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PHARMACOGNOSTIC ACCOUNT AND MEDICINAL USES OF *ACHYRANTHES ASPERA* LINN.

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ABSTRACT: Herbal medicines are widely used since time immemorial indicating that herbs are a growing part of modern, high-tech medicine. Current advancement in drug discovery technology and search for novel chemical diversity have intensified the efforts for exploring lead from "Ayurveda" the traditional system of medicine in India. *Achyranthes aspera* Linn. (Amaranthaceae) has been important coniferous plant in ayurvedic and indigenous medicinal systems. The medicinal plants are used for treatment of various diseases because of their safety and effectiveness. The problem of microbial resistance is growing and the outlook for the use of anti-microbial drugs in the future is still uncertain. The Clinical trials and animal research support the use of *Achyranthes aspera* Linn. for anti-inflammatory, anti-malarial, anti-ulcer genic, treatment of emotional stress and trauma, anti-microbial, insecticidal, fungicidal, asthma. Though almost all of its parts are used in traditional systems of medicines, seeds, roots and shoots are the most important parts which are used medicinally. The present review describes some of the important medicinal properties of *Achyranthes aspera* Linn. which are instrumental in making it potent against infections.

INTRODUCTION: Knowledge of herbs has been handed down from generation to generation for thousands of years Bown 1995. Herbal medicines have a strong traditional or conceptual base and the potential to be useful as drugs in terms of safety and effectiveness leads for treating different diseases. World Health Organization has made an attempt to identify all medicinal plants used globally and listed more than 20,000 species Srivastav *et al.* 2011.

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According to the WHO more than 80 % of the world's population relies on traditional herbal medicine for their primary health care Vijayan *et al.* 2007. Plants have an extraordinary ability to synthesize aromatic substances which are usually phenols or their oxygen substituted derivatives.

The medicinally active plant compounds are usually their secondary metabolites like terpenoids, quinones, flavonoids, tannins *etc* that are responsible for protecting the plants from microorganisms, insects and other natural pests [1]. In the recent past there has been a tremendous increase in the use of plant-based health products in developing as well as developed countries resulting in an exponential growth of herbal products globally. One of the many plants used is *Achyranthus aspera* Linn.

Achyranthus aspera Linn. belongs to the family Amaranthaceae, is an annual, stiffly erect or procumbent, annual or perennial herb, 1-2m in height, often with a woody base, commonly found as a weed of waysides, on roadsides Anonymous 2005, Jain *et al.* 2006, Zafar 2009 [2, 3]. *Achyranthes aspera* Linn. is a well-known plant drug in Ayurvedic, Unani-Tibbi, Siddha, Allopathic, Homeopathic, Naturopathic & Home Remedies Dhale *et al.* 2013. It is an annual shrub found distributed throughout the tropical and subtropical regions. It is commonly found in India, Baluchistan, Sri Lanka, tropical Asia, Africa, Australia, and America [The Wealth of India 1985]. This wild tropical plant is known by different names such as Chirchita (Hindi), Apamarga (Sanskrit), Aghedi (Gujarati), Apang (Bengali), Nayurivi (Tamil), Kalalat (Malyalam), Dwivedi *et al.*, 2008 and Agadha (Marathi) in India.

The plant is used in indigenous system of medicine as emenagogue, anti-arthritic, anti-fertility, laxative, ecbolic, abentifacient, anti-helminthic, aphrodisiac, antiviral, anti-plasmodic, anti-hypertensive, anticoagulant, diuretic and anti-tumor Anonymous 1985, Ratra *et al.* 1970. It is also useful to treat cough, renal dropsy, fistula, scrofula, skin rash, nasal, infection, chronic malaria, impotence, fever, asthma, piles and snake bites Singleton 1999. This plant is astringent, digestive, diuretic, laxative, purgative, and stomachic. The juice of the plant is used in the treatment of boils, diarrhea, dysentery, hemorrhoids, rheumatic pains, itches and skin eruptions Londonkar *et al.* 2011. It is reported to contain alkaloids, flavonoids, saponins, steroids and terpenoids. Flavonoids have shown to prevent or slows the development of some cancers Narayana *et al.* 2001 and mostly act as an anti-oxidant and anti-inflammatory agents [4, 5].

