International Journal of Pharma Sciences
Vol. 3, No. 6 (2013): 398-402
Review Article
Open Access

ISSN: 2320-6810

A Review on Natural Plant: *Aerva lanata*

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Received: 05 November 2013 Accepted: 15 November 2013 Online: 20 November 2013

ABSTRACT

Aerva lanata (L.) Juss. Schultz is herbal plant; its extract exhibits significant therapeutic effects such as antihyperglycaemic effect, urolithic effect, anthelmintic effect, anti hyperlipidemic effect, hepatoprotective activity, anti oxidant, and anti microbial activity etc. The *A. lanata* comprises the alkaloids, flavonoids, phenol, tannin, proteins, amino acids and carbohydrates respectively. The presence of minerals is responsible for conducting many activities in the body. The scientific validation is essential for acceptance of medicinal plant therapeutic effects against disorders. Hence, the phytochemical constituents and pharmacological effects of the plant are discussed in this review.

Keywords: *A. lanata*; Mineral elements; SEM-EDX; Urolithic; Anthelmintic

INTRODUCTION

India is a well known source for medicinal plants and its extracts were used in ayurvedic, siddha, and unani used for treating different types of diseases. Few of the medicinal plants have been evaluated scientifically. Phytochemical constituents possess important pharmacological properties like chemopreventive effects and cytotoxic effect. A natural constituent from traditional medicinal plants boost up the health and mitigates the ailments. In present days, scientific evaluation of various pharmacological effects of medicinal plants has increased throughout the world [1]. The 80% population from developing countries depends upon the traditional medicines mainly plant drugs used for primary health care reported by World Health Organization (WHO). Medicinal plants exhibit lower side effects compare to synthetic drugs because of this reason use of medicinal plant is growing worldwide [2].

Plant introduction

Aerva lanata (L.) Juss. Ex Schult belongs to the family *Amaranthaceae*. It is one of the important plant grow in the warmer parts of India ascending to 1,000 m. The Sanskrit terms of *A. lanata* are paashaanabheda, gorakshaganjaa, satkabhedi, aadaanpaak. It is commonly known as sirupeelar in Tamil or Siddha [3].

A. lanata is an herbaceous perennial weed [4]. It is indigenous in India, Srilanka, South Asia, Saudi Arabia, tropical Arica and South Africa [5]. It is known as polpala [6] from the family *Amaranthaceae* [7]. Amaranthaceae family consists of about 169 genera and 2300 species [8].

A. lanata is used as an important medicinal plant for illness. It is also called in English as a stone breaking plant. *A. lanata* comprises medicinal and pharmaceutical importance [9]. It is used by ayurvedic practitioners for many pathological conditions [10]. It is grown 30-80 cm in height, the main stem is short but stout and woody at base from which grows 4 to 10 or more extends to hairy branches. The branches carry many hairy white flowers which are of 8 to 20 mm length [11]. *A. lanata* leaves exhibits woolly in nature, and the branches of flowers are small. Flowers are small in size, sessile, greenish or dull white in colour, clustered with spikes. Seeds look like kidney shaped and shines black. Its root has camphor like aroma and medicinally important. Decoction of flowers treats the stones in any part of the stomach and decoction of root

also exhibits diuretic property and treats renal calculi [12].

Phytochemical Constituents

A phytochemical constituent of *A. lanata* is identified by qualitative phytochemical screening. The *A. lanata* comprises the alkaloid, flavonoids, phenol, tannin, proteins, amino acids and carbohydrates respectively. The percentage of crude chemical constituents in *A. lanata* estimated quantitatively. The root of *A. lanata* consists of highest percentage of alkaloid i.e., 0.58%, 0.49% of phenol content, 0.28% of tannin and 0.25% of flavonoids content. The phytochemical constituents of crude extracts are also estimated by thin layer chromatography using solvent system of chloroform. RF (Retention Factor) values are 0.191 for alkaloid, 0.333 for flavonoids and 0.701 for coumarin. Ethanolic crude extracts were reported the RF value 0.45 for alkaloid, 0.314 for flavonoids and 0.403 for coumarin [12]. The *A. lanata* comprises a large amount of carboxylic acid, amines, amides and sulphur derivatives confirmed after FTIR spectrum analysis and it also comprises the large amount of enzymatic and non enzymatic antioxidants. The isolated alkaloids from *A. lanata* leaves are canthin-6-one and β-carboline, hentriacontane, β-sitosterol and its D-glycoside, α-amyrin and betulin [13]. The *A. lanata* also comprises steroidal glycoalkaloid solanin and chaconine [14]. The four new alkaloids were reported includes aervine, methyl aervine, aervoside, aervolanine [15]. *A. lanata* also comprises β-amyrin, betulin, campesterol, chrysin, narcissi, stigmasterol, stigmasterol acetate, daucosterol, erosterol, lupoeol, olean-12-en-28-oicacid-3, 16-dioxymethyl ester, kaempferol-3-galactoside, kaempferol-3-rahmno galactoside, and starch. It also consists of free sugars like fructose, galactose, rhamnose, sucrose. The *A. lanata* flowering and fruiting parts comprises hemicelluloses, an acid soluble polysaccharide and monosaccharide which also consist of polysaccharides [16-17].

