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Review Article

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A Brief Study on Achyranthes Aspera: A Review

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ABSTRACT

Achyranthes aspera is an important medicinal herb that grows as a weed across Nepal's tropical region. It is a member of the amaranthaceae family. Dattiwan in Nepali, Apamarg in Sanskrit, prickly chaff flower in English, and Naayuruvi in Tamil are all names for this plant. Because of their safety and effectiveness, medicinal plants are used to treat a variety of ailments. Though practically all of its parts are employed in ancient systems of medicine, the seeds, roots, and shoots are the most essential medicinal elements. Carbohydrates, protein, glycosides, alkaloids, tannins, saponins, flavonoids, lignin, and other chemical components are important. According to the review, a large number of phytochemical compounds have been identified from the plant, which include antiperiodic, diuretic, purgative, laxative, antiasthmatic, hepatoprotective, anti-allergic, and other essential therapeutic characteristics. The herb is used as an emenagogue, antiarthritic, antifertility, laxative, ecbolic, abentifacient, and anti-helminthic, aphrodisiac, antiviral, anti-plasmodic, and antihypertensive, anticoagulant, diuretic, and anti-tumor in indigenous medicine. Cough, renal dropsy, fistula, scrofula, skin rash, nasal infection, chronic malaria, impotence, fever, asthma, piles, and snake bites are also treated with it. This herb has astringent, digestive, diuretic, laxative, purgative, and stomachic properties. The plant's juice is used to cure boils, diarrhoea, dysentery, haemorrhoids, rheumatic aches, itches, and skin eruptions. Metholic extraction offers higher yields than alcohol and petroleum extraction.

Key Words: *Achyranthes aspera, antiasthmatic, hepatoprotective, emenagogue, ecbolic.*

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INTRODUCTION

Himalayan country, represents one of the world's richest pockets in plant diversity.[1] The World Health Organization (WHO) estimates that about 80% of the population living in the developing countries relies almost exclusively on traditional medicine for their primary health care needs. [2] The plants are potential source of medicines since ancient times. Medicinal plants play an important role in the development of potent therapeutic agents. In the recent past there has been a tremendous increase in the use of plant based health products in developing as well as developed cuntries resulting in an exponential growth of herbal products globally. An upward trend has been observed in the research on herbals. 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 disease [3]

Scientific classification [4]

Kingdom - Planate
Subkingdom - Tracheobinota
Unranked - Angiosperms
Super division - Spermatophyta
Division - Mangoliophyta
Class - Mangoliophsida
Subclass - Caryophyllidae
Order - Caryophyllales
Family - Amaranthceae
Genus - Achyranthes
Species – Aspera

Figure.1; *Achyranthes aspera* Plant

Plant description: Growth form: perennial hair herb up to 1.2 m tall.
Foliage: Green, papery leaves (1.5-7 cm long, 0.4-4 cm wide) are broadly obovate (egg-shaped) or elliptic-oblong (oval-elongated). They are hairy on both sides.
Stem: Stems are 4 sided and covered in short hairs.
Flow: Flowers are arranged in a 10-30 cm long spike inflorescence which is initially erect, but later bends backwards after the flowers bloom.
Fruits: Dry, indehiscent fruit known as a utricle is bladder- like and covered by loose, papery tissue. Each egg-shaped fruit (2.5-3mm long) contains 1 brown, egg-shaped seed (2mm long).[5]

In recent time there has been a marked shift towards herbal cures because of the pronounced cumulative and irreversible reactions of modern drugs. However, due to over population, urbanization and continuous exploitation of these herbal reserves, the natural resources along with their related traditional knowledge are depleting day by day [6]. In the present era of drug development and discovery of newer drug molecules many plant products are evaluated on the basis of their traditional uses. One of the many plants which are being evaluated for their therapeutic efficacies is *Achyranthes aspera* which is commonly known as Latjeera (Hindi) & Rough Chaff tree (English). It is an 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 [7, 8, 9].

Geographical Source

It is found on road sides, 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 1- 2 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.

