BIOACTIVE COMPOUNDS OFACHYRANTHES
(AMARANTHACEAE) AND THEIR PHARMACOLOGICAL AND
PHYTOCHEMICAL USES

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ABSTRACT
The species of Achyranthes (fam. Amaranthaceae) is an important herbaceous weed plant has wide range of pharmacological and phytochemical properties. Several bioactive compounds have been isolated from different parts of plants contain saponins A, B, sugars like D-glucose, L-rhamnose, oleanolic acid and ecdysterone. These different parts of plant used as expectorant, stomach tonic, laxative, anti-helminthic, diuretic, linthontropic, sudorific, demulcent, anti-inflammatory and haematonic in indigenous medicine. The plant has antiviral, antibacterial activity, antifertility, anti-diabetic, spasmylytic to smooth muscle, diuretic and purgative. The plant has medicinal and ethno-botanical properties that make it more valuable in tribal and rural community.

Keywords: Pharmacological, Phytochemical, Amaranthus spinosus, Amaranthaceae, RAPD.

INTRODUCTION
The species of Achyranthes (fam.Amaranthaceae) play vital role as medicinal or ethno-botanical plant in human life. The common species in India Achyranthes aspera L., recognized viz. Latijira (Hindi), Apamargah (Sanskrit), Apang (Bengali), Katalati (Malyalam), Nayurivi (Tamil), Uttaren (Telugu) and Prickly-chaff flower plant (English). The plant grows in a range of climatic conditions but it is frost intolerant. It is commonly grown in all soil types but grows best in well drained and moist situations or in neutral soils. The plant found on disturbed ground, along roadsides, railway lines, neglected land and poorly maintained grazing land or also grown as a weed in a variety of crops and horticultural enterprises. A weed (plants intentionally grown by people in gardens or other cultivated-plant settings due to their economic value or ornamentation) is used in a variety of senses, generally centering on a plant that is not desired within a certain context or unwanted plants in human-controlled settings, especially farm fields, gardens, lawns and parks or any plants that grow, reproduce aggressively, invasively, grow in diverse environments quickly. Botanically, the plant is small herb found all over Indiaposessing valuable medicinal properties. It is the plant is widespread in the world as a weed, in Baluchistan, Ceylon, Tropical Asia, Africa, Australia and America.

THE PLANT
A perennial stiff erect herb, 0.2-2.0 m high, is growing up to 1000 m height. Stems are esquere, leaves elliptic ovate or broadly rhombate, 5-22 cm long, 2-5 cm broad, and adpressed pubescent. The inflorescences are 8-30 cm long, with many single, white or red flower of 3-7 mm wide. The flowering time of this plant is in summer.

CONSTITUENTS
Compounds in the seeds of A. aspera are the saponins A and B (glycosides of oleanolic acid). The carbohydrate components are the sugars D-
glucose, L-rhamnose, D-glucuronic acid (= Saponin A). Saponin B is the B-D-galactopyranosyl ester of Saponin A (Hariharn and Ragwaswami, 1970). The content of free oleanolic acid in A. aspera roots is 0.54 % (Batta and Ragwaswami, 1973, LiX and HuS, 1995), ecdysterone and oleanolic acid has been isolated from the roots. In the unripe seeds saponines, oleanonic acid, amino acids and hentriacontane (a long chained carbohydrate) have been found. In the shoots an aliphatic dihydroxyketone 36, 37-dihydroxyhenpentacontan-4-on and triacontanol could be found (Batta and Ragwaswami, 1973). Two other long chain compounds, isolated from the shoots, are characterized as 27-cyclohexylheptacosan-7-ol and 16-hydroxy, 26-methylheptacosan-2-on by chemical and spectral investigations (Misra et al, 1993). The petro extract of the shoots produced a yellow semi-solid mass. From this a pink coloured essential oil with a pleasant odour and an aliphatic alcohol (penta triacontanol) were found (Gariballa et al, 1983). Ecdysterone, (phytoecdysone) was yielded and characterized by its colour and special chemical reactions. Its Contents (g/kg) were 0.25 (seeds), 0.09 (roots), 0.04 (stem, leaves) (Banerji and Chadha, 1970, Banerji et al, 1971). Presence of ecdysterone the pronounced insect molting hormonal activity of this extract of roots has been found (Banerji and Chadha, 1970).

