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A brief review on the medicinal and phytochemical profiling of the *Achyranthes aspera* Linn. (Apamarga)

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Abstract
Medicinal plants contain secondary metabolites like polyphenols, flavonoids, triterpenoids etc. Which have significant antioxidant and antibacterial properties. *Achyranthes aspera* Linn. is very important medicinal plant and it belongs to the family Amaranthaceae. It is commonly known as Apamarga in Ayurveda and is found as a weed that has been traditionally used as diuretic, spermicidal, anti-allergic, cardiovascular, nephroprotective, antiparasitic, hypoglyceamic, analgesic anticoagulant, antiarthritic, antitumor antidepressant, wound Healing, antihepatocarcinogenic antinoniceptive and antipyretic. This present review article is about the magical pharmacological properties of *Achyranthes aspera* Linn. and different kinds of phytochemicals responsible for such properties.

Keywords: Achyranthes aspera Linn., Apamarga, phytochemicals, pharmacological potential

Introduction
Medicinal plants are gaining much interest recently due to their special attributes as a large source of therapeutic phytochemicals that may lead to the development of novel drugs. Phytochemicals are non-nutritive plant chemicals that possess protective and disease preventing capabilities. Phytochemicals in plants include a diverse array of different chemicals such as phenolic acids, flavonoids, isoflavones, epicatechins, catechins, carotenoids, anthocyanins, alkaloids, tannins etc. The physiological function of phytochemicals varies from their enzymatic action to anti-oxidative nature. The anti-oxidant potential of these plant derived chemicals is due to presence of various hydroxyl groups in their chemical structures. These hydroxyl groups scavenge or quench the free radicals generated during metabolism, thus preventing the body from oxidative stress and cancers. The pharmacological potential of these phytochemicals ranges from antimicrobial to anti-HIV nature. The superior nature of phytohemicals over allopathic drugs lies in the fat that chemicals present in plant extracts act synergetically with each other by reducing or eliminating its side effects.

Achyranthes aspera Linn. Is very versatile medicinal herb found as a weed throughout India and in tropical environment. It belongs to the family Amaranthaceae and commonly known as Apamarg (in Hindi) and Rough Chaff flower in English. Its roots, seeds and flowers are mainly used for various therapeutic activities in traditional system of medicine. It an important medicinal plant used in various diseases like odontalogic, rheumatism, bronchitis, skin disease, rabies [1]. fever, dysentery and diabetes. Ayurvedic system of medicine describes this plant as bitter, pungent, laxative, stomachic, carminative and useful for the treatment of vomiting, bronchitis, heart disease, piles, itching, abdominal pain, ascites, dysentery, blood disease etc [2, 3, 4]. Although it has many medicinal properties, it is particularly used as spermicidal,[5] Antipyretic [6], abortifacient activity [7], antibacterial [8, 9, 10], antifungal [11, 12], wound healing [13], anti-parasitic [14], anti-helmintic [15] and anti-hepatic activities [16].

Fig 1: *Achyranthes aspera* Linn. (Apamarga)

Various kinds of medicinally important chemicals like ecdysterone, achyranthine, betaine, pentatriaontane, 6-pentatriacontanone, hexatriacontane and tritriacontane are reported to be present in different parts of Apamarga which are responsible of different pharmacological activities. This review article analyses different therapeutic aspects of *Achyranthes aspera* which will support its usage in traditional system of medicine for cure of various ailments.

Traditional uses of *Achyranthes aspera* Linn. (Apamarga):

- The crushed leaves are used for curing strained back [17].
- The plant is used in treatment of asthma, bleeding, in facilitating delivery, boils, bronchitis, cold, cough, colic, debility, dropsy, dog bite, dysentery, ear complications, headache, leucoderma, pneumonia, renal complications, scorpion bite, snake bite and skin diseases etc [18].
- Decoction of powdered leaves with honey or sugar candy is useful in early stages of diarrhoea and dysentery [19].
- Crushed plant is boiled in water and is used in pneumonia. Infusion of the root is a mild astringent in bowel complaints. The flowering spikes or seeds, ground and made into a paste with water, are used as external application for bites of poisonous snakes and reptiles, used in night blindness and cutaneous diseases [20].
- The plant is used in dropsy, piles, skin eruptions, colic, as diuretic, astringent and purgative [21, 22], as an antidote to snake bite [23], in fractured bones, whooping cough, respiratory troubles, in asthma laxative and in leucoderma. The inflorescence is used in cough and in hydrophobia. Fruit is used in hydrophobia. The seeds are employed as an emetic, purgative, and cathartic, in gonorrhoea, for insect bite and in hydrophobia, cough including whooping cough, as an anti-asthmatic. The leaves are used in wounds, injuries, in intermittent fever, as an antiasthmatic, for urination, dog bite, and in typhoid. The root is used in whooping cough, tonsillitis, Hemorrhage, cough and hydrophobia, as an antiasthmatic, diuretic, diaphoretic, and antisyphilitic [24].