• **Plant Profile:** *Achyranthes aspera*

FIG. 1: ROOTS OF *ACHYRANTHES ASPERA*

FIG. 2: INFLORESCENCE OF *ACHYRANTHES ASPERA*

Taxonomic classification:

Kingdom	:	Plantae Subkingdom - Tracheobinota
Super Division	:	Spermatophyta
Division	:	Mangoliophyta
Class	:	Mangoliophsida
Subclass	:	Caryophyllidae
Order	:	Caryophyllales
Family	:	Amaranthaceae
Family	:	Achyranthes
Species	:	Aspera

Botanical Description:

Synonyms Latin	:	*Achyranthes aspera*
Sanskrit	:	Aghata
Hindi	:	Latjira, Chirchira
Gujarati	:	Safad Aghedo
Tamil	:	Safad Aghedo
Telugu	:	Uttaraene
Malayalam	:	Kadaladi
Punjabi	:	Kutri Unani - Chirchitaa
Ayurvedic	:	Apaamaarga, Chirchitaa, Shikhari

Shaikharika Persian	:	Khare-vazhun
Arabian	:	Atkumah
French	:	Achyranth a feuilles rudes, collant, gendarme
Spanish	:	Mosotillo, rabo de gato, rabo de chango, rabo de raton

FIG. 3: *ACHYRANTHES ASPERA*

Geographical Source: It is found on roadsides, field boundaries and waste places as a weed throughout India up to an altitude of 2100 m and in South Andaman Islands [8, 10]. The plant is also widespread in Baluchistan, Ceylon, Tropical Asia, Africa, Australia, and America.

Morphology: *Achyranthes aspera* L. (Latjeera) is an erect or procumbent, annual or perennial herb of about 12 meter in height, often with a woody base. Stems angular, ribbed, simple or branched from the base, often with tinged purple colour [8], branches terete or absolutely quadrangular, striate, pubescent [9], leaves thick [8], 3.8 - 6.3 × 22.5 - 4.5 cm [9], ovate-elliptic or obovate – rounded [8], finely and softly pubescent on both sides, entire, petiolate, petiole 6 – 20 mm long [9], flowers greenish-white, numerous in axillary or terminal spikes up to 75 cm long, seeds subcylindric, truncate at the apex, rounded at the base, reddish-brown.

FIG. 4: ROOTS OF *ACHYRANTHES ASPERA* L

Traditional Uses: Traditionally, the plant is used in asthma and cough. It is pungent, anti phlegmatic, antiperiodic, diuretic, purgative, and laxative, useful in oedema, dropsy and piles, boils and skin eruptions, *etc.* The crushing plant is boiled in water and is used in pneumonia. Infusion of the root is a mild astringent in bowel complaints. The flowering spikes or seeds, ground and made into a paste with water, are used as an external application for bites of poisonous snakes and reptiles, used in night blindness and cutaneous diseases [11]. For snake bites, the ground root is given with water until the patient vomits and regains consciousness. Inhaling the fume of *Achyranthes aspera* mixed with *Smilax ovalifolia* roots is suggested to improve appetite and to cure various types of gastric disorders [12]. It is useful in haemorrhoids, leaves and seeds are emetic, hydrophobia, carminative, resolve swelling, digestive and expel phlegm. Ash of the plant is applied externally for ulcers and warts. The crushed leaves rubbed on aching back to cure strained back [13]. A fresh piece of root is used as toothbrush. Paste of the roots in water is used in ophthalmia and opacities of the cornea. Paste of fresh leaves is used for allaying pain from bite of wasps [10]. The plant is useful in liver complaints, rheumatism, scabies, and other skin diseases. It also possesses tranquilizing properties [14, 15].