USES
A. aspera is an important medicinal herb found as a weed throughout India. Almost all of its parts are used in traditional systems of medicines. From the last few decades or so, extensive research work has been done to prove its biological activities and pharmacology of its extracts. Saponins, oleanonic acid, dihydroxy ketones, alkaloids, long chain compounds and many other chemical constituents have been isolated (Srivastavet al, 2011). Sahai et al (2007) reported that different parts of plant have been used as expectorant, stomach tonic, laxative, anthelmintic, diuretic, linthontriptic, sudorific, demulcent, anti-inflammatory and haematinic in indigenous medicine. Many studies reported (Auniappan and Savarimuthu, 2008) the diverse actions of Achyranthes aspera e.g. antiviral (Khurana and Bhargava, 1970) antibacterial activity (Ikrarn and Haq, 1980, Farouk et al, 1983) antifertility (Pakrashie, 1975) anti-diabetic, positive inotropic effect, spasmolitic to smooth muscle (Kapoor and Singh, 1967) diuretic and purgative (Neogi et al, 1970). An aqueous extract of aerial parts showed significant reduction in cholera toxin-induced intestinal hypersecretion in mice (Claeson and Samuelsson, 1989). It is also used in diabetes as hyperglycemia, hyperlipidemia and negative nitrogen balance. Tripathi (2003) reported a wide spread pathological change is thickening of capillary basement membrane, increased vessel wall thickening and cell proliferation resulting in vascular complications like early atherosclerosis; neuropathy and peripheral vascular insufficiency. Vascular complications are the major cause of developing diabetic ulcers. Diabetic ulcers/wounds are slow; non-healing that can last for weeks despite adequate and appropriate care because diabetic wound healing is an enigmatic and debilitating complication and poses a serious challenge in clinical practice.

A. aspera has been used as hypoglycemic, hypolipidemic, haematinic and ingeneral debility in folk medicine. Earlier studies reported its hypoglycemic, hypolipidemic activity on hematological parameters (i.e. RBC, WBC count, Hb%, cloting time, O2 carrying capacity). These actions may complement hypoglycemc, hypolipidemic actions in treating diabetic complications (Zambare et al. 2011). It is used in the treatment of fever, especially malaria, dysentery, asthma, hypertension. The roots of the A. aspera are reported to have anti-implantation, abortifacient activity and spermicidal activity. The deficiency or excess of trace elements lead to various complications and metabolic disorders in human being. It is useful in cough, bronchitis, rheumatism, renal and cardiac dropsy, and diabetes mellitus. It can stimulate the immunity, enhance the antigen clearance, potentiate antibody production, elevate thyroid hormone levels, decrease hepatic lipid peroxidation and also possesses spermicidal, chemopreventive, anti-inflammatory, anti-arthritic. In Chinese traditional medicine, the hot water extract of the plant has been used as an antiarthritic to alleviate arthritic pain. The dried leaf powder mixed with honey is useful in the early stages of asthma. Oleanolic acid is one of the constituents of A. aspera, A. bidentata extract can promote neuronal growth, protect hippocampal neurons against toxicity, and also has anti-stress and anti-apoptosis activities. Both the plants are found to be a source of many secondary metabolites (Gnanaraj et al. 2012). A. aspera is rich in Iron, Zinc and protein content can serve as a good dietary supplement especially for diabetes and obese people. Zinc and Iron was found to be high in this plant, 1.52 ppm and 63.26 ppm along with 0.87 mg/kg of protein respectively. It can be a good dietary supplement because of the significance of Iron.
towards providing remedy for diabetes and its complications including micro angiopathy and atherosclerosis (Swaminathan, 2007) and adequate protein intake is essential for the compensation of protein loss often encountered in hypoglycaemic conditions (Anonymous, 2004). Zinc, component of many enzymes that involved in the maintenance of several tissue functions (Zargar et al., 1998). The plant act as a slimming supplement for obese patients, due to its increased production of glycogen in liver and its appetitessuppressing property which increases body heat production byactivating thermogenesis and encourages weight loss (Mangal et al. 2009).

