

A REVIEW OF *ACYRANTHES ASPERA*

Rahul Thapa^{1*}, Shikha², Dr. Saahil Arora³

¹Research Scholar, University Institute of Pharmaceutical Sciences, Chandigarh University, Punjab.
Email ID: rahulthapa803@gmail.com

²Research Scholar, University Institute of Pharmaceutical Sciences, Chandigarh University, Punjab.
Email ID: Shikhathakur757@gmail.com

³Professor, University Institute of Pharmaceutical Sciences, Chandigarh University, Punjab.
Email ID: director.uips@cuchd.in

Corresponding Author Email ID: rahulthapa803@gmail.com

DOI: 10.47750/pnr.2023.14.S01.138

Abstract

For hundreds of years, plants have been used by humans as a medicine to treat different ailments. In ancient Ayurveda and Unani medicine, there exists a plethora of knowledge and information and benefits of herbal drugs. *Achyranthes aspera* is a very potential indigenous herbal plant which is found in South America, Asia and Africa and is usually found as weed. Various parts of *Achyranthes aspera* have been used traditionally as a cure for various diseases, which has been discussed in this review article. *Achyranthes aspera* contains wide range of chemical constituents such as terpenoids, alkaloids, steroids, saponins and flavonoids. In this paper, the phytochemicals present in various parts of *Achyranthes aspera*, traditional uses as well as pharmacological properties of *Achyranthes aspera* has been reviewed and explained.

Keywords: *Achyranthes aspera*, Phytochemistry, Pharmacology, *A.aspera*, Traditional uses, Taxonomic classification.

Introduction

Since nature has been a source of therapeutic (medicinal) chemicals for centuries, an impressive number of new or novel drugs have been derived from natural sources. [1]. Recently it is seen that there have been phenomenal rise in the preparation and usage of plants derived health products in both developed and developing countries, which results in ensuring an exponential growth of herbal products globally. In an effort to identify all medicinal plants used globally the WHO has identified more than 22,000 species [2].

According to a WHO survey, 80% of the population in developing nations uses traditional herbal medicine as their main source of healthcare [3].

Exploration of the chemical components of plants and pharmacological screening may give the foundation for developing leads for the development of new agents. The very important life-saving drugs that are now a part of modern medicine were also provided to us by herbs [4].

Because of prominent cumulative and permanent side effects of contemporary medications there has been a noticeable shift in recent years towards medicinal herbs. However, the natural reservoir and the related traditional knowledge are increasingly in danger due to urbanization, overpopulation, and continuing exploitation of these herbal reserves. [5].

Currently, in order to identify and develop novel drug agents, many plants are evaluated based on their traditional uses. *Achyranthes aspera* is one of the several plants whose medicinal uses are being investigated

which is commonly known as Rough chaff tree (English) and Chirchira (Hindi). In this paper, author intends to provide information of the chemical constituents present in various parts of *Achyranthes aspera* as well as the various pharmacological actions, which results in various uses of *Achyranthes aspera* for the treatment of various diseases.

Figure 1 – *Achyranthes Aspera l.*



Figure 2- Dried seeds of *Achyranthes Aspera*.



❖ **General information of *ACHYRANTHES ASPERA*:**

1. TAXANOMIC CLASSIFICATION [12]

Kingdom	Plantae
Subkingdom	Tracheobinota
Super division	Spermatophyta
Division	Mangoliophyta
Class	Mangoliopsida

Sub class	Caryophyllidae
Order	Caryophyllales
Family	Amaranthaceae
Genus	<i>Achyranthes</i>
Species	<i>Aspera</i>

2. Other names [12][13][14]

Synonyms

Spanish	Rabo de gato, Mosotillo, Rabo de raton , Rabo de chango,
Sanskrit	Aghata
English	Red chaff tree ,Prickly Chaff flower, Rough chaff tree
Hindi	Chirchira, Latjira
Gujarati	Safad Aghedo
French	Collant, Achyranth a feuilles rudes, Gendarme
Ayurvedic	Shikhari, Apaamaarga, Shaikharika, Chirchitaa
Malayalam	Kadaladi
Latin	<i>Achyranthes aspera</i>
Unani	Chirchitaa
Telugu	Uttaraene
Persian	Khare-vazhun Arabian - Atkumah
Tamil	Shiru-kadaladi
Punjabi	Kutri

3. Geographical distribution

Up to a height of 2100 m, it grows as a weed on road sides, field boundaries, and waste areas across India. It is also found in the Australia, Bangladesh, South Andaman Islands, America, Ceylon, Africa and Tropical Asia [15,7].

4. Botanical characterization

Achyranthes aspera is a perennial or annual herb, procumbent or erect [7, 13].

Seeds- Seeds are brown coloured, truncate at the apex, round at the base, endospermic, sub-cylindric.[12, 13].

Height- It is often found to be 0.2-2.0 m high with woody base [7, 13]

Leaf- The leaves are opposite, velvety, tomentose, and obovate, with wavy margins and a white hairy surface. The petiole has a crescent-shaped outline and a single-layered epidermis with a thick cuticle. Midrib shows a single layered epidermis, and on the both surfaces, epidermis is followed by 4-5 layered collenchymas on the upper side and 2-3 layered collenchyma on the lower side [14]. Leaves are 5.22cm long and 2.5 cm broad [13]. Occur in various sizes. Type of stomata are present on the lower epidermis is anomocytic [13].

Branch- Terete or quadrangular, striate, pubescent branches with thick leaves are present [8].

Roots- There are secondary and tertiary roots. The roots have a cylindrical shape, range in thickness from 0.1 to 1.0 cm, are somewhat ribbed, gradually tapering and are yellowish-brown in color [13].

Flowers- Flowers are arranged in spikes and range in length from 8 to 30 cm, 3 to 7 mm wide, bisexual, greenish-white, numerous, sessile, bracteate with two bracteoles, one spine-lipped, actinomorphic, hypogynous, with five segments of the perianth that are membranous, five stamens that are short filaments, and an anther that is two celled. Flowers bloom in the summer [13].

Stem- The stems are simple or branched, ribbed, angular and frequently tinged purple [7].

Fruits- Fruits are indehiscent dry utricles surrounded by persistent, bracteoles and perianth. It has a single nut with seeds, or utricle [9,12,13,17].

5. Traditional uses

Achyranthes aspera has been documented in Ayurveda and Chinese medicine [23,50,51]. In "Nighantus" the plant's medicinal characteristics as a digestive aid, purgative, cure for internal organ inflammation, itch, piles, enlarged cervical glands and abdominal enlargements has been described [50,51,52]. Ashes of the whole plant were used by Hindus to prepare caustic alkaline preparations [50].

Both European and Indian Physicians are familiar with the plant's diuretic properties [51,52]. In cases of general anasarca and renal dropsy, the plant's decoction is employed as a diuretic [51]. In the Philippines, the herb is used to treat toothaches, gastrointestinal issues, and dysentery [8].

The plant is used to cure asthma, dyspepsia, bronchitis, flatulence and menstrual disorders as well as it is used as an expectorant, revulsive, anodyne, depurative, anthelminthic, sudorific and stomachic [53]. The roots are utilised to cure cough, abdominal tumours and stomach [54].

The tribal people of Andhra Pradesh's Chittoor district use this plant to cure epilepsy and the Payasam Kheer made from its seed and milk is effective remedy for brain disease [55].

The plant is used as diuretic, astringent, purgatives, a remedy for colic, dropsy, piles, skin eruptions [56,57,58], laxatives [65] and antidote for snake bites [66]. It is also used to treat fractured bones [59,60,61], whooping cough, respiratory problems [62], asthma [63] and leucoderma [64]. The inflorescence is utilised for hydrophobia [61] and cough [67]. Hydrophobia is treated using fruit [65]. The seeds are used for gonorrhoea, insect bite, hydrophobia, cough, especially whooping cough, and as an antiasthmatic [64,68]. Additionally, they have cathartic, purgative, and emetic properties [68]. Dog bites, intermittent fever, asthma, wounds, injuries, and typhoid [67] are all treated with the leaves [59,61]. For whooping cough, tonsillitis [59,61], hemorrhage [64], cough, and hydrophobia [56], the root is used as an antiasthmatic [59], diuretic, diaphoretic, and antisiphilitic [56].

6. Phytochemistry

Whole Plant- According to reports, the plant yields a base that is both water- and chloroform-soluble. The former, which was earlier designated as achyranthine [21], was reported as a betaine derivative of N-methylpyrrolidine-3-carboxylic acid [22]. Later investigations revealed that betaine was the base that was water soluble, not achyranthine [23]. It was shown that the basic chloroform-soluble fraction is a mixture of two

uncharacterized alkaloid entities [24]. Alkaloids and saponin were present in the plant's ethanol extract, while tannin and flavonoids were not present [25]. Another study used the gas chromatography-mass spectrometry (GC-MS) technology to identify the phytochemical components present in the hydro-alcoholic extract of *A. aspera* whole plant extract [29]. As a result, 15 phytocompounds were characterized and identified. These phytocompounds were presented in Table 1 [29].