Phytochemicals present in *Achyranthes aspera* Linn. (Apamarga)

The plants are reported to contain following major classes of compounds: fatty acids, a number of oleonic acid, bisdesmosidic, triterpenoid based saponins, ecdysterone, n-hexacos-14- enoic, oleanolic acid, triacontanol, spinasterol, dihydroxy ketones, spathulenol, alkaloids, D-glucuronic, Betaine, Achyranthine and various amino acids.

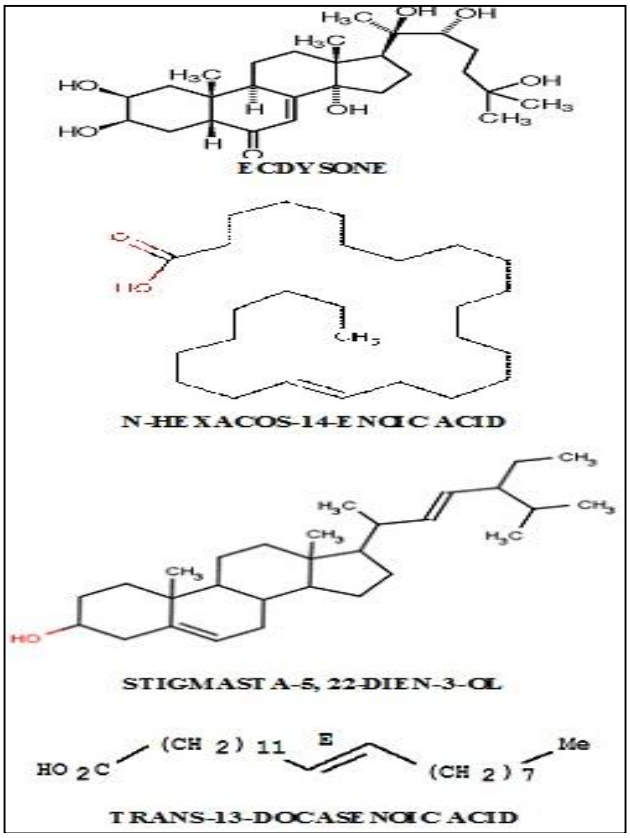

Fig 2: Different constituents present in the roots of *Achyranthes aspera* [25]

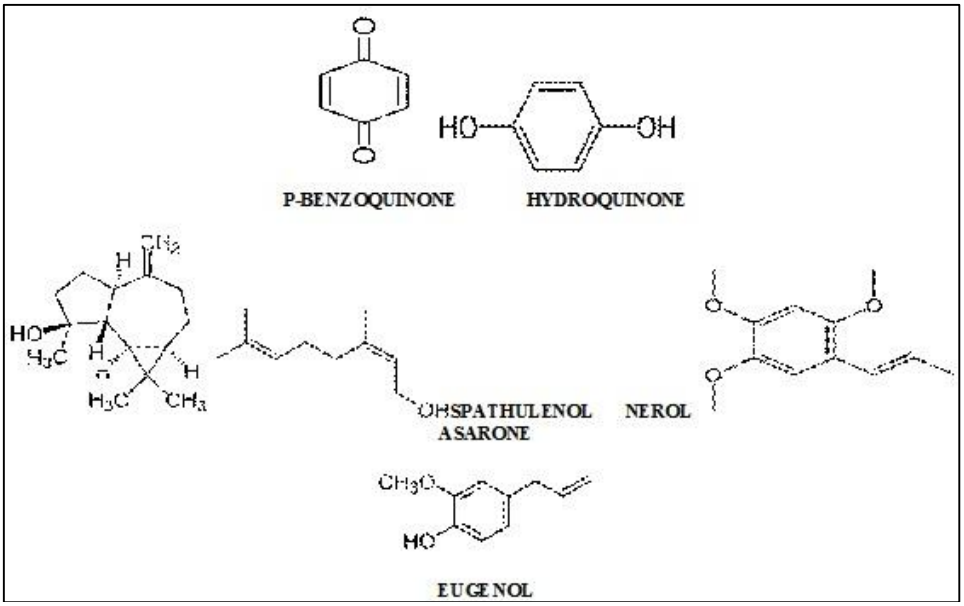

Fig 3: Different constituents present in the leaf of *Achyranthes aspera* [25]