Traditional Uses

Traditionally, the plant is used in asthma and cough. It is pungent, antiphlegmatic, antiperiodic, diuretic, purgative and laxative, useful in oedema, dropsy and piles, boils and eruptions of skin etc. Crushed 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 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 tooth brush. 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 tranquillizing properties [14, 15].

Phytochemistry

Chemical investigations of the seeds of *Achyranthes aspera* by V. Hariharan & S. Rangaswami (1970) and M. Ali (1993**)** 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-Dglucopyranosyluronic acid)-(1®3)-oleanolic acid, α-L-rhamnopyranosyl-(1®4)-(β-Dglucopyranosyluronic 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]. *Achyranthes aspera* is traditionally valued as a potent medicinal agent. Chemical constituents of various parts of the plant has been isolated and identified.

ROOT: A phytoecdysteroid 20-Hydroxyecdysone (ecdysterone or 20E) has been isolated from the methanolic extract of roots of *Achyranthes aspera* [21]. An aliphatic acid n-hexacos-14- enoic acid is obtained from the ethanolic extracts of roots [22]. Some other compound like strigmasta-5, 22-dien-3-E-ol, trans-13-docasenoic acid, n-hexacosanyl n-decaniate, n-hexacos-17-enoic acid and n-hexacos-11- enoic acid are also isolated from the root. Phytosterol strigmasta-5, 22-dien-3- E-ol is isolated from petroleum ether: benzene (75:25) elute as a colourless crystalline mass. It responds positively to Liebermann Burchard test for sterols. Oleanolic acid (0.54%) is found in *Achyranthes aspera* root extracts [23, 24].

STEM: Dihydroxy ketones-36, 37-dihydroxyhenpentacontan-4-one, and Triacontanol, aliphatic alcohol, 17-pentatriacontanol, penta-triaontane, 6-pentatriacontanone, Hexatriacontane, Tritriacontane, tetracontanol-2 (C40H82O), 4-methoxyheptatriacont-1-en-10-ol (C33H76O), E-sitosterol and spinasterol [25, 26 ,27] are isolated from the shoots of the plant. Triacontanol was also isolated along with 36, 47-dihydroxyhenpentacontan-4-one 21. Two long chain compounds, isolated from the shoots, have been characterized as 27-cyclohexylheptacosan-7-ol and 16-hydroxy-26-methyleheptacosan- 2-one 28. Kunert *et al*, 200029 has reported three bisdesmosidic saponins (I-III), 20-hydroxyecdysone and quercetin-3-O-β-D galactoside in the methanol extract of the aerialparts of *Achyranthes aspera* their structures are established on the basis of NMR spectroscopic analysis; the complete 1H and 13C assignments of the compounds are achieved by means of 2D NMR studies. Aziz *et al*, has been isolated 3-Acetoxy-6 benzoyloxyapangamide from an ethyl acetate extract of the stem of *Achyranthes aspera*. The extract shows mild antibacterial activity against *Bacillus cereus*.

LEAVES: Rameshwar, 2007; isolated chemical compounds of the volatile oil from *Achyranthes aspera* leaves. Hydroquinone (57.7%) is the chief constituent; others are p-benzoquinone, spathulenol, nerol, α-ionone, asarone and eugenol. Alkaloids, flavonoids, saponins, tannins and phenolic compounds are found in the leaves [31].

SEED: Phytochemical investigations of the seeds show the presence of triterpenoid Saponins A and B. Saponins C and D are reported from unripe fruits [32, 21]. Its carbohydrate components are the sugars D-glucose, L-rhamnose, D-glucuronic acid (Saponin A). Saponin B is identified as β-D galactopyranosyl ester of D-Glucuronic acid. The seeds also contain water soluble base, betaine and a water soluble alkaloid Achyranthine, 10-tricosanone, 10-octacosanone and 4-tritriacontanone [21].