Table 1: The phytochemical composition of hydroalcoholic extract of *Achyranthes aspera* whole plant [29]

S.NO	Name of compound	Molecular formula	Molecular weight
1.	Tetradecane	C ₁₄ H ₃₀	198
2.	Benzaldehyde, 4-hydroxy-3,5-dimethoxy	C ₉ H ₁₀ O ₄	182
3.	3-Buten-2-one, 4-(2,2,6-trimethyl-7-oxabicyclo[4.1.0] Hept-1-yl)	C ₁₃ H ₂₀ O ₂	208
4.	Xanthoxylin	C ₁₀ H ₁₂ O ₄	196
5	Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy	C ₁₀ H ₁₂ O ₃	180
6.	Patchouli alcohol	C ₁₅ H ₂₆ O	222
7.	dl-(2-Fluorophenyl)-glycine	C ₈ H ₈ FNO ₂	169
8.	Flurenol butyl ester	C ₁₈ H ₁₈ O ₃	282
9.	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284
10.	Ethanone, 2-(benzoyloxy)-1-[1,1'biphenyl]-4-yl	C ₂₁ H ₁₆ O ₃	316
11.	Phytol	C ₂₀ H ₄₀ O	296
12.	9,12-Octadecadienoic acid (Z, Z)	C ₁₈ H ₃₂ O ₂	280
13.	9,12-Octadecadienoic acid (Z, Z)-,2,3-dihydroxypropyl ester	C ₂₁ H ₃₈ O ₄	354
14.	Squalene	C ₃₀ H ₅₀	410
15.	Lupeol	C ₃₀ H ₅₀ O	426

Shoot- A novel aliphatic Dihydroxyketone known as 36, 47-Dihydroxyhenpentacontan-4 one was produced by the shoot along with tritriacontanol [26]. Dihydroxy ketones were produced from the shoots in another research study as 36, 37-dihydroxyhenpentacontan-4-one, and triacontanol [30]. A novel long chain alcohol known as 17-pentatriacontanol [27–28]; an essential oil, four novel compounds were reported and identified as 4-methylheptatriacont-1-en-10-ol, 16-hydroxy-26-methylheptacosan-2-one, and tetracontanol-2 [27–28]. An aliphatic alcohol, 17-pentatriacontanol isolated from the shoots [31]. Three bisdesmosidic saponins (β -D-glucopyranosyl-3-(O- α -L-rhamnopyranosyl(1 \rightarrow 3))(O- β -D-glucopyranosyloxy)oleanolate, (β -D-glucopyranosyl-3-(O- β -D-galactopyranosyl(1 \rightarrow 2))(O- β -D-glucopyranosyloxy)oleanolate and β -D-glucopyranosyl-3-(O-P-D-glucopyranosyloxy)oleanolate, 20-hydroxyecdysone, a steroid and quercetin-3-O- β -D-galactoside was isolated from the aerial parts of *A. aspera* growing in Africa, particularly in Ethiopia [48]. The unripe fruit is reported to yield two new saponins (C and D), which were identified as β -D-glucopyranosyl ester of α -L-rhamnopyranosyl (1 \rightarrow 4)- β -D-glucuronopyranosyl (1 \rightarrow 3)-oleanolic acid and β -D-glucopyranosyl ester of α -L-rhamnopyranosyl (1 \rightarrow 4)- β -D-glucopyranosyl (1 \rightarrow 4)- β -D-glucuronopyranosyl (1 \rightarrow 3)-oleanolic acid [49].

Stem- The pentatriacontanone, 6-pentatriacontanone, hexatriacontane, and triacontane were isolated from the stem's chloroform extract [32]. Ecdysterone was reportedly present in the stem [33]. The 3-acetoxy-6-benzoyloxyapangamide was produced by extracting the stem with ethyl acetate [47].

Inflorescence- Alkaloids and flavonoids have been found in the inflorescence [34].

Seeds- It was reported that seeds contained protein. It was discovered that the protein content was 24.8 and had a calorific value of 3.92/g, which is quite comparable to the protein content of Bengal gram. The typical amino acids are present in the hydrolysate. Leucine, isoleucine, phenylalanine, and valine content of the seed protein can be compared favorably with Bengal gram, while tryptophan and sulphur amino acid (methionine and cystine) content are higher than those of most pulses, according to values obtained for ten essential amino acids and cystine. In comparison to the whole egg protein, it is deficient in arginine, lysine, and threonine [35].

Saponin's sugar moiety was composed up of glucose, galactose, xylose, and rhamnose [36, 37]. Isolated a crude saponin fraction from the seeds, which yielded oleanolic acid [38]. Later, in an investigation two oleanolic based saponins, saponin A and saponin B were isolated which were characterized as α -l-rhamnopyranosyl (1 \rightarrow 4)- β -D-glucopyranosyl (1 \rightarrow 4)- β -D-glucuronopyranosyl(1 \rightarrow 3)-oleanolic acid and β -D-galactopyranosyl (1 \rightarrow 28) ester of saponin A, respectively [39]. In another study, the total saponins were hydrolysed with acid and the genin was identified as oleanolic acid [40]. Based on partition chromatography, a rapid procedure for separating triterpenoid saponin from the plant has been described [41]. Hexatriacontane, 10-octacosanone, 10-triaicosanone, and 4-triacontanone are reported to be present in the seeds [32]. The lauric, myristic, palmitic, stearic, arachidic, behenic, oleic, and linoleic acids comprised the fatty oil constituent of the seed oil [42]. The seeds were reported to contain Ecdysterone [33].

Roots- Different preliminary studies carried out showed various chemical constituents of the root. The aglycone of the saponin fraction, which is oleanolic acid, was reported to be present in the root [38]. There were found to be saponins and alkaloids in the plant's root and shoot, but no flavonoids [34]. The plant's root was discovered to contain alkaloids in a different investigation, however it did not report to contain saponin or tannins [43]. The root was found to contain steroids, flavonoids, alkaloids, saponins and terpenoids according to another preliminary chemical study. There were no glycosides found [44]. β -sitosterol was also reported from the root [45,27]. In another study the Ecdysterone was reported from the root [46]. Six novel compounds were isolated from the ethanol extract of the roots, including 22-dien-3-ol, strigmasta-5, trans-13-docasenoic acid, n-hexacos-17-enoic acid, n-hexacos-11-enoic acid, n-hexacosanyl, n-decanate and n-hexacos-14-enoic acid [45].

Pharmacology

Antimicrobial properties-

The whole plant and the base achyranthine were used in a study to demonstrate antibacterial activity against *Streptococcus haemolyticus*, *Staphylococcus aureus* and *Bacillus typhosus* [22,70]. Aqueous and alcoholic leaf extracts demonstrated antibacterial activity against *Staphylococcus aureus* and *E. Coli* [71].

The seeds grown on cow dung showed antibacterial activity against *Salmonella typhimurium*, *Pseudomonas cichorii*, and *B. subtilis* bacterial strains [72]. In another study, it was discovered that *B. subtilis* and *S. aureus* growth was inhibited by 25 mg/ml of an 80% concentrated ethanolic extract of the leaves and stem [73]. The diethyl ether extract of the leaves of *A. aspera* showed inhibitory efficacy against *T. rubrum*, *E. floccosum*, *Enterobacter* sp., *S. aureus*, *Salmonella* sp., *Shigella* sp., *Trichophyton mentagrophytes*, *Aspergillus* sp., *T. tonsurans*, *P. vulgaris*, *Klebsiella* sp., and *E. coli* [74].

The antimicrobial activity of the finished fabric from *Achyranthes aspera* was assessed using both quantitative (AATCC 100) and qualitative (Parallel Streak (AATCC 147) and Agar Diffusion method) methods against bacteria that typically exist in the textile environment, such as *Staphylococcus aureus* (ATCC 6538), Gram positive and Gram negative, *Escherichia coli* (ATCC 11230). (SN 195 920). The resulting cotton fabrics

exhibited bacterial reduction percentages against *S. aureus* and *E. coli* of 92 and 50, respectively [75]. It was discovered that saponin from the ethyl acetate extract of *A. aspera* has mosquito larvicidal properties [76].

An aqueous leaf extract showed antibacterial activity against *Proteus vulgaris* in in-vivo experiments. The extract had no effect on *Pseudomonas aeruginosa*, *Escherichia coli* or *Klebsiella aerogenes* [77]. Another sample of plant leaves' aqueous residue was found to have no effect on the bacteria *Escherichia coli*, *Klebsiella aerogenes*, *Cytophaga* sp., *Pseudomonas aeruginosa*, *Vibrio parahaemolytica*, *Aeromonas hydrophilla*, *Damsela*, *Bacillus cereus* and *Streptococcus pyogenes* [78]. *E. coli*, *S.citri* and aerobic spore formers from soft drinks were found to be susceptible to the leaf extract's antibacterial effects [79].