Elemental Analysis of *Aerva lanata*

Mineral elements are the inorganic substances present in the whole body tissues and fluids, it is necessary for the maintenance of certain physicochemical processes that are essential to life. The energy is not produced by minerals but they play an important role in many activities in the body. Minerals are divided into three types (Fig. 1) they are:

1. Macro elements
2. Micro elements or trace elements
3. Ultra trace elements [20]

The *A. lanata* comprises mineral elements confirmed by using Scanning Electron Microscope (SEM) with an Energy Dispersive X-ray spectrometer (EDX). SEM-EDX is an analytical technique used for the elemental analysis. This technique is highly quantified for the identification and quantification of different elements in medicinal plants for various biological and environmental importance. The *A. lanata* contains the minerals like calcium and chloride as a macro elements, potassium as a micro element, silicon as an ultra trace element and carbon. Among all the elements, carbon and oxygen was found to be in high concentration, potassium and calcium was found to be moderate; magnesium, silicon and chloride were found to be in trace amounts. These elements play an important role in preventing and treating the diseases, nutritive and catalytic disorders [9].

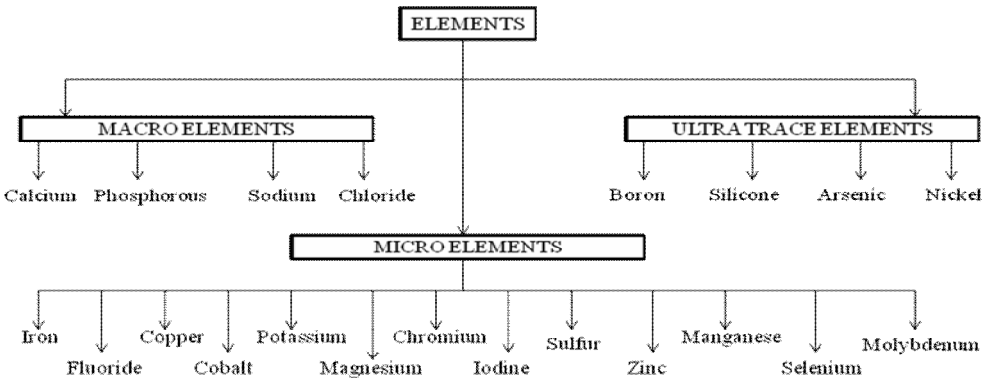

Figure 1. Minerals and its types [20]

Physiological role of elements

Minerals play a very important role for metalloproteins, nucleoproteins, lipoproteins and chromoproteins etc. Calcium is necessary for development of bone and teeth and it regulates heart rhythm, helps in normal blood clotting and useful for proper nerve and muscle functions. Magnesium acts as an anti-hyperlipidemic as it lowers the cholesterol levels. It is an important cofactor for converting the blood glucose into energy and it regulates muscular activity of heart rhythm. Potassium is necessary for the transport of nutrients inside the cell. Silicon prevents the hardening of veins and arteries. Chloride is another main element to transfer the electrical charge and play an important role to maintain the body pH. [9].