Three oleonolic acid glycosides: α-L-rhamnopyranosyl-(1→4)-(β-D-glucopyranosyluronic acid)-(1→3)-oleanolic acid, α-L-rhamnopyranosyl-(1→4)-(β-D-glucopyranosyluronic acid)-(1→3)-oleanolic acid-28-O-β-D-glucopyranoside and α-L-rhamno-pyranosyl-(1→4)-(β-D-glucopyranosyluronic acid)-(1→3)-oleanolic acid-28-O-β-D-glucopyranosyl-(1→4)-β-D-glucopyranoside isolated from the seeds [33,18].

MEDICINAL USE OF DIFFERENT PARTS OF *ACHYRANTHES ASPERA*:

Achyranthes aspera is a popular folk remedy in traditional system of medicine throughout the tropical Asian and African countries [34]. The whole plant and its different part like root, seeds, leaves, roots, flowers and fruits has been used for medicinal purpose [13].

Whole Plant: Mandar *et al,* 2011 showed the ethanol extract of whole plant on various Hematological (i.e. RBC, WBC count, Hb%, clotting time, O2 carrying capacity) and biochemical parameters (i.e. blood sugar level, lipid profile) in alloxan induced diabetic rats and concluded that *Achyranthes aspera* has haematinic, hypoglycemic and antihyperlipidemic activity which can complement in treatment of diabetic complications 19. Ethyl acetate extracts of whole plant (dried leaf, flower and seed extract) showed antiparasitic activity against the larvae of cattle tick *Rhipicephalus microplus*, sheep internal parasite *Paramphistomum cervi* 35. The methanolic extract of the whole plant showed nephroprotective activity against lead acetate induced nephrotoxicity in male albino rats [36]. The juice of the plant is used to treat opthalmia and dysentery [22].

Uma *et al*, 2010 [37] evaluated the antinociceptive activity of ethanolic extract of *A. Aspera* (EEAA) and to find the phytochemical responsible for this activity with possible mode of its activity.The aqueous extract of the entire plant is hepatoprotective [38]. The hydroalcohalic extract stimulates cell mediated immune system by increasing phagocytic function [39]. Krishnakumari and Priya, 2006 [40] evaluated the antihyperlipidemic effect of aqueous extract of *Achyranthes aspera* in experimental rats fed with diet containing sesame oil. Sandhyakumari, *et al*, 2002 [41] reported ethanolic extract of *A.aspera* caused induction of reproduction in male rat. Extracts of *A. aspera* possess antioxidant properties and could serve as free radical inhibitors or scavenger or acting possibly as primary antioxidants. The decline in the hepatic marker shows the hepatoprotective properties against chemically (NDEA and CCl4) induced hepatocellular carcinoma [42].

Prasad and Pathak, 2011 [43] studied *Achyranthes aspera* (Ash) on reproductive fitness on *Drosophila melanogaster* using larval and adult feeding. Goyal *et al*, 2008 [44] studied the bronchoprotective effect of ethanolic extract in toluene diisocyanate (TDI) induced occupational asthma in wistar rats. Apart from this whole plant also used for the treatment of bronchial infection, blindness, rheumatism, cough, diuretic in renal dropsy, beriberi, pneumonia [45, 46, 47].

Stem/aerial part: Bhattarai, 1994 [48] observed abortifacient activity of benzene extract of the stem bark in the rat. The ethanolic extract of stem inhibited the growth of *Bacillus subtilis* and *Staphylococcus aureus* bacterial strains [49]. Aziz *et al*, 2005 isolated 3-Acetoxy-6-benzoyloxyapan-gamide from an ethyl acetate extract of the stem of *Achyranthes aspera*. The extract was found to show antibacterial activity against *Bacillus cereus.* Bafna and Mishra, 2004 [50] reported hepatoprotective activity of methanolic extract of the aerial parts on rifampicin induced hepatotoxicity in albino rats which decreases levels of serum glutamic pyruvic transaminase (SGPT), serum glutamic oxaloacetic transaminase (SGOT), Alkaline phosphatase (ALP) and total bilirubin.