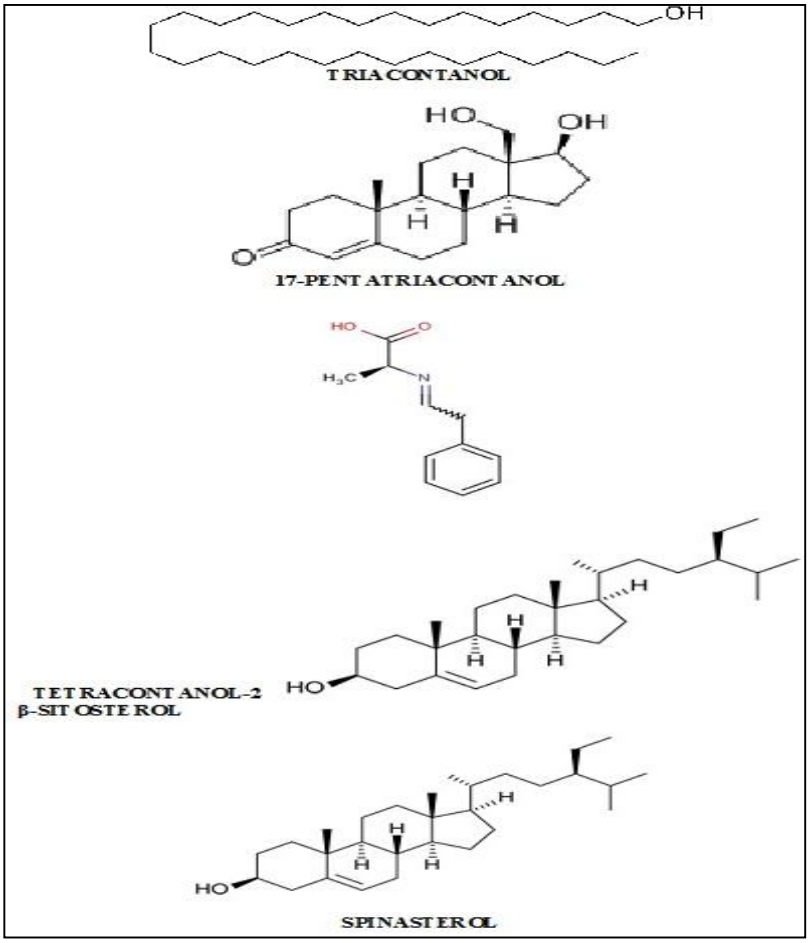

Fig 4: Different constituents present in stem of *Achyranthes aspera* [25]

Several phytochemicals such as Triacontanol, aliphatic alcohol, 17-pentatriacontanol, penta-triaontane, 6-pentatriacontanone, Hexatriacontane, Tritriacontane, tetracontanol-2 ($C_{40}H_{82}O$), 4-methoxyheptatriacont-1-en-10-ol ($C_{33}H_{76}O$), E-sitosterol and spinasterol.[ali, George, Mishra] [25, 26, 27]. are isolated from the stems of the plant. Some other compound like strigmasta-5, 22-dien-3-E-ol, trans-13-docasenoic acid, n-hexacosanyl n-decaniate, n-hexacos-17-enoic acid and n-hexacos-11- enoic acid are also isolated from the root. Hydroquinone (57.7%), p-benzoquinone, spathulenol, nerol, α-ionone, asarone and eugenol. Alkaloids, flavonoids, saponins, tannins and phenolic compounds are found in the leaves. Phytochemical investigations of the seeds show the presence of triterpenoid Saponins A and B. Saponins C and D are reported from unripe fruits [26, 27]. Its carbohydrate components are the sugars D-glucose, L-rhamnose, D-glucuronic acid (Saponin A). Saponin B is identified as β-D galactopyranosyl ester of D-Glucuronic acid. The seeds also contain water soluble base, betaine and a water soluble alkaloid Achyranthine, 10-tricosanone, 10-octacosanone and 4-tritriacontanone [26].