PHARMACOLOGICAL EFFECTS

Anthelmintic activity

Anthelmintic activity of methanol and aqueous extract of aerial parts of *A. lanata* was screened by using adult Indian earthworm pheritima posthuma. Selection of this earthworm is because of its anatomical and

physiological resemblance with the intestinal round worm parasite of human beings. Piperazine citrate (15 mg/ml) have been chosen as a standard compound which produces flaccid paralysis on worm and it leads to expulsion of the worm by peristalsis, because of raised chloride ion conductance of worm muscle membrane leads to hyper polarization which results in muscle relaxation and flaccid paralysis. Increasing dose of methanol extract (100 mg/ml) showed promising anthelmintic activity than aqueous extract (100 mg/kg). Phytochemical analysis of the crude extracts showed the anthelmintic activity due to presence of tannins. Tannins of extract, act through interfere with energy generation in helminth parasites by uncoupling oxidative phosphorylation. These also act by binding to free proteins in the gastro intestinal tract (GIT) of host animal or glycol proteins on the cuticle of the parasite resulted into death. The study concluded that the methanol and aqueous extract of aerial parts of *A. lanata* demonstrates the anthelmintic activity by causing the paralysis or death of *pheritima postuma* [2].

Hepatoprotective activity

The hydro-alcoholic extract of *A. lanata* exhibited significant hepatoprotective activity on paracetamol induced hepatotoxicity in wistar rats. The paracetamol (3 mg/kg) induces hepatotoxicity by increased levels of Aspartate aminotransferase (AST), Alkaline phosphatase (ALP), Alanine transaminase (ALT) and bilirubin. The plant extract at the dose of 200 mg/kg reduces the increasing levels of AST, ALP, ALT and bilirubin in serum compared to standard drug silymarin at the dose of 25 mg/kg. Paracetamol induced the hepatotoxicity because of its toxic metabolite N-acetyl-p-benzo quinone imine; it reduces the glutathione levels and causes oxidative stress. *A. lanata* extract showed hepatoprotective activity due to presence of flavonoids. The study concluded that the hydro-alcoholic extract of *A. lanata* reverses the paracetamol induced hepatotoxicity [4]. The petroleum ether, chloroform and methanol extract of whole plant of *A. lanata* also possess hepatoprotective activity against carbon tetra chloride (CCl_4) induced hepatic damage in Sprague dawley albino rats. The CCl_4 causes hepatotoxicity by increasing the levels of AST, ALP, ALT and bilirubin. The extract at the dose of 200 and 300 mg/kg remarkably reduces raised levels of serum marker enzymes and level of bilirubin. These were well predictable to silymarin at the dose of 30 mg/kg as a standard drug. The study concluded that the whole plant of *A. lanata* extract reverses the CCl_4 induced hepatotoxicity [10].

Anti-microbial activity

The methanol and aqueous extracts of aerial parts of *A. lanata* shows anti-microbial as well as anti-oxidant activity screened by using reducing power determination, nitric acid scavenging, determination of zone of inhibition and determination of minimum inhibitory concentration. These two extracts demonstrated significant anti-bacterial activity to gram positive bacteria like *bacillus subtilis* UC564 and *staphylococcus aureus* NCTC8530 than gram negative bacteria like *E. coli* ATCC2457 and *Pseudomonas aeruginosa* 25619. In DPPH method, the methanol and aqueous extract of exhibited anti-oxidant property in increasing doses up to a concentration of 250 µg/ml. Methanol extracts exhibited more anti-oxidant property than aqueous extract. Ascorbic acid was chosen as a standard compound exhibited anti-oxidant property at the concentration of 1 µg/ml. In reducing power determination, the methanol extract (500 µg/ml) exhibited significant anti-oxidant activity than aqueous extract (500 µg/ml) which can be compared with ascorbic acid. The methanol extract possess significant anti-oxidant property at the concentration of 250 µg/ml than aqueous extract at a dose of 250 µg/ml when compared to standard drug ascorbic acid (1 µg/ml) in nitric oxide scavenging method. This activity proved the presence of high content crude flavonoids and saponins. The study reveals the methanol extract of aerial parts of *A. lanata* exhibited significant anti-microbial activity and anti-oxidant activity than aqueous extract [7].

Hypoglycemic effect

Ethanol extract of aerial parts of *A. lanata* Linn. shown remarkable hypoglycemic effect on albino rats. Extract given at a dose of 50 mg/kg, 100 mg/kg, and 200 mg/kg on alloxan induced diabetic rats at a dose of 60 mg/kg. The metformin as a reference compound was given at a dose of 25 mg/kg. Alloxan is a toxic glucose analogue causes destruction of pancreatic beta cells which promotes the suppression of insulin release, further increases blood glucose levels. The ethanolic extract of *A. lanata* reduced the blood glucose levels by dose depending manner. Extract shown significant reducing the blood glucose levels observed at 200 mg/kg and it is predictable to metformin. Extract and metformin profoundly reduces the serum cholesterol levels. The whole study reported the ethanolic extract of aerial parts of *A. lanata* possess the anti-hyperglycemic effect and reduces the serum cholesterol levels [11].

