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A RECENT REVIEW ON- PHYTOCHEMISTRY AND PHARMACOLOGICAL IMPORTANCE OF ACYRANTHES ASPERA (*AMARANTHACEAE*) PLANT

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ABSTRACT

Since the dawn of civilization, people have revered plants, and these plants have been genetically preserved. 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.

Plant profile

Figure 1: Plant of *Achyranthes aspera*

Figure 2: Leaves of *Achyranthes aspera*

- **General information of *ACHYRANTHES ASPERA:***

Classification:

- **Kingdom** Plantae
- **Subkingdom** Tracheobinota
- **Super Division** Spermatophyta
- **Division** Mangoliophyta
- **Class** Mangoliophsida
- **Subclass** Caryophyllidae
- **Order** Caryophyllales
- **Family** Amaranthaceae
- **Genus** *Achyranthes*
- **Species** *Aspera*
- **Common name** Latjira, Chirchira

Other names

Table: 1 Classify Synonyms name of *Achyranthes Aspera*

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	*Achyranthes aspera*
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 **[6, 7]**.

4. Botanical characterization

Achyranthes aspera is a perennial or annual herb, procumbent or erect **[8]**.

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

Height- It is often found to be 0.2-2.0 m high with woody base.

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. Leaves are 5.22cm long and 2.5 cm broad. Occur in various sizes. Type of stomata are present on the lower epidermis is anomocytic **[8]**.

Branch- Terete or quadrangular, striate, pubescent branches with thick leaves are present **[9]**.

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.

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. Flowers bloom in the summer **[8]**.

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 **[8-9]**.

5. Traditional uses

Achyranthes aspera has been documented in Ayurveda and Chinese medicine **[10, 11, 12]**. 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 **[11, 12, 13]**. Ashes of the whole plant were used by Hindus to prepare caustic alkaline preparations **[10]**. Both European and Indian Physicians are familiar with the plant's diuretic properties **[11, 12]**. In cases of general an asarca and renal dropsy, the plant's decoction is employed as a diuretic **[11]**. 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, anthelminitic, sudorific and stomachic **[14]**. The roots are utilised to cure cough, abdominal tumours and stomach **[15]**.

The tribal people of Andhra Pradesh's Chitoor district use this plant to cure epilepsy and the Payasam Kheer made from its seed and milk is effective remedy for brain disease **[16]**.

The plant is used as diuretic, astringent, purgatives, a remedy for colic, dropsy, piles, skin eruptions **[17, 18, 19]**, It is also used to treat fractured bones **[20, 21, 22]**, whooping

cough, respiratory problems **[23]**, asthma **[24]** and leucoderma **[25]** and laxatives **[26]** antidote for snake bites **[27]**. The inflorescence is utilised for hydrophobia and cough **[28]**. Hydrophobia is treated using fruit. The seeds are used for gonorrhoea, insect bite, hydrophobia, cough, especially whooping cough, additionally, they have cathartic, purgative, and emetic properties **[29]**.

6. Photochemistry

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 **[30]**, was reported as a betaine derivative of N-methylpyrrolidine-3-carboxylic acid **[31]**. Later investigations revealed that betaine was the base that was water soluble, not achyranthine **[32]**. It was shown that the basic chloroform-soluble fraction is a mixture of two uncharacterized alkaloid entities **[33]**. Alkaloids and saponin were present in the plant's ethanol extract, while tannin and flavonoids were not present **[34]**. 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 **[35]**. As a result, 15 phytocompounds were characterized and identified. These phytocompounds were presented in **Table 2 [35]**.

Table 2: The phytochemical composition of hydroalcoholic extract of Achyranthes aspera whole plant [35]

S.NO	Name of compound	Molecular formula	Molecular weight
1.	Tetradecane	$C_{14}H_3O$	198
2.	Benzaldehyde, 4-hydroxy-3,5-dimethoxy	$C_9H_{10}O4$	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	$C_8H_8FNO_2$	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-Octadecadienoicacid (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

7. 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* **[36]**. Aqueous and alcoholic leaf extracts demonstrated antibacterial activity against Staphylococcus aureus and *E. coli* **[37]**.