In some other reports, the antifungal activity of the essential oil that was extracted from the shoot against *Asperigillus cameus* at different concentrations was found. Mycelial growth was inhibited by the oil [26]. The plant significantly decreased the number of microbial colonies in air samples when compared to formalin in a comparative study of herbal fumigation agents [80].

Aedes aegypti L and *Culex quinquefasciatus* early fourth-instar larvae were selected as test subjects for the effects of leaf extracts from *Achyranthes aspera*, *Leucas aspera*, *Acalypha indica*, *Ocimum sanctum* and *Morinda tinctoria* in chloroform, acetone, hexane, ethyl acetate and methanol extracts. A 24 hour exposure showed the larval mortality. The highest larval mortality was seen in the *A. aspera*'s ethyl acetate extract, while larvicidal activity was only moderate in other extracts. The isolation and identification of a saponin as a potential mosquito larvicidal component in the current investigation, with LC50 values of 27.24 and 18.20 ppm against *C. quinquefasciatus* and *A.aegypti*, respectively, was achieved using bioassay-guided fractionation of *A.Aspera* [81].

The plant has been characterized as a potent antibacterial agent in another study [82]. It has been observed that dried leaf extracts in chloroform, petroleum ether and methanol have antibacterial and antifungal activities [83]. The extracts of *Achyranthes aspera* were examined for their antibacterial efficacy using the disc diffusion and well plate methods against a variety of pathogens, including *Pseudomonas aeruginosa*, *Escherichia coli*, *Bacillus subtilis*, *Citrobacter* species and *Micrococcus* species. *Achyranthes aspera* extracts were characterized phytochemically using thin layer chromatography (TLC) techniques and other phytochemical studies. It was found that *Achyranthes aspera* extracts exhibit the greatest *E.Coli* inhibition [84].

Strong hormonal actions associated with insect molting have been found in root extract. High larvicidal activity was demonstrated by crude ethanol extract against *Boophilis microplus* tick larvae. *Aedes aegypti* and *Culex quinquefasciatus* have been examined for larvicidal saponins from leaf extracts. It was discovered that ethyl acetate leaf extract is effective against *Aedes subpictus* mosquito larvae. It was reported that the plant was effective at regulating mosquito larvae. The plant's leaves have been reported to exhibit larvicidal action against *Culex quinquefasciatus* and *Aedes aegypti*. The essential oils of the plant's stem and leaves were extracted by steam distillation [85].

Anti-inflammatory activity-

Achyranthes aspera alcohol extract was used to treat albino male rats with a cotton pellet granuloma model and a carrageenin-induced hind paw oedema, both of which showed anti-inflammatory effect [86]. The ethanolic extract of *A. aspera* is also said to have anti-inflammatory and anti-arthritis activities in doses of 100-200 mg/kg [87]. *A. aspera*'s achyranthine, a water-soluble alkaloid, was studied in rats for its anti-inflammatory and antiarthritic properties against carrageenin-induced foot oedema, granuloma pouch, formalin-induced arthritis as well as adjuvant arthritis. It showed significant anti-inflammatory activity in all four models tested, however it performed less effectively than phenylbutazone and betamethasone. Achyranthine also decreased the weight of the thymus, spleen, and adrenal glands while increased the levels of ascorbic acid and cholesterol in adrenal glands. The effects resembled betamethasone qualitatively. All three of the medications examined reduced food intake but had no appreciable impact on urination, mortality rate, or faeces output. With betamethasone, maximum gastric ulcer incidence was showed and minimum with achyranthine [88].

A. aspera has been reported to have anti-inflammatory properties in another study [89].

The anti-inflammatory properties of *A. aspera* have been documented in another investigation [89].

The alcohol extract of *Achyranthes aspera* was evaluated on cotton pellet granuloma and carrageenin-induced hind paw oedema models in albino male rats. While using diclofenac sodium as the reference drug, plethysmometric measurements of the paw volume were taken at 0, 1, 2, 3, and 5 hours. The alcohol extract (375 and 500 mg/kg) showed the best inhibition of oedema at the end of three hours with carrageenin-induced rat paw oedema, 65.38% and 72.37%, respectively. In a chronic test, the extract showed a 45.32% and 40.03% decrease in granuloma weight [90].

Immunomodulatory activity-

Following intraperitoneal injection of the extract along with ovalbumin (OVA), the *Achyranthes aspera* Linn extract was found to enhance the induction of the humoral antibody response specific for OVA in mice. The development of an OVA-specific antibody response from the plant extract was also seen to rise in a dose-dependent manner. Significantly elevated levels of IgM, IgG 1, and IgG 3 antibodies were present, but interestingly, decrease in anti-OVA PCA titers was reported. The extract's adjuvant ability was subsequently investigated in other mice strains, and it was shown that all strains tested significantly increased their IgG antibody response to OVA. When the extracts from the various parts of the plant were examined, the seed and root extracts seemed to show considerably higher activity [91].

Prior to receiving an intraperitoneal injection of chicken erythrocytes, *Catla* was given a food containing 0.5% *Achyranthes aspera* seed and a control diet without *Achyranthes aspera*. The test group of fishes had considerably higher levels of the RNA/DNA ratio of the kidney and spleen, hem agglutination antibody titers, anti-trypsin activity caused by alpha1-antiprotease and total serum protease inhibitors than the control group. Serum globulin levels in the test group were significantly higher than in the control group on days 14 and 21. These outcomes support the notion that *Achyranthes aspera* increases *catla*'s immunity [92].

The immunomodulatory function of *Achyranthes aspera* seed was studied by including it in the meals of *Labeo rohita*, rohu fingerlings. Super oxide anion generation, lysozyme, serum bactericidal activity, serum protein, ALP and albumin: globulin ratio (A/G) was increased in *Achyranthes*-treated groups compared to the control group. SGOT and SGPT levels were higher in the control group than in the group that had not been exposed to *Achyranthes*, but they were similar in the *Achyranthes*-treated groups. Up to day 9 post infection, the control group (77%) had higher cumulative mortalities. This gradually declined when the *Achyranthes* dose was increased, indicating that *Achyranthes aspera* boosts *L. Rohita*'s immune and enhances his resistance to infection [93][94]. In a different study, *Catla* was fed an artificial fish diet that contained *Achyranthes aspera*. In comparison to the untreated control group, *Achyranthes* significantly (P less than 0.05) increased the BSA-specific antibody titers over throughout the duration of the study. *Achyranthes* significantly enhanced antigen clearance efficiency in *C. catla* [95].

The hydroalcoholic extract of *A. aspera* has been shown to boost the cell-mediated immune system by enhancing phagocytic function [96].

Antifertility activity

The root's ethanol extract was given orally on days 1-7 of pregnancy in albino female rats that had been scientifically confirmed to be fertile to test for antifertility activity. A 200 mg/kg body weight oral dose of the ethanol extract resulted in 83.3% anti-implantation activity. The rats that carried their pregnancies to term did not give birth to any litters. Therefore, the combined antifertility (abortifacient and antiimplantation) activity of the ethanol extract was 100%. When studied on immature female albino rats with ovariectomies, the ethanol extract also demonstrated estrogenic potency [93].

In a another study, it was found that from the acetone extract of roots 50 percent of anti-implantation was observed, while the methanolic extract of roots produced 60% of anti-implantation activity in rats [97][98]. The effects of a composite plant extract prepared from the leaves and roots of *A. aspera* and *Stephania hernandifolia* in a weight-to-weight ratio of 1:3 on sperm motility and function were studied. This composite extract showed good effects by completely immobilising sperm within 2 minutes after administration at a dosage of 0.32 g/mL. Due to the irreversible nature of the sperm immobilisation effect, the results were spermicidal but not spermistatic. Sperm viability was significantly reduced when treated with the composite extract at a concentration of 0.32 g/mL and it was found that the sperm were nonviable after 30 minutes. At this highest concentration, the hypo-osmotic swelling of these sperm was significantly reduced, showing that the crude extract may likely cause injury to the sperm plasma membrane [99].

The effects of *Achyranthes aspera*'s methanolic leaves extract on some indicators of anti-fertility activity, such as abortifacient, estrogenicity, pituitary weight, ovarian hormone level, and lipid profile in female rats, were evaluated. The extract significantly elevated pituitary and uterine wet weights in ovariectomized rats and showed an abortifacient effect. The extract had no noticeable effect on the serum levels of ovarian hormones and other different lipids except from reducing HDL at the doses studied [100].