Phytochemical Investigation: Chemical investigations of the seeds of *Achyranthes aspera* reported the isolation & identification of Saponins A and B [16, 18]. Saponin A was identified as D-glucuronic Acid and saponins B was identified as β-Dgalactopyranosyl ester of D-glucuronic Acid. Along with these constituents, certain other constituents were also isolated like oleanolic acid, amino acids and hentriacontane. The seeds also contain chemical constituents like 10-tricosanone, 10-octacosanone & 4-tritriacontanone [17, 18]. The studies of R.D. Rameshwar & N. Akito (2007) revealed three oleonolic acid glycosides from the seeds of *Achyranthes aspera,* which were identified as α-L-rhamnopyranosyl- (1→4)-(β-Dgluco-pyranosyluronic acid)-(1→3)-oleanolic acid, α-L-rhamnopyranosyl -(1→4)-(β-D- gluco-pyranosyluronic acid)-(1→3)-oleanolic acid-28-O-β-D-glucopyranoside and α-Lrhamnopyranosyl-(1→4)-(β-D- glucopyranosyluronic acid)-(1→3)-oleanolic acid-28-O-β-Dglucopyranosyl-(1→4)-β-D- glucopyranoside [19]. A.S. Chauhan *et al.* (2002)

isolated a new cyclic chain aliphatic fatty acid (I) was also isolated from seeds of the plant [20]. H.N. Khastgir *et al.* (1958) isolated sapogenin along with oleanolic acid from the seeds [21].

Pharmacological Actions Spermicidal Activity: D. Paul et al. (2010) studied effects of various extracts from the roots of *Achyranthes aspera* and reported spermicidal activity in human and rat sperm. The hydroethanolic, n-hexane and chloroform extracts were found to be most effective for sperm immobilization, sperm viability, acrosome status, 5'-nucleotidase activity and nuclear chromatin decondensation [41]. N. Vasudeva & S.K. Sharma (2006) reported the ethanolic extract of the root of *Achyranthes aspera* shows post coital anti-fertility activity in female albino rats. The said extract exhibited 83.3% anti-implantation activity when given orally at 200 mg/kg body weight [42]. W. Shibeshi et al. (2006) studied effects of methanolic extract of the leaves and reported for anti-fertility activities such as abortifacient, estrogenesity, pituitary weight, and ovarian hormone level and lipids profile in female rats.

The abortifacient effect of the methanolic extract of the leaves of *Achyranthes aspera* was determined by counting the dead fetuses in vivo. Effect on estrogenesity was assessed by taking the ratio of the uterine weight to body weight. The ratio of the pituitary weight to body weight was also calculated. The effect of the extract on the level of ovarian hormones and lipid profile were evaluated using electrochemiluminescence immunoassay [43]. A. Pakrashi & N. Bhattacharya (1977) reported that benzene extract of the whole plant shows abortifacient activity in mice [44]. D.Paul *et al.* (2006) reported 50% ethanolic extract of the leaf of Stephania hernandifolia and the root of *Achyranthes aspera* shows effect on sperm motility and function in a ratio of 1:3 by weight at different concentrations [45]. V. Wadhwa et al. (1986) reported n-butanol fraction of aerial parts also shows contraceptive and hormonal properties [46].