Anti asthmatic effect

Asthma is a chronic inflammatory disease affects the airways leads to airway obstruction. Symptoms of asthma consist of wheezing, coughing, chest tightness, shortness of breath. The ethanolic extract of aerial parts of *A. lanata* carries the anti-asthmatic activity. Anti-asthmatic activity of extract was screened by using in-vitro and in-vivo animal model. In in-vitro model, the isolated goat tracheal tissue is chosen and plotted the dose response curve with asthma inducing agent like histamine and with extract (100 µg/ml) and without extract. Histamine causes the bronchoconstriction, play a major role in asthma. The extract exhibited the anti-asthmatic activity at a dose of 100 µg/ml. In in-vivo model, anti-asthmatic activity was screened by using two methods. Clonidine (1 mg/kg) induced catalepsy on albino mice and mast cell degranulation induced by clonidine (0.5 µg/ml). The extracts (30 and 60 mg/kg) reverse the catalepsy induced by clonidine and it is

comparable to reference drug chlorpheniramine maleate at dose of 10 mg/kg. The extract (60 mg/kg) also exhibits protective effect on mast cell degranulation induced by clonidine and protects the mast cells. This effect of extract is predictable to standard drug disodium chromoglycate at the dose of 0.5 mg/kg. The study reported the ethanol extract of aerial parts of *A. lanata* possess the anti-asthmatic activity [13].

Urolithiatic activity

Renal calculi are the most common disorder of the urinary tract [5]. Kidney stone disorder assessed to occur nearly 12% of the population. The stone comprises of 80% of calcium oxalate. Aqueous extract of aerial parts of *A. lanata* used for calcium oxalate urolithiasis in male wistar albino rats. Extract of dose 2 gm/kg body weight/dose/day administered into rats having kidney stone induced by 0.75% of ethylene glycol into drinking water for 28 days ad libitum. Ethylene glycol disturbs the oxalate metabolism which leads to raise in substrate availability in turn results in raising the oxalate synthesizing enzymes activity. The formation of glycolate and oxalate by glycolic acid oxidase (GAO), lactate dehydrogenase (LDH) catalyzes the coupling of oxidation and reduction of glyoxylate. The urolithic rats showed remarkably raised levels of GAO, LDH and oxalate levels when compared to normal control rats. The aqueous extract significantly brings the raised levels of GAO, LDH and oxalate levels to normal when compared to normal control rats. And also phosphorous, uric acid, protein excretion were remarkably increased in 24 hrs urine of urolithic rats when compared to normal control rats and the extract brings the phosphorous, uric acid, protein excretion to normal. In urolithic rats the citrate and magnesium excretion decreased while calcium and oxalate excretion were remarkably increased and as these changes are corrected by aqueous extract by bringing levels to normal. The extract raised solubility of calcium oxalate stones and restored the normal renal architecture; this effect is due to presence of flavonoids such as kaemepferol-3-rhamnoside, kaemepferol-3-rhamno galactoside, and triterpenes such as betulin and tannins. The study reveals that the aqueous extract of aerial parts of *A. lanata* reverses the ethylene glycol induced calcium oxalate urolithiasis [15].

Diuretic activity

The alcoholic extract of *A. lanata* possesses diuretic activity on albino rats screened by measuring the following parameters before and after administration of extract. The parameters are body weight (before and after test period), total urine volume, concentration of sodium, potassium and chloride in urine. Here the acetazolamide (20 mg/kg) chosen as a reference compound. The increasing doses of extract (400 and 800 mg/kg) posses aquaretic, kaliuretic, chloruretic effects and it also increases the urine volume by 2.5 fold and comparable to acetazolamide which increases the urine volume by 3 fold [16].

Anti-inflammatory activity

Anti-inflammatory activity of extract was screened by using carrageenan induced paw edema method. Ketorolac tromethamine (10 mg/kg) is chosen as a standard drug. The alcoholic and benzene extract of *A. lanata* at the dose of 400 and 800 mg/kg administered into rat paw. The increasing dose of extract showed significant inhibition of carrageen induced rat paw edema. It can be compared to ketoralac tromethamine [16].