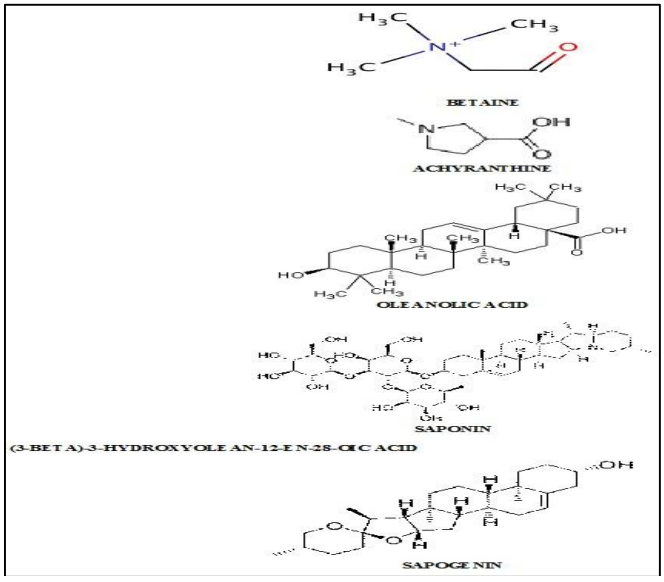

Fig 5: Different constituents present in the seed of *Achyranthes aspera* [25]

Pharmacological activities of *Achyranthes aspera* Linn. (Apamarga)

Gastroprotective activity

Ggastroprotective effect of *A. aspera* leaf was evaluated by analysis of antiulcer activity of ethanolic extracts of *A. aspera* leaf (EEAA). The anti-ulcer assays were performed on pylorus ligation and chronic ethanol induced ulcer model and the effects of the EEAA on gastric content volume, pH, free acidity, total acidity and ulcer index were evaluated. They found out that the percentage of ulcer protection (59.55 % & 35.58) was significantly higher in groups treated with the high dose of EEAA (600 mg/Kg), it also reduced the volume of gastric juice and total acidity whereas gastric pH was increased significantly. The results of this study clearly indicated that significant gastroprotective activity of EEAA may be due to presence of phyto-constituents like flavonoids, saponins and tannins [28].

Antipyretic activity

Goli *et al.* studied the anti-pyretic activity of methanol extracts of Achyranthes aspera Linn, leaves using experimental animal models. The extracts were screened for alkaloids, steroids, proteins, flavanoids, saponins, mucilage, carbohydrates, tannins, fats and oils. Anti-pyretic activity was evaluated using the brewer's yeast-induced pyrexia in rats. The extracts in dose levels of 100 and 200 mg/kg orally were used for anti-pyretic studies. The methanol extracts of leaves of Achyranthes aspera Linn produced significant ($P<0.01$) anti-pyretic activity. The 200mg/kg extracts has shown a good anti-pyretic effect ($P<0.01$) with all the doses used when compared to the control group. The results obtained indicate that the crude leaf extracts of *Achyranthes aspera* Linn possess potent anti-pyretic activity by supporting the folkloric usage of the plant to treat various diseases [29].

Antioxidant activity

Pandey *et al.* reported that in 50% ethanolic extract of the leaves of *A. aspera* the free radical scavenging activity of the extract was concentration dependent and IC50 was observed at a concentration of 62.24µg/ml for DPPH free radical scavenging activity and 68.32µg/ml for hydroxyl radical scavenging activity. The extract showed significant total antioxidant activity and reducing power [30]. Antioxidant activities of Hexane and Chloroform extracts of *Achyranthes aspera* for different parts of the plant was evaluated by Beaulah *et al.* they found out that the antioxidant activity varied from parts to parts and it increased as the time and the concentration increased and the order was: root > stem > inflorescences > leaf in hexane extract and in Chloroform extract, the stem showed high radical scavenging potential and it almost closer to standard Ascorbic acid. The Inflorescence exhibited a higher activity (82 %) and the order of activity was: Stem> Inflorescences > leaf. Root did not show any antioxidant activity and this may be due to the interference of individual chemical components present in the chloroform extract [31].