The seeds grown on cow dung showed antibacterial activity against *Salmonella typhimurium*, Pseudomonas cichorii, and B. subtilis bacterial strains **[38]**. 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 **[39]**. 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* **[40]**.

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 **[41]**. It was discovered that saponin from the ethyl acetate extract of A. aspera has mosquito larvacidal properties **[42]**.

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* **[43]**. 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* **[44]**. *E. coli, S.citri* and aerobic spore formers from soft drinks were found to be susceptible to the leaf extract's antibacterial effects **[45]**.

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. The plant significantly decreased the number of microbial colonies in air samples when

compared to formalin in a comparative study of herbal fumigation agents **[46]**.

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* **[47]**.

The plant has been characterized as a potent antibacterial agent in another study **[48]**. It has been observed that dried leaf extracts in chloroform, petroleum ether and methanol have antibacterial and antifungal activities **[49]**. 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.

Strong hormonal actions associated with insect molting have been found in root extract. High larvicidal activity was demonstrated by crude ethanol extract against *Boophilis microplusl* 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 **[50]**.

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 **[51]**. The ethanolic extract of A. aspera is also said to have anti-inflammatory and anti-arthritic activities in doses of 100-200 mg/kg **[52]**. 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 **[53]**.

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

The anti-inflammatory properties of A. aspera have been documented in another investigation **[54]**.

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 **[55]**.

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.

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 **[56]**.

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 **[57-58]**. 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 **[59]**.

The hydroalcoholic extract of A. aspera has been shown to boost the cell-mediated immune system by enhancing phagocytic function **[60]**.

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.

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 **[61-62]**. 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 spermiostatic. 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 **[63]**.

The effects of Achyranthes aspera's methanolic leaves extract on some indicators of anti-fertility activity, such as abortifacient, estrogenesity, pituitary weight, ovarian hormone level, and lipid profile in female rats, were evaluated. The extract significantly elevated pituitary and uterine wet weights in ovarectimized 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 **[64]**.

In a different trial, oral administration of benzene extract of stem resulted in a 100% prevention of conception on post-coitum or day 1 **[65]**. In mice, a strong abortifacient effect of the stem's crude benzene extract was found **[66]**. 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 **[67]**.

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 **[68]**.

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 **[69]**. 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 **[70-71]**. Oral administration of the ethanol and chloroform extracts of A. Aspera exhibited both estrogenic and 100% antiimplantation effect **[72]**.

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 **[73]**. Antiimplantation activity in Female albino rats was showed by the plant's benzene extract (without the root) **[74]**.

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 **[75]**.

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 **[76]**.

Anti-feedent activity

On cauliflower borer and brinial 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 spodopter litura, the plant extract had a significant antifeedant and a low larvacidal activity **[77]**.

Anti-diabetic activity

For preliminary biological activities, the entire plant's 50% ethanolic extract **[78]** was investigated. It had hypoglycemic effects in rats. It had no effects on respiration, CVS, CNS, isolated g. pig ileum and it had no anthelminitic, anticancer, anti-protozoal or antiviral properties. The MTD for the extract in mice was determined to be 1000 mg/kg bw orally **[79]**. 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 plants aqueous and methyl alcohol extracts **[80]**.

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 **[81]**.

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 **[82]**. 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 **[83]**. 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 **[84]**.

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. 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 **[85]**.

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 was 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 **[86]**.

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. 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 **[87]**. 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 **[88]**.

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 **[89]**. In another study analgesic activity was showed by leaves and seeds of Achyranthes Aspera **[90]**. 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 **[91]**.

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 **[92]**.

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-induction 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%) **[93]**.

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 **[94]**. To test A. aspera's anti-cancerous activity, Swiss albino mice were given an intraperitoneal injection of mineral oil. 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 **[95]**.

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 **[96]**. 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 **[97-99]**.

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 **[100-102]**.

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 **[103]**.

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.

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Conflicts of Interest

None declared

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Not applicable

Conflict of Interest

We declare that we have no conflict of interest

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