**REVIEW OF LITERATURE**

Diabetes mellitus (metabolic disorders) characterized by hyperglycemia, hyperglycemia, dyslipidemia, vascular complications and defective metabolism of glucose and lipids characterized by relative orabsolute deficiency of insulin (Porter, and Barrett, 2005, Turner et al 2005, Singh and Chandra, 2009, Udupa et al, 1995) and management of chronic ulcers is another major problem due to the high cost of therapy and the presence of unwanted side effects (Porras et al, 1993, Suh et al 1998). The American Diabetic Association- 2000 reported that there was marked reduction in RBC count and Hb content of diabetics which may be due to imbalance in erythropoiesis and anemia associated with diabetes; evidenced in present study by significant (P < 0.05) reduction in the RBC's and Hb count in alloxan induced diabetic animals. At the same time prolonged clotting time due to disturbed blood clotting cascade because of the delayed expression of clotting factors in diabetics was also observed. Furthermore the natural defense mechanism that operates through WBCs by phagocytosis observed to be hampered in diabetics due to reduction in WBC count (Veronelli, 2004). The basic requirement of optimal healing is to minimize tissue damage and provide adequate tissue perfusion and oxygenation, proper nutrition and moist wound healing environment to restore the anatomical continuity and function of the affected (Pierce and Mustoe, 1995). The findings of present study clearly demonstrated that EEA improves the hematological parameters like RBC, WBC count, Hb%, clotting time, O2 carrying capacity and color index which may play an important role in offering favorable environment for wound healing. Phytochemical screening of EEA has revealed presence of many phytochemicals i.e. alkaloids, triterpenoids, saponins, flavonoids, amino sugars and tannins etc. Literature search have revealed that hypoglycemic and hypolipidemic activity of EEA is due to presence of flavonoids and saponins as major phytochemicals (Erdman et al. 2007, Luo et al. 2005). Achyranthes aspera whole plant extract shows haematinic along with antidiabetic anti-hyperlipidemic activity. Our results fortify importance of these plants as an alternative haematinic, antidiabetic-anti-hyperlipidemic remedy (Pierce and Mustoe, 1995).

Health improvement mediated by “Nutraceuticals” has triggered an increased global interest and the current global market size of herbal Nutraceuticals is estimated between 30 and 60 billion (Anonymous, 2004). In order to contribute to the human health and National economy, attempts were made to evaluate Nutraceutical potentials of certain common plants available from Tamil Nadu, India. Common plants such as A.aspera L, Boerhavia diffusa L, Mukiamadra spatana (L) Roem, Scoparia dulcis, and Phyllanthus madaraspotensis L were collected, identified, authenticated and evaluated for their nutraceutical potential. The shade dried, coarsely powdered and extracted with water and alcohol were subjected to nutraceutical analysis and their nutraceutical values were determined. Among the selected plants Mukiamadr aspatana (L) Roem possessed high nutraceutical values. The ethanolic leaf extract of A. aspera by *in vitro*, Hen’s Egg Chorioallantoic Membrane method (HET-CAM) Showed increased density of newblood capillaries as compared with control group treated with 0.9% NaCl. The results of leaf extract revealed a significant scope to develop novel broad spectrum of herbal formulations for wound healing and different herbal formulations (Kumar et al. 2012).

Great interest in herbal medicine as a potential source of phytopharmaceuticals has created the need to review common factors responsible for major diseases and body disorders. Traditional medicinal herbal remedies in the southern African region have long been used to treat various pain-or inflammation-related symptoms. There is increasing evidence to indicate that both peripheral and central nervous system cells play a prominent role in the chronic inflammatory responses in the body system and anti-inflammatory herbal medicine and its constituents are being proved to be a potent protector against various pro-inflammatory mediators indiesases and disorders. The structural diversity of these medicinal herbs makes them a valuable source of novel lead compounds against the therapeutic molecular targets, cytokines and mediators that have been
newly discovered by the platforms of genomics, proteomics, metabolomics and high through technologies. The basic mechanisms of inflammation and the potential of 123 southern African plant species were found effective as chronic inflammatory disease preventive agents (Iwalewa et al. 2007).

The anti-inflammatory activity of an alcohol extract of *A. aspera* was tested on carrageenin induced hind paw oedema and cotton pellet granuloma models in albino male rats. The animals were fed with an alcohol extract at various dose levels (125, 250, 375 and 500 mg/kg). Diclofenac sodium was used as a standard drug. The alcohol extract (375 and 500 mg/kg) showed the maximum inhibition of oedema of 65.38% and 72.37% at the end of 3 h with carrageenin-induced rat paw oedema, respectively. Using a chronic test, the extract exhibited a 40.03% and 45.32% reduction in granuloma weight (Vertichelvan et al. 2003). Efficiency of *A. aspera* was evaluated in Swiss albino mice after treated with mineral oil. The anti-cancerous activity of plant leaves was tested against mineral oil-induced cancer in mice which indicated that the ether extract at the concentration of 3 mg/ml was very effective in reducing the cancer symptoms (Geethaet al. 2010).