In a different trial, oral administration of benzene extract of stem resulted in a 100% prevention of conception on post-coitum or day 1 [101]. In mice, a strong abortifacient effect of the stem's crude benzene extract was found [103]. The plant's ethanolic extract (without the root) showed a 60% antifertility effect in rats when doses of 100 to 200 mg/kg body weight were given orally. During follow-up tests, the plant also showed promising results [104].

The n-butanol fraction of the aerial parts inhibited pregnancy in female rats when administered orally at doses of 75 mg/kg or more per day on 1 to 5 days after coitum, but was ineffective in hamsters up to doses of 300 mg/kg. The aqueous fraction had no anti-fertility effects on hamsters or rats. In immature female ovariectomized rats, the extract showed potent estrogenic activity at a dosage of 75 mg/kg. The uterine weight was stimulated noticeably as a result. Even at a level of 3.75 mg/kg, there was still a clearly noticeable uterotrophic effect [105].

It was found in a different study that feeding male rats a 50% ethanolic extract of *Achyranthes aspera* have no effect on sperm motility or HMG CoA reductase activity, on the other hand *Achyranthes aspera* lowered sperm counts, epididymis weight, serum testosterone levels, and testicular 3beta-hydroxysteroid dehydrogenase activity. Increased levels of 17-ketosteroids in the urine, fecal bile acids and hepatic, cholesterol levels in the testicles, and incorporation of labeled acetate into cholesterol all refer to reproductive toxicity in male rats, with the mechanism of action possibly being the inhibition of androgen synthesis [106]. Whole plant extracts showed an abortifacient effect in mice. The extract of benzene that was examined had the maximum level of activity. It was implied that the drug had blocked conception by the corpus luteum in the ovaries. Rats did not experience any effects. When progesterone or pituitary extract was administered with the drug, abortions in mice were not prevented, proving that the drug is species-specific. A benzene fraction of the benzene extract of the entire plant demonstrated an abortifacient effect in rabbits at a single dose of 50 mg/kg [107] [108]. Oral administration of the ethanol and chloroform extracts of *A. Aspera* exhibited both estrogenic and 100% antiimplantation effect [109] [93].

The alkaloidal fraction derived from the alcoholic extract of the root bark hindered the response of oxytocin in an isolated rat uterus. This fraction did not inhibit the guinea pig or rat uterus' responses to histamine or to serotonin and acetylcholine, respectively [110]. Antiimplantation activity in Female albino rats was showed by the plant's benzene extract (without the root) [111].

Anti-hyperlipidemic activity

The alcoholic extract of the plant *Achyranthes aspera* reduced the levels of phospholipid (PL), triglycerides (TG), total blood cholesterol (TC) and total lipids (TL) in rats with hyperlipidemia induced by triton. The serum concentrations of PL, TC, TL & TG% were decreased by 62, 56, 67 & 68 % respectively, after chronically

administering the extract to healthy rats for 30 days at the same doses. hepatic lipids were also significantly reduced. The quick excretion of bile acids that results in poor cholesterol absorption may represent the plant's potential mode of action for decreasing cholesterol [112].

In rats that had been given triton-induced hyperlipidemia, the alcoholic extract of *Achyranthes aspera* was reported to reduce 100 mg/kg of blood triglycerides, phospholipids, total lipids, and cholesterol (TC), PL, and TG. Hypolipidemic efficacy of the plant was examined in sesame oil fed rats. Lipid peroxidation caused by sesame oil has been reported [113].

Anti-feedent activity

On cauliflower borer and brinjal borer, the *A. Aspera* crude ethanolic extract was tested. Records were kept of the larvae's initial and final weight, mortality rate as well as their death rate. Both the rate of food consumption and the amount of feces in excreta significantly decreased. The worm's total body weight suddenly grew by 600µg and 800 g. In 800µg, the larvae reached an unhealthy size. After the third day, the 1000µg concentration of larvae had died. The amount of feces excreted was significantly decreased in 1000µg. So, on *spodoptera litura*, the plant extract had a significant antifeedant and a low larvacidal activity [114].

Anti-diabetic activity

For preliminary biological activities, the entire plant's 50% ethanolic extract [115] was investigated. It had hypoglycemic effects in rats. It had no effects on respiration, CVS, CNS, isolated g. pig ileum and it had no anthelmintic, anticancer, anti-protozoal or antiviral properties. The MTD for the extract in mice was determined to be 1000 mg/kg bw orally [115]. A considerable dose-related hypoglycemic effect was shown to be achieved by administering 2-4 g/kg of whole plant powder orally in another study in both normal and diabetic rabbits treated with alloxan. Both healthy and alloxan diabetic rabbits' blood glucose levels were reduced by the plant's aqueous and methyl alcohol extracts [116].

Both healthy and alloxan-diabetic rabbits developed hypoglycemia after administering whole plant's powder and a several aqueous and methanolic preparations. The plant could function by supplying the beta cells with essential nutrients like zinc, manganese, magnesium, calcium and copper. After applying plant seeds, redox and oxidative status in the plasma and other tissues of rats given high doses of fructose were examined [117].

After being starved for 12 hours, a group of normoglycemic albino rats developed diabetes mellitus. A 150 mg/kg body weight dose of alloxan monohydrate was injected intraperitoneally after being dissolved in physiological saline (IP). This dose of alloxan produced persistent hyperglycemia after four days, according to the analysis of blood and urine samples used to monitor glucose levels [118]. Blood glucose and HbA1C levels were significantly lower in the *A. aspera* aqueous extract group (500 mg/kg) compared to the control group.

Six Wistar rats (adult) weighing 250 to 300 grams (75 to 90 days old) were used to induce diabetes. The dose of streptozotocin administered to the animals intravenously was 60 mg/kg bw. By damaging the beta cell, streptozotocin causes diabetes to develop within 3 days [119]. It was reported that an ethanol extract of *A. aspera* (600 mg/kg) considerably decreased blood glucose levels.

Diuretic activity

Rats treated with 10–20 milligram/kilogram i.m. of the saponin from *A. aspera* seeds produced considerably more urine after 2, 6 and 24 hours than untreated rats. Rats treated with 10–20 milligram/kilogram i.m. of the saponin from *A. aspera* seeds produced considerably more urine after 2, 6 and 24 hours than untreated rats. Mersalyl at a concentration of 3 milligram/kilogram had a diuretic effect similar to that observed with it. The optimum dosage of the saponin was 10 milligrams per kilogram. Rats administered doses of the saponin (5–10

milligram/kilogram) orally showed a considerable rise in urine output which was par with acetazolamide at 10 milligram/kilogram. The diuretic effects of saponin were similar to acetazolamide which was associated with an increase in potassium and sodium excretion in the urine [120].

Activity on Cardiovascular system

The combination of the isolated saponins from seeds of *A.aspera* significantly increased the contraction force of the isolated heart of g. pig, frog and rabbit. Pronethol blocked the stimulating effects of the saponins' lower doses (1 to 50 µg) as well as mepyramine partly blocked the stimulating effects of the saponins' lower doses (1 to 50 µg). The force of contraction of failing papillary muscle along with the increase in the tone of hypodynamic heart occurs due to saponins. Compared to the effects of digoxin, it has quicker onset of action as well as shorter in duration [120]. Investigations into and comparisons between the effects of saponin and adrenaline on the phosphorylase activity of the perfused rat heart have been conducted. The effects of saponin and adrenaline on the phosphorylase activity of the perfused rat heart have been investigated and compared. Saponin has been found to stimulate the heart's phosphorylase activity, and this action was comparable to that of adrenaline [121].

In an early study, the roots of *A.aspera* reduced blood pressure suddenly without having any noticeable effects on the breathing of anesthetized dogs. At higher doses, there was a slight depression in respiratory rate. The hypotensive effects of the extracts were countered with atropine sulphate. The frog's heart experienced negative chronotropic and ionotropic effects temporarily from the extracts. The extracts increased the tone and amplitude of contractions in the gravid and non-gravid uteri of albino rats, guinea pigs, and rabbits as well as the spasm of an isolated rabbit's ileum. The medication is administered orally to rabbits, which significantly increases urine output [122].

In dogs under anesthesia, a water-soluble alkaloid known as achyranthine was reported to increase the rate and amplitude of respiration in addition to lowering blood pressure, depressing the heart, and dilate the blood vessels [70] [88]. In a another study, the saponin from *A. aspera* seeds was found to have cardiac stimulant activity and to enhance the force of contraction of an isolated and intact hypodynamic heart [123]. Cardiovascular toxicity was reported from a leaf decoction. In dogs under anesthesia, the water-soluble alkaloid achyranthine increased the rate and amplitude of breathing while lowering blood pressure and pulse. The plant was found to activate the cardiovascular system when studied in tropical West Africa [124].