Antiparasitic Activity: The ethyl acetate extracts of *A. aspera* show antiparasitic activity (dried leaf, flower, and seed extract) against the larvae of cattle tick Rhipicephalus (Boophilus) microplus (Canestrini, 1887) (Acari: lxodidae), sheep internal parasite *Paramphistomum cervi* [47]. A. Bagavan *et al.* (2008) studied the acetone, chloroform, ethyl acetate, hexane and methanol leaf extracts of *Achyranthes aspera* against the early fourth-instar larvae of *Aedes aegypti* L and *Culex quinquefasciatus* Say. The larval mortality was observed after 24 h exposure. All extracts showed moderate larvicidal effects; however, the highest larval mortality was found in the ethyl acetate extract of *A. aspera*. In the present study, bioassay-guided fractionation of *A. aspera* led to the separation and identification of saponin as a potential mosquito larvicidal compound, with LC_{50} value of 18.20 and 27.24 ppm against *A. aegypti* and *C. quinquefasciatus*, respectively. 1H NMR, 13C NMR and mass spectral data confirmed the identification of the active compound. This is the first report on the mosquito larvicidal activity of the saponin from the ethyl acetate extract of *A. aspera* [48].

Hypoglycaemic Activity: The aqueous and methanolic extracts of the powdered whole plant, which shows hypoglyceamic activity. Blood glucose levels of normal and Alloxan induced diabetic rabbits were determined after oral administration of various doses [49]. Cancer Chemopreventive Activity A. Chakraborty *et al.* (2002) reported that the methanolic extracts of leaves, alkaloid, nonalkaloid, and saponin fractions show cancer chemopreventive action on Epstein-Barr virus early antigen activation induced by tumor promoter 12-O-tetradecanoylphorbol-13-acetate in Raji cells [50].

Hepatoprotective Activity: A.R. Bafna & S.H. Mishra (2004) reported that the methanolic extract of the aerial parts of *Achyranthes aspera* shows hepatoprotective activity on rifampicin induced hepatotoxicity in albino rats. Methanolic extract showed a dose-dependent decrease in the levels of SGPT, SGOT, ALKP and total bilirubin [51].

Analgesic and Antipyretic Activity: Sutar N.G. *et al. (*2008) reported a methanolic extract of leaves for analgesic and antipyretic activities by using a hot plate and brewer's yeast induced methods using aspirin as a standard drug [52]. F.A. Mehta *et al.* (2009) studied the leaves and seeds of *Achyranthes aspera*, which shows analgesic activity. Both leaves and seeds show analgesic activity in mice

using acetic acid-induced writhing response and hot plate method [53]. H. Kumar *et al.* (2009) reported that the hydroalcoholic extract of the roots and leaves of Achyranthes aspera shows centrally acting analgesic activity in adult male albino rats using tail flick, hot plate acetic acid-induced writhing method for peripherally acting analgesic activity using aspirin as standard drug. The doses administered were 200 mg/kg and 400 mg/kg. The animal that administered a dose of 400 mg/kg leaf extract has shown the maximum analgesic activity [54]. Neogi N *et al.* (1970) reported that achyranthine, a water-soluble alkaloid had a slight antipyretic activity in rats [34].

Anti-inflammatory and Anti-arthritic Activity: S. Vijaya Kumar *et al.* (2009) studied the alcoholic extract of the roots of *Achyranthes aspera*, which shows anti-inflammatory activity in Wistar rats using carrageenan-induced paw edema method and cotton pellet granuloma test [55]. The alcoholic extracts of leaves and seeds show anti-inflammatory activity in rats using the carrageenan-induced paw edema method and formalin model [53]. T. Vetrichelvan & M. Jegadeesan (2003) reported the alcohol extract of *Achyranthes aspera* was tested on carrageenin-induced hind paw oedema and cotton pellet granuloma models in albino male rats. The paw volume was measured plethysmometrically at 0, 1, 2, 3, 4 and 5 h and diclofenac sodium was used as a standard drug. The alcohol extract (375 and 500 mg/kg) showed the maximum inhibition of oedema of 65.38% and 72.37%, respectively, at the end of 3 h with carrageenan-induced rat paw oedema. Using a chronic test, the extract exhibited a 40.03% and 45.32% reduction in granuloma weight [56]. A.B. Gokhale et al. (2002) reported the ethanolic extracts of the *Achyranthes aspera* at the doses of 50, 100 and 200 mg/kg were screened for their effect on acute and chronic inflammation induced in mice and rats using carrageenan and Freund's complete adjuvant model. *A. aspera* inhibited these inflammatory responses at doses of 100-200 mg/kg [57].