Plants and plant-based medicaments are the basis of many of the modern pharmaceuticals. The radical scavenging activity of the different extracts of root, stem, leaf and inflorescences was evaluated by DPPH assay and the antibacterial activity against *Staphylococcus aureus* a gram positive and *Escherichia coli* a gram negative bacterium was studied by Agar well cut diffusion method. All of the extracts exhibited different antioxidant and antibacterial activities and the activities varied from solvent to solvent and the activities were concentration and time dependent. The antioxidant and antibacterial activities were compared with the positive control using ascorbic acid and gentamycin. A qualitative phytochemical analysis was carried out and found to possess bioactive compounds like alkaloids, glycosides, terpenoids, steroids, flavonoids and tannins (Blualah et al. 2011).

The antifungal activity and minimum inhibitory concentration (MIC) of various plant extracts indicated different solvents such as hydro-alcohol (50% v/v) and hexane of plants traditionally used as medicines as *Valeriana jatamansi* (Sugandhbal), *Coleus barbatus* (Patharchoor), *Berberis aristata* (Kingore), *Asparagus racemosus* (Satrawal), *Andrographis paniculata* (Kalmegha), *A. aspera* (Latjiri), *Tinospora cordifolia* (Giloei), *Plantago depressa* (Isabgol) were evaluated against *Aspergillus niger* and *Candida albicans*. Hydro-alcoholic extracts of all the plants were found to have maximum antifungal activity in comparison to hexane extracts. Hydro alcoholic extracts of *Andrographis paniculata* and *A. aspera* showed maximum potency against *Aspergillus niger* and *Candida albicans* at highest MIC value of 0.5 and 0.3 mg/ml respectively. Hexane extracts of *Andrographis paniculata* showed highest MIC value of 0.7 mg/ml against *A. niger* (Mathur et al. 2011).

An ideal Anti-microbial is perpetual and never ending in any system of medicine and becomes mandatory as the microbial evolve newer methods of resisting the antimicrobial activity of the existing drugs in the market. To improve the quality of therapy and hence the quality of life of the patient, it is required to find out new molecules, which are patient friendly, reasonably affordable, least toxic and available in plenty. Still fight for identifying such an ideal drug to fight common organisms that inhabit human systems. The Siddha system of medicine is regarded as the most unique system because of its exclusive Materia Medica. Among the various sources of drugs, salt based preparations are noted worthy. The herbal salts mentioned in Siddha literatures include Madar (*Calotropis gigantean*), Indian marsh mallow (*Sida mauritiana*), Rubbish plant (*Acalypha indica*), Plantain tree (*Musa paradisiaca*) and Drumstick tree (*Hyperanthera moringa*). The superiority of these herbal based salts are that they are easily available, economical, time tested and have no side effects. It is used in the treatment of lipid disorders in the Indian system of medicine. The saponin extract of *Achyranthes aspera* has both hypolipidemic and weight reducing effects on high fat diet fed rats (Lathaet al. 2011).

**BIOTECHNOLOGICAL APPROACH**

The latest studies reported that extract of *A. aspera* was found to enhance the induction of ovalbumin specific humoral antibody response in mice, on intra-peritoneal injection of extract along with ovalbumin specific humoral antibody. The antibody response was evaluated by passive cutaneous anaphylaxis and ELISA for IgE and other classes or subclasses of antibodies, respectively. The adjuvant property of the extract was further examined in different strains of mice and a significant elevation of the OVA-specific IgG antibody response in all strains tested was found. When the extracts of different parts of the herb were tested, the seed and root extracts appeared to exhibit relatively higher activity. It has been established and validated for
determination. Detection and quantification were of oleanolic acid in methanolic extract of A. aspera roots and leaves by HPTLC method was performed by densitometry at $\lambda = 529$ nm. In roots and leaves methanolic extract oleanolic acid content was found 0.37% and 0.13 %w/w respectively.

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