Analgesic and Antipyretic activities

The leaves of *Achyranthes aspera* showed analgesic and antipyretic activity, respectively, that can be compared to aspirin at doses of [25 mg/kg] for analgesic effect and [125 mg/kg] for antipyretic effect, utilizing the hot plate method and the brewer's yeast induced method [125]. In another study analgesic activity was showed by leaves and seeds of *Achyranthes Aspera* [126]. Both leaves and seeds exhibit analgesic efficacy in mice when administered using the hot plate method and an acetic acid-induced writhing response. The hydro alcoholic extract of the roots and leaves of *Achyranthes aspera* exhibits centrally acting analgesic activity in adult male albino rats when tested using the tail flick, hot plate, and acetic acid-induced writhing methods for peripherally acting analgesic activity with aspirin as the standard drug [127].

Two doses were administered: 200 mg/kg and 400 mg/kg. According to studies that showed the animal given a dose of 400 mg/kg leaf extract demonstrated the highest analgesic effectiveness, achyranthine, a water-soluble alkaloid, had a minor antipyretic effect in rats [88].

Anti-carcinogenic activity

Researchers have investigated into the *Achyranthes aspera* plant's leaves for chemopreventive activity. The methanolic extract, alkaloid, non-alkaloid, and saponin fractions effectively reduced the tumor promoter 12-O-tetradecanoylphorbol-13-acetate of the Epstein-Barr virus early antigen activation in Raji cells (concentration 100 µg). In this in vitro study, the non-alkaloid fraction, which mostly included nonpolar molecules, displayed the most notable inhibitory activity (96.9%; 60% viability). In the in vivo two-stage mouse skin carcinogenesis test, the entire methanolic extract demonstrated a very potent anticarcinogenic activity (76%) [128].

The plant's non-alkaloid components were discovered to be potential anticancer agents. Inhibitory activity against human pancreatic cancer cells was discovered from leaves extracted in methanol, indicating its anti-proliferative and anti-cancer capabilities [129]. To test *A. aspera*'s anti-cancerous activity, Swiss albino mice were given an intraperitoneal injection of mineral oil [130]. The entire methanolic extract had a significant anticarcinogenic impact in in vivo investigations utilizing mouse skin carcinogenesis, but the non-alkaloid fraction, which only included non-polar molecules, displayed the strongest inhibitory efficacy in in-vitro testing [130].

Renal Disorders

The mineralization of urinary stone (calculi) such as calcium oxalate, calcium carbonate, and calcium phosphate was found to be inhibited by *A. aspera*. Methanolic extracts were discovered to be protective against lead-induced nephrotoxicity in albumin rats [131]. The effectiveness of the plant's roots was evaluated using in vitro calcium oxalate crystal nucleation and development as well as oxalate-induced damage in NRK-52E (rat renal tubular epithelial) cells. The hydroalcoholic extract of the plant's inhibitory effect on calcium oxalate crystallization in synthetic urine was researched as a potential anti-lithiasis medication [132].

Anti-Dandruff Activity

The efficiency of the polyherbal hair oil made from the methanolic leaf extract of *A. aspera* against dandruff was observed (PHO). In clinical experiments, coumarin, which is present in the crude extracts of *Achyranthes aspera*, has been shown to reduce dandruff scales and inhibit the growth of *Pityrosorum ovale* [133].

Anti-Depressant Activity

200, 400, and 600 mg/kg doses of the methanolic extract of *A. aspera* were administered to rats, and the total time of immobility was measured. The methanolic extract of *Achyranthes aspera* (600 mg/kg) significantly reduced the immobility time when administered orally, showing its antidepressant-like effects [13].

Miscellaneous

The effects of *Achyranthes aspera* leaf extract were evaluated on body weight, lipid peroxidation (LPO), hepatic protein content, catalase (CAT) activities, superoxide dismutase (SOD), as well as on blood thyroxine (T4), triiodothyronine (T3) and glucose levels the extract demonstrated considerable prothyroidic action as it increased the levels of both thyroid hormones, serum glucose concentration, body weight, and hepatic protein content. However, it had no significant effect on the two antioxidant enzymes, SOD and CAT, reducing hepatic LPO, which shows that the extract directly scavenges free radicals [134]. The plant's water-soluble alkaloid, achyranthine, which was isolated, has spasmogenic effects on the rectus muscle of frogs and purgative and diuretic effects on albino rats. On isolated g. pig, rat and rabbit ileum as well as on CNS, no effect was seen. The drug has a slight antipyretic effect [135]. The leaf extract was found in experiments to lack anti protozoal,

antiviral, effects on CVS, respiration, CNS and preganglionically stimulated nictitating membrane. The LD50 of latter extract's in mice was greater than 1000 mg per kg i.p. [136]. *Achyranthes aspera* fresh leaf extracts were evaluated against the *Alternaria alternata* that causes *Vicia faba* leaf spot disease. Growth inhibition was observed [137].

The alkaloidal fraction produced from the alcoholic extract of the root bark of *Achyranthes aspera* inhibited the oxytocin response in an isolated rat uterus. This fraction did not inhibit the response to histamine in the uterus of guinea pig or to serotonin and acetylcholine in the uterus of rat [138]. The plant *A. aspera*'s total chloroform soluble basic fraction (alkaloidal residue) showed slight anti-diuretic activity in rats and spasmolytic action against several spasmogens on guinea pig uterine and gut muscles. In mice, no particular CNS effects were noticed. Rats exposed to the fraction showed no analgesic efficacy [24].

Conclusion

For hundreds of years, medicinal plants have very important part for the survival of humans. The understanding of how plants can be used to treat different diseases has been passed down through the generations. In modern days, the indigenous knowledge and modern techniques are being combined together to understand the medicinal values, efficacy and safety of plants.

One of the many herbal plants utilized in the Unani, Ayurvedic and Siddha systems of medicine to treat a variety of diseases is *Achyranthes aspera* L. The plant can be used as a astringent, diuretic, and purgative, as well as to treat piles, dropsy and skin eruptions. It is also employed as a treatment for snake bites as well as for broken bones, breathing difficulties and whooping cough. For the treatment of leucoderma and asthma, it serves as a laxative. This plant includes a vast variety of chemical components, including flavonoids, alkaloids, steroids, saponins, and terpenoids; as a result, there is a vast scope for the development of novel therapies and medications for treating various diseases.. However, more exploration of chemical constituents of *Achyranthes aspera* is required since fewer studies have been done regarding the same. There are very less phytochemical and phyto-analytical studies available of this plant. There is a wide scope to carry out further studies like phyto-pharmacology of different extracts, standardization of the extracts, identification and isolation of isolated compounds. These studies may be followed by development of lead molecules as well as it serves for the purpose of use of specific extract in specific herbal formulation.

References

1. Cragg GM, Newman DJ. Medicinals for the millennia: the historical record. *Annals of the New York Academy of Sciences*. 2001 Dec;953(1):3-25. doi: 10.1111/j.1749-6632.2001.tb11356.x available on <https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/j.1749-6632.2001.tb11356.x>
2. Pandey MM, Rastogi S, Rawat AK. Indian herbal drug for general healthcare: an overview. *The internet journal of alternative medicine*. 2008 Jan;6(1):3. doi:10.5580/1c51 available on <https://print.ispub.com/api/0/ispub-article/10275>
3. Vijayan Arun, V.B. Liju, John J.V. Reena, B. Parthipan, C. Renuka. *Indian Journal of Traditional Knowledge*, 2007, 6(4), 589-594.
4. D. John. One hundred useful raw drugs of the Kani tribes of Trivendrum forest division, Kerala, India. *Int J Crude Drug Res*. 22: 17-39 (1984).
5. P.C. Pande, Lalit Tiwari, H.C. Pande. *Indian Journal of Traditional Knowledge*, 2007, 6(3), 444-458.
6. Jitendra B. Jain, Sheetal C. Kumane, S Bhattacharya. *Indian Journal of Traditional Knowledge*. 2006, 5(2), 237-242.
7. Anonymous. *The Wealth of India - Raw Materials*, Council of Scientific & Industrial Research, New Delhi, 2005, 55-57.
8. R. Zafar. *Medicinal Plants of India*. CBS publishers & distributors, 2009, 1-15.
9. D. Paul, D. De, K.M. Ali, K. Chatterjee, D.K. Nandi, D. Ghosh. *Contraception*, 2010, 81(4), 355-361.
10. N.G. Sutar, U.N. Sutar, Y.P. Sharma, I.K. Shaikh, S.S. Kshirsagar. *Biosciences Biotechnology Research Asia*, 2008, 5(2), 841-844.
11. N. C. Neogi, R. D. Garg, R. S. Rathor. *Indian Journal of Pharmacy*, 1970, 32(2), 43-46.
12. Srivastav S, Singh P, Mishra G, Jha KK, Khosa RL. *Achyranthes aspera*-An important medicinal plant: A review. *J Nat Prod Plant Resour*. 2011;1(1):1-4.
13. Singh N, Mrinal PS, Gupta VK. A Review on Pharmacological Aspects of *Achyranthes Aspera*. *Int J Pharmacogn Chinese Med*. 2019;3(4):000188.
14. Singh S, Singh A, Navneet S. 'Ethnobotanical and Pharmacological Benefits of *Achyranthes aspera* Linn. An overview. *Int. J. Pharm. Sci. Rev. Res*. 2018;48(2):1-7.