Misra *et al*, 1992 [51] reported antifungal activity of shoots against *Asperigillus carneus* which is due to 17-pentatriacontanol as a chief constituent isolated from essential oil of the shoots of plant 51. Patil *et al*, 2012 [52] studied *in-vitro* antibacterial potential of dry stem extracts against dental caries causing microbes. The ethanol and methanol extract of stem showed antimicrobial activity against *Escherichia coli* and also reported secondary metabolites as flavonoid and glucoside [53]. Shendkar *et al*, 2012 [54] has been prepared activated carbon from stem of *Achyranthes aspera* by chemical treatment (by X-ray fluorescence spectroscopy). Activated carbon is used in gas purification, gold purification, metal extraction, water purification, medicine, sewage treatment, air filters, as an efficient catalyst and many other applications.

Leaf: The leaves are used for the treatment of ophthalmic and other eye infections, it also has nephroprotective, post-coital antifertility, nephroprotective and immunomodulatory activities [55]. Shendkar *et al*, 2012 [56] showed the presence of total thirteen amino acids in different mobile phases. Elumalai *et al*, 2009 [57] evaluated antifungal activities from aqueous, ethanol and methanol extracts. The the methanolic extract of the leaves showed antifertility activities such as abortifacient, estrogenesity, pituitary weight, ovarian hormone level and lipids profile in female rats, hypoglycaemic effect, analgesic antipyretic and diuretic activities [58, 59], anti-depressant effects [60] and anti-tumor activity [61].

Bagavan *et al*, 2008 [62] first reported mosquito larvicidal activity of the saponin from the ethyl acetate extract and studied the acetone, chloroform, ethyl acetate, hexane and methanol leaf extracts against larvae of *Aedes aegypti* and *Culex quinquefasciatus*. The ethanol crude extract inhibited the growth of *Bacillus subtilis* and *Staphylococcus aureus* bacterial strains [49].

Prothyroidic activity as it enhanced the levels of both the thyroid hormones along with an increase in serum glucose concentration, body weight and hepatic protein content, antiperoxidative properties [63], anti-oxidant activity [64], anti-inflammatory and anti-nociceptive [65], antimicrobial activity [66, 67], analgesic activity [65, 68], antibacterial and antifungal activities against *E. coli, P. aeruginosa, P. vulgaris, Staphylococcus aureus, Klebsiella* species [69], wound healing activity [70], anti-inflammatory activity [71,72] antimicrobial activity against *Escherichia* coli [53], *in vitro* anti-cataract and antioxidant activities against glucose-induced cataractogenesis using goat lenses [31], hypolipidemic effect on high fat diet induced atherogenic rats [20].

Adnyana *et al*, 2008 [73] reported that the alkaloid fraction of *Achyranthes aspera* leaf induced apoptosis breast cancer cell through p53 pathways i.e leaf is used to treat cancer, particularly breast and cervix cancer. Apart from this leaves are also used for the treatment of syphilitic sores, bowel complaint, pile, stomache, skin eruption, early stages of diarrhea, dysentery, antiperiodic, Gonorrhoea, asthma,,cure strained back, mitigate pain from bite of wasps and also recommended in several Women's diseases [15,45,47,74,75].

ROOT: Roots or its different extracts are used as astringents to wounds, in abdominal tumor and stomach pain, pneumonia, stomachic, menstrual disorders, antifertility, mild astringent, cough, ascites and anasarca [45, 76], bleeding in delivery [77], nephrolithiasis and prevented urolithiasis induced with ethylene glycol and reduced the growth of calcium oxalate stones [78], Spermatotoxicity [79], snake bites, tooth brush, ophthalmia and opacities of the cornea [74], spermicidal activity in human and rat sperm, sperm immobilization, sperm viability, acrosome status, 5'-nucleotidase

activity and nuclear chromatin decondensation [80, 81, 15], post coital antifertility and estrogenicity [82], anti-inflammatory activity [68, 83], antilithiatic activity or effective antiurolithiatic agent [27], infantile diarrhea and cold [52], anti-fertility drug [22], induce labor pains [84] and inhibited the growth of *Bacillus cereus* and *Staphylococcus aureus* bacterial strains [84, 85].