Anti-diarrheal activity

Diarrhea defined by the WHO (World Health Organization) as having three or more loose or liquid stools per day or having more stools than the normal. Alcohol extract of *A. lanata* exhibits the anti-diarrheal activity on albino wistar rats. The activity of extracts was screened by using three methods. They are castor oil induced diarrhea, charcoal meal test; Prostaglandin E_2 (PGE_2) induced enterpooling. The extract (400 and 800 mg/kg) possess significant anti-diarrheal activity in castor oil induced diarrhea which inhibits the onset time and severity of diarrhea. Castor oil prevents reabsorption of water leads to increasing the volume of intestinal content further leads to diarrhea. The extract shows significant effect which can be compared to loperamide (2 mg/kg). The extract (400 and 800 mg/kg) and standard drug atropine (0.1 mg/kg) reduces propulsive movements in the charcoal meal study these leads to prevention of diarrhea. In PGE_2 induced enterpooling causes the duodenal and jejunal secretion of water and electrolytes such as chloride and sodium. Extract (400 and 800 mg/kg) protect against PGE_2 induced enterpooling which might be because of inhibition of synthesis of prostaglandins in turn leads to inhibition of diarrhea. The anti-diarrheal activity of extract is due to presence of alkaloids and flavonoids. The study declared the alcohol extract of *A. lanata* demonstrates the anti-diarrheal activity by decreasing the gastro intestinal motility and inhibits the synthesis of prostaglandins [17].

Anti-oxidant activity

In humans, the levels of oxidants and anti-oxidants maintained in balance for proper physiological functions but lack of balance in these, in certain specified conditions undergo oxidative damage of large biomolecules such as proteins, lipids and deoxyribonucleic acid (DNA). This oxidative damage plays a pathological role in many chronic diseases. Leaves of *A. lanata* possess the anti-oxidant property and was screened by using various methods includes superoxide radical scavenging activity, di(phenyl)-(2,4,6-trinitrophenyl)iminoazanium (DPPH) radical scavenging activity and hydroxyl radical scavenging activity. Ethanolic, chloroform and hexane extracts exhibit the dose dependent scavenging activity on super oxide generated radicals, hydroxyl radicals and DPPH radicals. The following order of scavenging activity was observed.

Ethanol extract > Chloroform fraction> Hexane fraction

The IC_{50} (Half Maximal Inhibitory Concentration) values of ethanolic extract of *A. lanata* leaves against super oxide radical, hydroxyl radical and DPPH radical are 219.6 µg, 223.72 µg and 168.13 µg. The preliminary phytochemical studies of ethanolic, hexane and chloroform extract exhibits the free radical scavenging activity due to the presence of flavonoids and phenolic compounds. The ethanol extract possess moderate effect on hydroxyl, DPPH radical and low activity on superoxide radical which can be predictable to standard drug ascorbic acid. The study concluded the ethanol, chloroform and hexane extracts of *A. lanata* leaves exhibits free radical scavenging activity [19].

Anti-nociceptive effect

Aerial parts of *A*. *lanata* possess the anti-nociceptive effect. Anti-nociceptive is the agent which reduces the nociception. The anti-nociceptive effect was screened by using acetic acid induced abdominal writhing test and hot plate test on Swiss albino mice. The extract exhibited anti-nociceptive effect by dose depending manner. Aspirin (100 mg/kg) was taken as reference compound for acetic acid (0.6%) induced abdomen writhing test. High dose of *A. lanata* extract (100 mg/kg) exhibits remarkable anti-nociceptive effect predictable to aspirin. Naloxone (5 mg/kg) was chosen as an opiod receptor antagonist but *A. lanata* is not antagonized by naloxone. Morphine (5 mg/kg) was chosen as a reference compound for hot plate test. The extract also exhibits the profound anti-nociceptive effect at highest dose (100 mg/kg). It extends the latency period predictable with morphine. Naloxone antagonizes the anti-nociceptive action of morphine but does not antagonize the anti-nociceptive activity of *A*. *lanata*. The study concluded that the ethanolic extract of *A*. *lanata* demonstrates the analgesic effect [21].

CONCLUSION

The *A*. *lanata* is one of the most important medicinal plant used for many diseases and disorders. The presence of phytochemical constituents such as alkaloids, flavonoids, tannins etc and minerals such as sodium, potassium, calcium, chloride etc play a therapeutic role in pathologic conditions. It exhibits diuretic activity, anti-inflammatory, anti-hyperglycemic, urolithic, anti-hyperlipidemic and so on. Hence, applying more scientific methods on this plant may lead to discover new entity and helpful for pharmaceutical industry for making new therapeutic drugs.

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