15. Gupta RK. Medicinal & Aromatic Plants. CBS Publishers & Distributors. 2010, 190
16. L.V. Asolkar, K.K. Kakkar, O.J. Chakre; "Second supplement to Glossary of Indian medicinal plants with active principles"; Part-I (A-K); Publication and Information Directorate (CSIR) New Delhi, 15-16; 1992.
17. Sharma V, Chaudhary U. An overview on indigenous knowledge of *Achyranthes aspera*. *Journal of Critical Reviews*, 2(1), 2015, 7-19.
18. Gupta V, Krishna CM, Bansal P, Kumar S, Prasad GP, Ravi KD. Phytochemistry and Pharmacological Potential of *Achyranthes Aspera*-A. Review. *International Journal of Ayurvedic Medicine*. 2010;1(1):1-1.
19. Goyal BR, Goyal RK, Mehta AA. PHCOG rev.: plant review phyto-pharmacology of *Achyranthes aspera*: a review. *Pharmacogn Rev*. 2007 Jan;1(1).
20. Saini S. Review on *Achyranthes aspera* L. *International Education and Research Journal*. 2016;2(2):84-6.
21. Bhide NK, Altekar WW, Tnvedi JC and Slieth UK (1958). Potassium diuretics in the Ayurvedic system of medicine. *J Postgrad Med* 4, 21-27.
22. Basu NK, Singh HK and Aggarwal OP (1957a): A chemical investigation of *Achyranthes aspera* Linn. *JProc Inst Chem* 29, 55-58.
23. Kapoor V. K, Singh H. Isolation of betain from *Achyranthes aspera* Linn. *Ind J Chem*. 1966; 4; 461-463.
24. Kapoor V. K, Singh H. Investigation of *Achyranthes aspera* Linn. *Ind J Pharm*. 1967; 29; 285-288
25. Kumar S, Singh J. P, Kumar S. Phytochemical screening of some plants of Manipur-I. *J Econ Bot Phytochem*. 1990; 1; 13-16
26. Misra T. N, Singh R. S, Pandey H. S, Prasad C, Singh B. P. Antifungal essential oil and a long chain alcohol from *Achyranthes aspera*. *Phytochemistry*. 1992; 31; 1811-1812
27. Misra T. N, Singh R. S, Pandey H. S, Prasad C, Singh B. P. Two long chain compounds from *Achyranthes aspera*. *Phytochemistry*. 1993; 33; 221-223.
28. Misra T. N, Singh R. S, Pandey H. S, Prasad C, Singh S. Isolation and characterization of two new compounds from *Achyranthes aspera* Linn. *Ind J Chem*. 1996; 35B; 637- 639.
29. Varadharaj V, Kuppan M. Identification and determination of bioactive phytochemical constituents from the hydro-alcoholic extract of *Achyranthes aspera* whole plant by gas chromatography-mass spectrometry analysis. *Asian Journal of Pharmacy and Clinical Research*. 2015;8:125-9.
30. A.K. Batta, S. Rangaswami. *Phytochemistry*, 1973, 12(1), 214-216.
31. Y. Gariballa, G.M. Iskander, El Beit Daw. *Fitoterapia*, 1983, 54, 269-272.
32. Ali M (1993): Chemical investigation of *Achyranthes aspera* Linn. *Oriental JClient*, 9, 84-85.
33. A. Banerji, G.J. Chintalwar, N.K. Joshi, M.S. Chadha. Isolation of ecdysterone from Indian plants. *Phytochemistry*. 10: 2225-26 (1971).
34. Sinha S. K. P, Dogra J. V. V. A survey of plants of Bhagalpur and Santhal pargana for saponin, flavonoids and alkaloids. *Int J Crude Drug Res*. 2002; 23; 77-86.
35. Satyanarayana M. S, Susheela B. A, Rao N. A. N, Vijayaraghavan P. K. The proximate composition and essential amino acid content of Aghada seeds. *J Food Sci Technol*. 1964; 1; 26-27
36. Gopalachari R, Dhar M. L. Chemical examination of the seeds of *Achyranthes aspera* Linn. *J Sci Ind Res*. 1952; 11B; 209-210
37. Gopalachari R, Dhar M. L. Studies in the constitution of the saponin from the seeds of *Achyranthes aspera*: Part I – Identification of the sapogenin. *J Sci Ind Res*. 1958; 17B; 276-278
38. Khastgir H. N, Sengupta S. K, Sengupta P. The sapogenin from seeds of *Achyranthes aspera* Linn. *J Ind Chem Soc*. 1958; 35; 693-694
39. Hariharan V, Rangaswamy S. Structure of saponins A and B from the seeds of *Achyranthes aspera*. *Phytochemistry*. 1970; 9; 409-414
40. Batta AK and Rangaswami S (1973): *Angiospermae dicotyledonae :Amaranthaceae etc. Crystalline chemical components of some vegetable drugs. Phytochemistry* 12, 214-216.
41. Sarkar B, Rastogi R. P. Paper chromatography of triterpenoid saponins. *J Sci Ind Res*. 1960; 19B; 106-107.
42. Daulatabad CD and Ankalgi RF (1985): Minor seed oils. EL Fatty acid components of some seed oils. *Fette Seifen Anstrichm* 87, 196-197 (Chem Abstr 1985 103,34909p)
43. Joshi M. C, Sabnis S. D. A phytochemical study of South Gujarat forests plants with special reference to the medicinal and of ethnobotanical interest. *Bull Med Ethnobot Res*. 1989; 10; 61-82
44. Agrawal R. G, Pant P, Tewari L. C, Singh J, Pandey M. J, Tiwary D. N. Preliminary phytochemical screening of medicinal plants of hilly district of U.P. *Bull Med Ethnobot Res*. 1989; 10; 176-186
45. Sharma S. K, Vasudeva N, Ali M. A new aliphatic acid from *Achyranthes aspera* Linn. roots. *Indian Journal of Chemistry*. 2009; 48B; 1164-1169
46. Banerji A, Chadha M. S. Insect moulting hormone from *Achyranthes aspera*. *Phytochemistry*. 1970; 9; 1671-1673
47. Muhammed AA, Muhammed MR, Anjon KM, Tanvir M, Azizur R and Muhammed AQ (2005): 3-Acetoxy-6-benzoyloxyapangamide from *Achyranthes aspera*. *Dhaka University Journal of Pharmaceutical Sciences* 4,21.
48. Olaf K, Ernst H, Martin GS, Josef R, Frans B, Erfem M, Dawit A and Asfaw D (2000): Three saponins, a steroid and a flavanol glycoside from *Achyranthes aspera*. *Monatshefte fur Chemie* 131, 195-204.
49. V. Seshadri, A.K. Batta, S. Rangaswami. Structure of two new saponins from *Achyranthes aspera* . *Indian J Chem*. 20B: 773-75 (1981).
50. Saini S. Review on *Achyranthes aspera* L. *International Education and Research Journal*. 2016;2(2):84-6.
51. Krishnaveni A, Thaakur SR. Pharmacognostical and preliminary phytochemical studies of *achyranthes aspera* linn. *Ancient Science of Life*. 2006 Jul;26(1-2):1.
52. Basu et. al., *Indian J. Pharm*. 32, 43.
53. Kirtikar, K.R. and Basu. B.D.; "Indian Medicinal Plants"; Volume-III; International Book Distributors – Dehra Dun India.2nd Edition.. 2065-2069; 1981
54. Dr. S. Vedavathy, V. Mrudula and A. Sudhakar; "Tribal Medicines of Chittoor District, A.P. (India)"; Herbal Folklore Research Centre, Tirupati.. 16, 17; 1997
55. "The Ayurvedic Pharmacopoeia of India"; The controller of Publications, New Delhi VolumeII; 7-9; 1999
56. Bhatnagar L. S, Singh V. K, Pandey G. Medico-botanical studies on the flora of Ghaigaon forests, Gwalior, Madhya Pradesh. *J Res Indian Med*. 1973; 8; 67-100