Pharmacognostic, preliminary phyto-chemical and pharmacological studies showed its anti-cancer, anti-diabetic, anti-inflammatory, anti-spasmodic, anti-bacterial, diuretic and antileprotic activities [85, 86].

Seed: *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 presence of phytoactive constituent. Seeds are rich in protein, and used in night blindness and cutaneous diseases, antipyretic activity, expectorants, hepatoprotective potency or treatment of Jaundice and antioxidant activity [16, 45, 86, 87].

Ethanol and chloroform extracts of seeds of *Achyranthes aspera* shows mild to moderate antibiotic activity against *B. subtilis, E. coli* and *P. aeruginosa* [88]. Achyranthine, a water-soluble alkaloid isolated from *Achyranthes aspera*, decreased blood pressure and heart rate, dilated blood vessels, it also possess antipyretic activity and anti-inflammatory activity [71]. Oleanolic acid present in *A. aspera, A. bidentata* extract can promote neuronal growth, protect hippocampal neurons against toxicity, and also has anti-stress and anti-apoptosis activities [89, 90, 91].

Different proportion (0.25%, 0.5%, and 1.0%) of raw seed and its different fraction (alcohol, petroleum ether and 50% aqueous alcohol extracts) have shown growth stimulating and immunostimulatory properties in Indian major carps [92, 93, 94]. Dietary supplementation of seed enhanced the growth of fish, provided protection against oxidative stress, prevented tissue damage and also enhanced the resistance of larvae against the pathogen *A. hydrophila* i.e. seeds improved the overall health status of the fish.

Plant ingredient plays dual role - directly enhances the immunity of fish, indirectly fastens the growth rate and helps fish to overcome vulnerable early developmental stages.

The growth-stimulating component of *Achyranthes aspera* seed is ecdysterone, whereas immune stimulating effect is primarily due to essential fatty acids (EFAs). The immune stimulation is higher when EFAs (linolenic acid and oleic acid) [95] are given in combination with other constituents of the seed. This synergetic effect may be due to the nutrients present in the whole seed or it may be due to some coexisting components, which possibly increase the bioavailability of EFAs. Seeds at the 0.50% level provided protection against oxidative stress, prevented tissue damage, increased myelperoxidase activity, lysozyme activity, hemmaglutinetion antibody titre, total serum and protein, albumin and globulin levels [95]. Therefore, the seeds can be made available to the aquaculture industry on a commercial scale.

FLOWER AND FRUIT: Flowers and fruits of *achyranthes aspera* are used for the treatment of menorrhagia and respiratory disease [47], snakes and reptiles bites [45].

CONCLUSION:

Natural items are extremely important in ancient traditional healing systems. Herbs are natural medications used to restore normal physiological system abnormalities caused by alien pathogens or body dysfunction. From different literature and review it have been seen that plant Achyranthes aspera is a resuscitative plant due to the abundance of medicinal properties and having medicinally significant compounds like ecdysterone, n-hexacos-17-enoic, spinasterol, achyranthine, betaine, which is pentatriaontane, hexatriacontane, tritriacontane, a type of hydro p-benzoquinone, spathulenol, nerol, asarone, and essential fatty acids. It is seen from the literature that *Achyranthes aspera* is a very important plant for its large number of medicinal properties as well as medicinally important chemicals like ecdysterone, achyranthine, betaine, pentatriaontane, 6-pentatriacontanone, hexatriacontane and tritriacontane. The plant shows many pharmacological activities like spermicidal, anti-allergic, cardiovascular, nephroprotective, antiparasitic, hypoglyceamic, analgesic and antipyretic. Many traditional uses are also reported like antiperiodic, purgative and laxative, in various types of gastric disorders and in body pain which are being studied till today and further research has to be done. Thus, *Achyranthes aspera* is quite promising as a multipurpose medicinal agent so further clinical trials should be performed to prove its efficacy.

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