Antimicrobial Activity: M.T.J. Khan *et al.* (2010) reported that the ethanol and chloroform extracts of seeds of *Achyranthes aspera* show mild to moderate antibiotic activity against *B. subtilis*, *E. coli*, and *P. aeruginosa* [58]. S.H.K.R. Prasad *et al.* (2009) studied the various extracts of the leaves and callus of the plant also showed anti-microbial activity [59]. P. Saravanan *et al.* (2008) reported the solvent leaf extracts were tested for antibacterial and antifungal activities against *E. coli*, *P. aeruginosa*, *P. vulgaris*, *S. aureus*, Klebsiella species [60]. T.N. Misra *et al.* (1992) reported 17-pentatriacontanol as a chief constituent isolated from the essential oil of the shoots of the plant; the oil shows antifungal activity against *Asperigillus carneus* [61]. S. Sharma *et al.* (2006) studied the alcoholic extract, which shows the presence of the triterpenoid saponin with dose-dependent inhibitory activity against Staphylococcus aureus, a bacteria causing skin disease in humans beings. Minimum inhibitory concentration was found to be highest (0.15 mg) for a purified fraction. The identification of the compound on spectral analysis gave a triterpenoid saponin purified fraction [62].

Anti-oxidant Activity: P. Tahiliani & A. Kar (2000) studied various extracts of the leaves for anti-oxidant activity [64]. D. S. Gayathri *et al.* (2009) also reported antioxidant activity on leaves and roots [65]. T. Malarvili & N. Gomathi (2009) reported antioxidant activity on seeds of the plant [66]. *Achyranthes aspera* is well documented for the presence of phytoactive constituents. Reduction in rate of lipid peroxidation and enhancement in free radical scavenging activity of the herbal seed powder is due to the presence of phytoactive constituent. S. Edwin *et al.* (2008) reported free radical scavenging activity of the ethanolic and aqueous extracts. Both extracts were assessed using two methods, DPPH radical scavenging activity and superoxide scavenging activity. The plant exhibited good antioxidant effect by preventing the formation of free radicals in the two models studied [67].

Nephroprotective Activity: T. Jayakumar *et al.* (2009) reported the methanolic extract of the whole plant of *Achyranthes aspera* shows nephro-protective activity against lead acetate induced nephrotoxicity in male albino rats [68]. Anti-depressant Activity C.C. Barua *et al.* (2009) showed that Methanolic extract of the leaves of *Achyranthes aspera* shows anti-depressant effect in mice and rats using forced swimming test in mice and rats and tail suspension test in rats [69].

Diuretic Activity: S.S. Gupta *et al.* (1972) reported a saponin isolated from the seeds of *Achyranthes aspera* which shows significant diuretic effect in adult male albino rats [70]. Achyranthine (5 mg/kg, orally) had diuretic activity in rats.

Bronchoprotective Activity: B.R. Goyal *et al.* (2007) reported ethanolic extract of *Achyranthes aspera* shows bronchoprotective effect in toluene diisocyanate (TDI) induced occupational asthma in Wistar rats. The total and differential leucocytes were counted in blood and bronchoalveolar (BAL) fluid. The liver homogenate was utilized for assessment of oxidative stress, and lung histological examination was performed to investigate the inflammatory status of the airway. The results suggest that *Achyranthes aspera* treated rats did not show any airway abnormality [71].

Cardiovascular Activity: Achyranthine, a water-soluble alkaloid isolated from *Achyranthes aspera*, decreased blood pressure and heart rate, dilated blood vessels and increased the rate and amplitude of respiration in dogs and frogs. The contractile effect of the alkaloid at 0.5 mg/ml on frog rectus abdominal muscle was less than that of acetylcholine (0.1 mg/ml) and its spasmogenic effect was not blocked by tubocurarine [34].