57. Raj K. P. S, Patel M. R. Some medicinal plants of Cambay and its immediate vicinity and their uses in Indian indigenous system of medicine. *Indian Drugs*. 1978; 15; 145-152
58. Khanna K. K, Mudgal V, Shukla G, Srivastava P. K. Unreported ethno medicinal uses of plants as aphrodisiac from the folklores of Uttar Pradesh plains, India. *Bull Bot Surv India*. 1994; 36; 91-94
59. Singh V. K, Ali Z. A. Folk medicines of Aligarh (Uttar Pradesh), India. *Fitoterapia*. 1989; 60; 483-490
60. Girach R. D, Aminuddin A, Khan S. A. Ethno medicinal uses of *Achyranthes aspera* in Orissa (India). *Int J Pharmacog*. 1992; 30; 113-115
61. Anis M, Iqbal M. Medicinal plantlore of Aligarh, India. *Int J Pharmacog*. 1994; 32; 59-64
62. Husain W, Siddiqui M. B. Ethnobotanical approach of North-western U.P. *Acta Bot Indica*. 1987; 15; 94-97
63. Reddy M. B, Reddy K. R, Reddy M. N. A survey of medicinal plants of Chenchu tribes of Andhra Pradesh, India. *Int J Crude Drug Res*. 1988; 26; 189-196
64. Pal D. C, Jain S. K, Notes on Lodha medicine in Midnapur district, W. B., India. *Econ Bot*. 1989; 43; 464-470
65. John D. One hundred useful raw drugs of the Kani tribes of Trivendrum forest division, Kerala. India, *Int J Crude Drug Res*. 1984; 22; 17-39
66. Elvanayagum Z. E, Gnvanendham S. G, Balakrishna K, Bhima R. R, Usman S. A. Survey of medicinal plants with anti snake venom activity in Chengalpattu district, Tamil Nadu, India. *Fitoterapia*. 1995; 66; 488-492
67. Sebastnia M. K, Bhandari M. M. Medico ethno botany of Mount Abu, Rajasthan, India. *J Ethnopharmacol*. 1984; 12; 223-230
68. Singh V, Pandey R. P. Medicinal plant-lore of the tribals of eastern Rajasthan (India). *J Econ Tax Bot*. 1980; 1; 137-147
69. Neogi N. C, Rathor R. S, Shreshtha A. D, Banerjee B. K. Studies on the anti inflammatory and antiarthritic activity of achyranthine. *Indian J Pharmacol*. 1969; 1; 37-47
70. Basu NK, Neogi NC and Srivastava VP (1957b): Biological investigations of *Achyranthes aspera* Linn. and its constituent achyranthine. *J Proc Inst Chem* 29, 161-165
71. George M, Venkatraman PR and Pandalai KM (1947): Investigation on plant antibiotics: Part II. A search for antibiotic substances in some Indian medicinal plants. *J Sci Ind Res* 6B, 42-46.
72. K. Sushil, G.D. Bagchi, M.P. Darokar. Antibacterial activity observed in the seeds of some coprophilous plants. *Int J Pharmacog*. 35: 179-84 (1997)
73. Valsaraj R, Pushpangadan P, Smitt U. W, Andersen A, Nyman U. Antimicrobial screening of selected medicinal plants from India. *J Ethnopharmacol*. 1997; 58; 75-83
74. Saravanan P, Ramasamy V, Shivakumar T. Antimicrobial activity of leaf extracts of *Achyranthes aspera* Linn. *Asian Journal of Chemistry*. 2008; 20(1); 823-825
75. Thilagavathi G, Kannaian T. Application of Prickly chaff (*Achyranthes aspera* Linn.) leaves as herbal antimicrobial finish for cotton fabric used in healthcare textiles. *Natural Product Radiance*. 2008; 7(4); 330-334
76. Bagavan A, Rahuman A. A, Kamaraj C, Geetha K. Larvicidal activity of saponin from *Achyranthes aspera* against *Aedes aegypti* and *Culex quinquefasciatus* (Diptera: Culicidae). *Parasitology Research*. 2008; 103(1); 223-229
77. Perumal Sarny R, Ignacimuthu S and Sen A (1998): Screening of 34 mdian medicinal plants for antibacterial properties. *J Ethnopharmacol* 62, 173- 182.
78. Perumal Sarny R, Ignacimuthu S and Patric Raja D (1999) Preliminary screening of ethnomedicinal plants from India. *J Ethnopharmacol* 66, 235- 240.
79. Meera P, Amta Dora P and Karunyal Sameul J (1999): Antibacterial effect of selected medicinal plants on the bacteria isolated from fruit juices. *Geobios* 26, 17- 23.
80. Bisht LSB, Brindavanam NB and Kimothi GP (1988): Comparative study of herbal agents used for fumigation in relation to formalin. *Ancient Sci Life* 8, 125-132.
81. Bagavan, A, Rahuman, A., Kamaraj C, Geetha and Kannappan (2008): Larvicidal activity of saponin from *Achyranthes aspera* against *Aedes aegypti* and *Culex quinquefasciatus* (Diptera: Culicidae). *Parasitology Research*, 103, 223-229
82. Kumar S, Bagchi GD, Darokar MP (1997) Antibacterial activity observed in the seeds of some Coprophilous plants. *Pharmaceutical Biology* 35(3): 179-184.
83. Londonkar, R.L., Reddy, C., & Abhaykumar, K. (2011). Potential Antibacterial and Antifungal Activity of *Achyranthes aspera* L. *Recent Research in Science and Technology*, 3, 53-57.
84. Manjula M, Indira V, Dhasarathan P. In Vitro Action Of *Coccinia Grand's* Against Bacterial Organisms. *Asian J of Microbiology, Biotechnology and Environmental Sciences*. 2009;11(2):317-20.
85. Chungsamarnyart N, Jiyajinda S, Jangsawan W (1991) Larvicidal effect of plant crude extracts on the tropical cattle tick (*Boophilus microplus*). *Kasetsart J* 25: 80- 89.
86. Vetrichelvian T, Jegadeesan M. Effect of alcohol extract of *Achyranthes aspera* Linn. on acute and subacute inflammation. *Phytother Res*. 2003; 17(1); 77-79
87. Gokhale A. B, Damre A. S, Kulkarni K. R, Saraf M. N. Preliminary evaluation of anti-inflammatory and anti-arthritis activity of *S. lappa*, *A. speciosa* and *A. aspera*. *Phytomedicine*. 2002; 9(5); 433-437
88. Neogi N. C, Garg R. D, Rathor R. S. Preliminary pharmacological studies on achyranthine. *Indian J Pharm*. 1970; 32; 43-46
89. Iwalewa, E. O., et al. "Inflammation: the foundation of diseases and disorders. A review of phytomedicines of South African origin used to treat pain and inflammatory conditions." *African Journal of Biotechnology* 6.25 (2007).
90. Kumar SP, Sucheta S, Deepa VS, Selvamani P, Latha S (2008) Antioxidant activity in some selected Indian medicinal plants. *African J of Biotechnology* 7(12): 1826-1828.
91. Vasudeva R. Y, Duddukuri G. R, Sunil B. G, Athota R. R. Immunomodulatory Activity of *Achyranthes aspera* on the Elicitation of Antigen-Specific Murine Antibody Response. *Pharm. Biol*. 2002; 40(3); 175-178
92. Rao Y. V, Chakrabarti R. Stimulation of immunity in Indian major carp *Catla catla* with herbal feed ingredients. *Fish Shellfish Immunol*. 2005; 18(4); 327-334