Antibacterial activity

Infectious skin diseases like scabies, *Pediculosis capitis*, *Tinea capitis*, contact dermatitis and non-infectious skin ailments like dermatitis are of common occurrence in India due to low socioeconomic status, climatic factors and poor hygiene. An important group of skin pathogens are *Staphylococcus aureus*, *Streptococcus pyogens*, *Pseudomonas aeruginosa*, *Micrococcus luteus*, *Candida species etc.* Understanding the potential of *A. aspera* as a cure for skin diseases can help in development of cost effective medicine as the plant is abundantly grown and has been traditionally used by various tribes. Pandey *et al.* studied the antibacterial activity of ethanoilc extracts of *A. aspera* leaves (AALE) against four bacterial strains viz. *S. aureus*, *M. luteus*, *P. aeruginosa*, *E. coli* and they found out that (AALE) showed effective antibacterial activity against all four bacterial strains. Highest activity was observed against *S. aureus* and lowest activity was observed against *E. coli*. The extract inhibited the growth of *S. aureus* at a concentration of 1 mg/ml, thus to calculate the MIC, the antibacterial effect of extract was observed at 0.25, 0.5 and 0.75 mg /ml. AALE was found to inhibit the growth of *S. aureus* at 0.75 mg/ml which was hence recorded as the MIC. Similarly, the effect of AALE against *M. luteus* was observed at 0.2, 0.4, 0.6 and 0.8 mg/ml, the growth was inhibited at 0.8 mg/ml. AALE did not inhibit the growth of Gram negative *E. coli* up to a concentration of 2 mg/ml, however the extract was effective at a concentration of 3 mg/ml. Thus the effect of extract on growth inhibition of *E. coli* was observed at varying concentrations (2.25, 2.5 and 2.75 mg/ml). The minimum inhibitory concentration was recorded at 2.75 mg/ml. The MIC of extract against *P. aeruginosa* was observed at a concentration of 0.8 mg/ml [30]. Lupeol, a pentacyclic triterpene, is a biologically active constituent that has received much attention due to its wide spectrum of medicinal properties, most importantly, strong anti-inflammatory effects. Lupeol has been extensively studied for its inhibitory effects on inflammation under *in vitro* studies and *in vivo* models of inflammation [32]. The anti-inflammatory potential of lupeol could be assessed from the observation that lupeol pre-treatment significantly reduced prostaglandin E2 (PGE2) production in A23187-stimulated macrophages [33]. Results of these studies support the view that lupeol present in AALE may play a significant role in curing skin ailments particularly those related to skin allergy and inflammation.

Aziz *et al*, 2005 has been isolated 3-Acetoxy-6 benzoyloxyapangamide from an ethyl acetate extract of the stem of *Achyranthes aspera*. The extract shows mild antibacterial activity against *Bacillus cereus* [34].

Cardiovascular activity

Neogi *et al.* found out that a water-soluble alkaloid, Achyranthine isolated from *Achyranthes aspera*, was able to decreased blood pressure and heart rate, dilated blood vessels, and increased the rate and amplitude of respiration in dogs and frogs [35].

Antiobesity activity

Treatment of obesity depends upon the development of such inhibitors of nutrient digestion and absorption, which reduce energy intake through gastrointestinal mechanism without altering any central mechanisms. At present, the potential of natural products for the treatment of obesity is still largely unexplored and might be an excellent alternative strategy for the development of safe and effective antiobesity drugs. A.K. Khanna *et al.* (1992) investigated the alcoholic extract of *A. aspera*, at 100 mg/kg dose lowered serum cholesterol (TC), phospholipid (PL). Triglyceride (TG) and total lipids (TL) levels by 60, 51, 33 and 53% respectively in triton induced hyperlipidemic rats [36].

Rani *et al.* evaluated the antiobesity effect of ethanol extract of *Achyranthes aspera* Linn. seed (EAA) by employing *in vitro* and *in vivo* models. The inhibitory activity of EAA on

pancreatic amylase and lipase was measured. The *in vivo* pancreatic lipase activity was evaluated by measurement of plasma triacylglycerol levels after oral administration of EAA along with lipid emulsion to Swiss albino mice. The EAA inhibited pancreatic amylase and lipase activity *in vitro* and elevations of plasma triacylglycerol level in mice. Furthermore, the antiobesity effect of EAA (900 mg/kg) was assessed in mice fed a high-fat diet with or without EAA for 6 weeks. EAA significantly suppressed the increase in body, *retroperitoneal adipose* tissue, liver weights, and serum parameters, namely; total cholesterol, total triglyceride, and LDL-cholesterol level. The anti-obesity effects of EAA in high-fat-diet-treated mice may be partly mediated through delaying the intestinal absorption of dietary fat by inhibiting pancreatic amylase and lipase activity [37].

Diuretic activity

Diuretic substances increase the rate of urine excretion, sodium excretion and balance the body fluid volume. Drug-induced diuresis is helpful in many serious disease conditions such as congestive heart failure, hypertension and pregnancy taxaemia [38]. But synthetic drugs cause many harmful effects on human body. Aqueous and ethanolic extracts of the *A. aspera* leaves were tested for diuretic activity in rats. The parameters studied on individual rats were body weight before and after test period, total urine volume, urine concentration of Na^+, K^+ and Cl^- by taking Furosemide as reference diuretic. *A. aspera* leaves extract showed increase in urine volume, cation and anion excretion [39].

Conclusion

Brief discussion on various kinds of phytochemicals present in different parts of *Achyranthes aspera* and various pharmacological activities support the applications of it for prevention and cure of various ailments. It is advisable to further emphasize on the need of isolation of new phytochemicals that can act as novel drug after their approval by carrying out clinical trials.

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