S.S. Gupta *et al.* (1972) studied a mixture of saponins isolated from the seeds of *Achyranthes aspera* increased the force of contraction of the isolated frog, guinea pig, and rabbit heart. The stimulant effect of the lower doses (1-50 µg) was blocked by pronethalol and partly by mepyramine. At higher saponin doses, the effect was not blocked by pronethalol. The saponins also increased the tone of the hyperdynamic heart and the force of contraction of the failing papillary muscle [72]. A. K. Ram *et al.* (1971) studied perfusion of isolated rat heart with adrenaline bitartrate or the saponin of *Achyranthes aspera* increased the activity of phosphorylase a but had no effect on the total phosphorylase activity [73].

Antiallergic Activity: S.B. Datir *et al.* (2009) reported that the petroleum ether extract (200 mg/kg, *i.p.)* of the plant shows significant antiallergic activity in both milk induced leukocytosis and milk induced eosinophilia in mice. Thus the antiallergic activity of *A. aspera* may be due to nonpolar constituents. The phytochemical screening of petroleum ether extract shows the presence of steroids. Literature shows the presence of steroids like β-sitosterol, ecdysone, and ecdysterone. Thus these steroids present in the plant may be responsible for the antiallergic activity [74].

Wound Healing Activity: S. Edwin *et al.* (2008) investigated the ethanolic and aqueous extracts of leaves of *Achyranthes aspera* for wound healing activity. The wound healing activity was studied using two wound models, the excision wound model and incision wound model [75].

Immunomodulatory Activity: R. Chakrabarti & R.Y. Vasudeva reported that *Achyranthes aspera* show immuno-stimulantaction 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 [76].

Hypolipidemic Activity: A.K. Khanna *et al.* (1992) investigated the alcoholic extract of A. aspera, at 100 mg/kg dose lowered serum cholesterol (TC), phospholipid (PL). triglyceride (TG) and total lipids (TL) levels by 60, 51, 33 and 53% respectively in triton induced hyperlipidemic rats. The chronic administration of this drug at the same doses to normal rats for 30 days, lowered serum TC, PL, TG and TL by 56, 62, 68 and 67% respectively followed by significant reduction in the levels of hepatic lipids. The faecal excretion of cholic acid and deoxycholic acid increased by 24 and 40% respectively under the action of this drug. The possible mechanism of action of cholesterol lowering activity of *A. aspera* may be due to rapid excretion of bile acids causing low absorption of cholesterol [77].

CONCLUSION: It is seen from the literature that *Achyranthes aspera* is a very important plant for its large number of medicinal properties. Thus, *Achyranthes aspera* is proved to be a multipurpose medicinal agent, thus instrumental in curing a large number of ailments. Phytochemical and pharmacological investigations carried out in the plant reveals its multidisciplinary usage. The plant was found to be very useful in ethnomedicine to

treat sexual and gynecological disorders like menstrual problems, gonorrhea, impotence, *etc*. The species is a potent anti-fertility agent and abortifacient, which was supported by experiments. The spermicidal activity of the plant can be used to generate male contraceptives. This property can be exploited in contraception and control population explosion in third world countries. Naturally occurring polyploids and different gametophytic and sporophytic ploidy levels have made the species an interesting cytological sample. Widespread ethnic use of the plant against snakebite makes it a potent anti venomous plant. The plant is an ingredient of Ksharsutraan Ayurvedic preparation used in the treatment of fistulain-ano. Antitumour and cytotoxic potential are the exciting aspects of the plant. The plant is a potent immunostimulant too. Several investigators have reported the plant as a valuable antibacterial, antifungal, larvicidal and active against other plant pathogens. Insect molting hormone is another interesting constituent of the plant.

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