93. Vasudeva N, Sharma S. K. Post-coital antifertility activity of *Achyranthes aspera* Linn. root. *J. Ethnopharmacol.* 2006; 107(2); 179-181
94. Vasudeva R. Y, Das B. K, Jyotirmayee P, Chakrabarti R. Effect of *Achyranthes aspera* on the immunity and survival of *Labeo rohita* infected with *Aeromonas hydrophila*. *Fish Shellfish Immunol.* 2006; 20(3); 263-273
95. Chakrabarti R, Vasudeva Y. *Achyranthes aspera* stimulates the immunity and enhances the antigen clearance in *Catla catla*. *Int Immunopharmacol.* 2006; 6(5); 782-790
96. Mali RG, Hundiwale JC, Gavit RS, Patil KS, Kulkarni MV (2006) Effect of *Achyranthes aspera* extract on phagocytosis by human neutrophils. *J of Natural Remedies* 6(2): 115-119.
97. Pakrashi A, Basak B, Mookerji N. Search for antifertility agents from indigenous medicinal plants. *Ind J Med Res.* 1975; 63; 378-381
98. Prakash A. O. Potentialities of some indigenous plants for antifertility activity. *Int J Crude Drug Res.* 1986; 24; 19-24
99. Paul D, Bera S, Jana D, Maiti R, Ghosh D. In vitro determination of the contraceptive spermicidal activity of a composite extract of *Achyranthes aspera* and *Stephania hernandifolia* on human semen. *Contraception.* 2006; 73(3); 284-288
100. Shibeshi W, Makonnen E, Zerihun L, Debella A. Effect of *Achyranthes aspera* L. on fetal abortion, uterine and pituitary weights, serum lipids and hormones. *Afr Health Sci.* 2006; 6(2); 108-112
101. Kamboj V. P, Dhawan B. N. Research on plants for fertility regulation in India. *J. Ethnopharmacol.* 1982; 6(2); 191-226
102. Prakash A. O, Shukla S, Mathur R. Interceptive plants: Present and future aspects. *Comp Physiol Ecol.* 1987; 12; 157-171
103. Pakrashi A, Mookerji N, Basak B. Effect of chromatographic fraction of the plant *Achyranthes aspera* Linn. on female albino mice. *J. Reprod Fert.* 1975; 43; 127-128
104. Prakash A. O, Shukla S, Mathur R. Interceptive plants: Present and future aspects. *Comp Physiol Ecol.* 1987; 12; 157-171
105. Wadhwa V, Singh M. M, Gupta D. N, Singh C, Kamboj V. P. Contraceptive and hormonal properties of *Achyranthes aspera* in rats and hamsters. *Planta Med.* 1986; 5; 231-232
106. Sandhyakumary K, Boby R. G, Indira M. Impact of feeding ethanolic extracts of *Achyranthes aspera* Linn. on reproductive functions in male rats. *Indian J Exp Biol.* 2002; 40(11); 1307-1309
107. Pakrashi A, Bhattacharya N. Abortifacient principle of *Achyranthes aspera* Linn. *Indian J Exp Biol.* 1977; 15(10); 856-887
108. Pakrashi A, Mookerji N, Basak B. Effect of chromatographic fraction of the plant *Achyranthes aspera* Linn. on female albino mice. *J. Reprod Fert.* 1975; 43; 127-128
109. Vasudeva N, Sharma S. K. Estrogenic and pregnancy interceptory effects of *Achyranthes aspera* Linn. root. *African Journal of Traditional, Complementary and Alternative Medicines.* 2007; 4(1); 7-11
110. Gupta SS and Khanijo I (1970): Antagonistic effect of *Achyranthes aspera* on uterine contractility induced by oxytocin. *Indian J Physiol Pharmacol* 14, 63.
111. Mathur R, Chauhan S, Saxena V, Shukla S and Prakash AO (1983): Antiimplantation activity of some indigenous plants in rats. *J Jiwaji Univ (Sci Technol Med)* 9, 37-46.
112. Khanna A. K, Chander R, Singh C, Srivastava A. K, Kapoor N. K. Hypolipidemic activity of *Achyranthes aspera* Linn. in normal and triton-induced hyperlipidemic rats. *Indian J Exp Biol.* 1992; 30; 128-130.
113. Priya K, Krishnakumari S (2007) Phytochemical analysis of *Achyranthes aspera* and its activity on sesame oil induced lipid peroxidation. *Ancient Science of Life* 27(1): 6-10.
114. Girija S, Valarmathy N. Antifeedant effect of *Achyranthes aspera* Linn on cauliflower borer (*Hellula undalis*), fruit and leaf borer of cauliflower (*Spodoptera litura*) and Brinjal fruit borer (*Leucinodes arbonalis*). *Biosciences Biotechnology Research Asia.* 2008; 5(2); 663-672
115. Dhar M. L, Dhar M. M, Dhawan B. N, Mehrotra B. N, Ray C. Screening of Indian plants for biological activity. Part I, *Indian J Exp Biol.* 1968; 6; 232-247
116. Akhtar M. S, Iqbal J. Evaluation of hypoglycemic effects of *Achyranthes aspera* in normal and alloxan-diabetic rabbits. *J. Ethnopharmacol.* 1991; 31; 49-51
117. Malarvili T, Gomathi N (2009) Effect of *Achyranthes aspera* (Linn) see on redox and oxidative status in plasma and selected tissues of rats fed with high doses of fructose. *Biosciences Biotechnology Research Asia* 6(2): 659-664.
118. Szkudelski T (2001) The mechanism of alloxan and streptozotocin action in cells of the rat pancreas. *Physio Res* 50: 537-546.
119. Karunanayake EH, Hearse DJ, Mellows G (1975) The metabolic fat and elimination of streptozotocin. *Biochemical society Transaction* 3: 410-414.
120. Gupta S, Verma S. C, Ram A. K, Tripathi R. M. Diuretic effect of the saponin of *Achyranthes aspera* (Apamarga). *Ind J Pharmacol.* 1972; 4; 208-214
121. Ram A. K, Bhagwat A. W, Gupta S. S. Effect of saponin of *Achyranthes aspera* on the phosphorylase activity of rat heart. *Ind J Physiol Pharmacol.* 1971; 15; 107-110
122. Gambhir S. S, Sanyal A. K, Chowdhury N. K. Pharmacological study of *Achyranthes aspera* Linn. A preliminary report. *Ind J Physiol Pharmacol.* 1965; 9; 185-188
123. Oliver Bever B (1982) Medicinal plants in tropical West Africa. I. Plants acting on the cardiovascular system. *J Ethnopharmacol* pp: 5(1): 1-72.
124. Jayakumar T, Sridhar MP, Bharath Prasad TR, Ilayaraja M, Govindasamy S, et al. (2009) Experimental studies of *Achyranthes aspera* (L) preventing Nephrotoxicity induced by lead in Albino rats. *J Health Science* 55(5): 701-708. 5
125. Sutar N. G, Sutar U. N, Sharma Y. P, Shaikh I. K, Kshirsagar S. S. Phytochemical investigation and pharmacological screening of leaves of *Achyranthus aspera* Linn. as analgesic and antipyretic. *Biosciences Biotechnology Research Asia.* 2008; 5(2); 841-844
126. Mehta FA, Patel BG, Pandya SS, Ahire KB (2009) Densitometric HPTLC method for analysis of oleanolic acid in *Achyranthes aspera* L. *J of Planer Chromatography* 23(4): 289-292.
127. Kumar H, Singh D, Kushwaha SKS, Gupta AK (2009) Comparison of leaf and root extract of *Achyranthes aspera* for its analgesic activity. *Der Pharmacia Lettre* 1(2): 193-198

128. Chakraborty A, Brantner A, Mukainaka T, Nobukuni Y, Kuchide M, Konoshima T, Tokuda H, Nishino H. Cancer chemo preventive activity of *Achyranthes aspera* leaves on Epstein-Barr virus activation and twostage mouse skin carcinogenesis. *Cancer lett.* 2002; 177(1); 1-5
129. Subbarayan PR, Sarkar M, Impellizzeri S, Raymo F, Lokeshwar BL, et al. (2010) Anti-proliferative and anti-cancer properties of *Achyranthes aspera*: Specific inhibitory activity against pancreatic cancer cells. *J Ethnopharmacol* 131(1): 78-82.
130. Geetha P, Narayanan KR, Murugesan AG (2010) Screening the anticancerous efficacy of *Achyranthes aspera* Linn. using animal model Swiss Albino mice. *J Biomed Sci Res* 2(4): 231-235.
131. Pareta SK, Patra KC, Harwansh R (2011) In-vitro calcium oxalate crystallization inhibition by *Achyranthes indica* Linn. hydroalcoholic extract: an approach to antilithiasis, *Int J Pharma Bio Scienc* 2(1): 432-437.
132. Anantha D (2010) In vitro anti helminthic activity of aqueous and alcoholic extracts of *Aerva lanata* seeds and leaves. *J Pharmaceut Sci Resc* 2(5): 317-321.
133. Barua CC, Talukdar A, Begum SA, Buragohain B, Roy JD, et al. (2009) Antidepressant like effects of *Achyranthes aspera* Linn. in animals models of depression. *Pharmacology* 2: 587-594.
134. Tahiliani P, Kar A. *Achyranthes aspera* elevates thyroid hormone levels and decrease a hepatic lipid peroxidation in male rats. *J. Ethnopharmacol.* 2000; 71(3); 527- 532
135. Basu N. K, Neogi N. C, Srivastava V. P. Biological investigation of *Achyranthes aspera* Linn. and its constituent achyranthine. *J Proc Inst Chem.* 1957; 29; 161-165
136. Aswal B. S, Goel A. K, Kulshrestha D. K, Mehrotra B. N, Patnaik G. K, Screening of Indian plants for biological activity. *Ind J Exp Biol.* 1996; 34; 444-467
137. Kumar S, Upadhyay JP, Kumar S. Evaluation of plant extracts for control of *Alternaria* leaf spot of *Vicia faba*. *Annals of Plant Protection Sciences.* 2005;13(1):258-9.
138. Gupta, S.S. and Khanijo, I., 1970. Antagonistic effect of *Achyranthes aspera* on uterine contractility induced by oxytocin. *Indian Journal of Physiology and Pharmacology*, 14, p.63.