumor promoters in carcinogenesis.[20].

Wound Healing Activity-

Edwin S et al (2008) studied the ethanol and aqueous extracts of leaves of *A. aspera* were prepared and its wound healing and antioxidant activity were evaluated. The wound healing activity was studied using excision and incision wound model. The free radical scavenging activity of the extracts was also assessed using two methods, DPPH radical scavenging activity, and superoxide scavenging activity. The extracts responded significantly in both the wound models tested. Also, the plant exhibited good antioxidant effect by preventing the formation of free radicals in the two models studied. [21].

Anti-oxidant activity-

In this study, *A. aspera* stem extracts were screened for antioxidant potential. Methanol and aqueous extracts were screened for the estimation of total phenolic content by Folin-Ciocalteu assay. Antioxidant potential of both extracts was measured by DPPH radical (2,2-diphenyl-1-picrylhydrazyl) scavenging assay. Phytochemical screening showed the presence of carbohydrates, phenolic compounds, saponins, alkaloids, oil and fats and tannins. Methanol extract exhibits high phenolic content than that of aqueous extract. Methanol extract showed high antioxidant potential compare to aqueous extract. With all results it concluded that *A. aspera* possess high antioxidant activity (22)

Antidiabetic Activity:

In the present study authors tried to evaluate hypoglycemic effects of ethanolic extract of *A. aspera* in Streptozotocin induced hyperglycemia. Streptozotocin causes selective destruction of beta-cells, which are involved in the production of Insulin. Deficiency of Insulin after Streptozotocin treatment leads to an elevation in the blood glucose. After treatment with the aqueous extract there was a significant reduction in the blood glucose levels. [23].

Immunomodulatory Activity:

Chakrabarti & Vasudeva reported that *A. aspera* shows immuno-stimulant action in *Catla catla*. *Achyranthes* has significantly ($P < 0.05$) enhanced the BSA-specific antibody titers than the untreated control group throughout the study period. The efficiency of antigen clearance was also enhanced. [24].

Antimicrobial Activity:

Ethanollic and chloroform extracts of seeds of *Achyranthes aspera* studied for mild to moderate antibiotic activity against *E. coli*, *B. subtilis* and *P. aeruginosa* by M.J. Khan *et al* [25]. Various extracts of the leaves and callus of the plant was studied by Prasad *et al.* for antimicrobial activity [26]. T. N. Misra *et al.* reported that the plant oil possess antifungal activity against *A. carneus* in which main constituent isolated was 17-pentatriacontanol from essential oil of the shoots of plant [27]. S. Sharma *et al.* when studied the alcoholic extract with dose dependent inhibitory activity against *Staphylococcus aureus*, a bacterium causing skin disease in human beings proved the presence of triterpenoid saponin [28].

Anticonvulsant activity –

The Petroleum ether extract of aerial parts of *A. aspera* was studied for anti-epileptic activity in mice. The potent extract was evaluated against the PTZ model by co-administering with flumazenil (FMZ), and also evaluated for its effect on GABA levels in brain and NMDA-induced lethality in mice. The extract exhibited potent antiepileptic activity through its GABAergic mechanism. [29].

Anti-ulcer Activity-

The antiulcer potential of ethanolic extract of *A. aspera* Linn. was studied in ethanolic extract of the leaves of *A. aspera* was in Sprague-dawley (SD) rats. The extracts exhibited gastroprotection by following the antisecretory and cytoprotective mechanism. In anti secretory mechanism the ethanolic extract of the *A. aspera* was inhibiting the free and total acid in pyloric ligated ulcer models. It was showing protection in alcohol induced ulcer model and it also improved the depleted levels of mucin in pyloric ligated model. [30].

Gut Modulatory Activity-

It was observed that *A.aspera* crude extract at 30, 100, 300, and 700 mg/kg, have potential against castor oil-induced diarrhea in mice. It caused spasmogenic effect on guinea pig ileum and rabbit jejunum [31].

Thrombocytopenia and Lymphocytopenia-

It was observed that, methanolic leaf extract of *A. aspera* elevates lymphocyte and platelet counts in albino mice as showed in a dose dependent changes in hematological parameter. Thus, leaf extract has the potentials of being efficient in the treatment of diseases caused by thrombocytopenia and lymphocytopenia. [32].

In vaginal infection-

The herbal cream containing hydro-alcoholic extract of *Achyranthes aspera* Linn. (Roots) prepared using different ratio of ingredients and were evaluated. The data obtained indicated that formulation have excellent results when compared with other formulation codes. [33].

Spermicidal Activity-

Spermicidal activity in human and rat sperm was studied in various root extract of *A.aspera*. The n-hexane, hydroethanolic and chloroform extracts were observed to be most efficient for sperm viability, sperm immobilization, acrosome status and nuclear chromatin de-condensation [34].

Nutraceuticals values

Devi *et al* reported that *A.aspera* plant have zinc and Iron and was found to be high, 1.52 ppm and 63.26 ppm along with 0.87 mg/kg of protein respectively [35]. The presence of before said components proves to be a good dietary supplement due to their significance presence towards providing treatment for diabetes and other metabolic disorders including its complications involving microangiopathy and atherosclerosis. [36] The ample amount of protein intake is necessary for the compensation of protein loss often noticed in hypoglycaemic conditions [37]. Zinc is also considered as essential component for many enzymes which is involved in the maintenance of several tissue functions [38]. This plant also proved useful in case of obese patients by acting as a slimming supplement. *A. aspera* raises the production of glycogen in liver and its appetite suppressing property which leads to elevated body heat production by activating thermogenesis and encourages weight loss [39].

Conclusion

Achyranthes aspera is having wealthy source of numerous therapeutically and pharmacologically lively constituents. The plant gave its vigor due to its pharmacological efficiency and medicinal belongings. The ethno-medical, phytochemical, pharmacological and toxicological uses of the *Achyranthes aspera* proved its value in field of Ayurveda. As *Achyranthus aspera* is rich in Iron, Zinc and protein content can serve as a nutraceuticals for healthcare of population. Additional attention must be taken to recognize its bio-active compounds accountable for its biological potential.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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