Aerva lanata (Linn.) Juss. ex Schult. – An overview

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Aerva lanata (Linn.) Juss. ex Schult. (Family—Amaranthaceae) is an important source of chemicals of immense medicinal and pharmaceutical importance such as O-acyl glycosides, β-sitosterol, daucosterol, syringic acid, vanillic acid, feruloyl tyramine, feruloyl homovanillylamine, narcissin and aervitrine which are effective as diuretic, anthelmintic, antidiabetic, expectorant and in the treatment of lithiasis and jaundice. Hence, considering the importance of A. lanata an attempt is made to present an overview of phytochemical and pharmacological activities of this plant.

Keywords: Aerva lanata, Amaranthaceae, Phytochemical constituents, Pharmacological activity.

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Introduction

Aerva lanata (Linn.) Juss. ex Schult. (Family—Amaranthaceae) is known as Polpala. The plant (Plate 1) is prostrate to decumbent, sometimes erect herb, 30-60 cm in height, woolly, tomentose throughout; leaves simple, alternate, short petioled, densely tomentose, usually smaller in the flowering branches; flowers very small, sessile, bisexual, greenish or hairy white, often clustered in spikes, perianth calycine membranous, five free filaments of the five stamens connate at the base with alternating linear staminodes; fruit greenish, roundish, compressed urticle and seeds kidney shaped with shining black coriaceous testa. Plant is distributed throughout Tropical India as a common weed in fields and is also found to be growing in Arabia, Tropical Africa, Sri Lanka, Philippines and Java. It is commonly known as Chaya (Hindi), Sirupulai (Tamil) and Bhadra (Sanskrit). The present review gives an overview of the traditional uses, phytochemical and pharmacological studies on A. lanata highlighting the correlation between the active constituents and various pharmacological activities.

Traditional Uses

In the Traditional System of Medicine, the plant is being used as diuretic and anthelmintic, antidiabetic, expectorant and in the treatment of lithiasis. The plant is used for arresting haemorrhage during pregnancy, burn healing, as an anti-inflammatory, headache, skin diseases, to dissolve kidney and gall bladder stones, for uterus clearance after delivery and to prevent lactation. The plant extract is used to treat nasal bleeding, cough, scorpion stings, fractures and spermatorrhoea. The flowers are used in dysentery, diarrhoea and bronchitis. The seeds find use in rheumatism and bronchitis. The leaves are used as anti malarial, in fever and to expel stones from kidney and also as an antidote for scorpion sting, spermaorrhoea, urinary troubles and as an anti rheumatic. The roots are used in headache, scabies, cough, as demulcent, diuretic, to cure diarrhoea, jaundice, cholera, dysentery and in snake bite.
Chemical constituents

*A. lanata* plant has many medicinal properties due to the presence of numerous secondary metabolites. Sitosterol palmitate, hentriacontane, β-sitosterol and its D-glucoside, α-amyrin and betulin were isolated from the whole plant. The glycosides like kaempferol 3-rhamnoglactoside and kaempferol 3-(6”-p-coumaryl) O-glucoside along with alkaloids, saponins and sugar like fructose, galactose, rhamnose and sucrose and also minerals are reported to occur in the plant. O-acyl glycosides, isorhamnetin 3-(6”-p-coumaryl) O-glucoside, β-sitosterol, daucosterol, syringic acid, vanillic acid, feruloyl tyramine, feruloyl homovanillylamine, narcissin and aervitrine have been isolated from the aerial part of *A. lanata*. Alkaloids like canthine 6-one and 3-β-carboline 1-yl propionic acid, 10-methoxy canthin 6-one (Methyl aervine), 10-hydroxy-canthin 6-one (Aervine), 10-O-β-propionic acid, 10-methoxy canthin 6-one (Methyl aervoside), 6-D-glucopyranosyl oxycanthin 6-one (Aervoside) and flavonoids like tiliroside, coumaryl tiliroside, isorhamnetin glycoside, 4-ethylpyridine (4′-methoxycoumarin), 10-hydroxy-canthin 6-one (Aervoline) and flavonoids like trilobin, coumarin trilobin, isorhamnetin glycoside have been isolated from the whole plant. Flowering and fruiting parts of the plant contain polysaccharides like starch, hemicelluloses and monosaccharides like galactose, glucose, mannose, xylose, arabinose and rhamnose. β-sitosterol, its palmitate and α-amyrin were isolated from the heartwood of the plant. From the Egyptian plant sample campessterol and chrysin has been isolated and presence of monosaccharide content of polysaccharides has been determined. Presence of phytocaccin 6-carbinol in the plant is also reported.

Pharmacological activities

Diuretic

The aqueous alcoholic extracts of leaf, stem and root have shown significant diuretic activity on albino rats. The test extracts were given in the dose of 1600 mg/ kg body weight. Sodium (Na⁺) output in urine was markedly increased in case of drug treatment, while difference in potassium (K⁺) output was negligible in comparison to the control group of animals, the stem extract had better diuretic activity than the other two extracts. The activity may be due to presence of mineral salts, different types of sugars and flavonoids which are present in the plant. The alcoholic extract at the dose of 800 mg/kg also showed diuretic activity in albino rats.

Hepatoprotective

Hepatoprotective activity was studied on the aqueous alcoholic extracts of leaf and root of *A. lanata* on albino mice at the dose of 600 mg/kg body weight. At the dose of 400 mg/kg body weight the extracts have no significant hepatoprotective activity, while at the dose of 800 mg/kg body weight, the extracts are fatal to the animals. The hepatoprotective activity may be due to polyphenolic compounds, tannins, vitamin C, etc. which are reported to be present in the herb. Partially purified petroleum ether extractable fraction of the whole plant had protective effect against liver damage induced by Carbon tetrachloride in Sprague Dawley rats. The extracts were administered at the dose of 50 and 100 mg/kg body weight for 14 days. The petroleum ether fraction of extract significantly reversed the histopathological changes and restored the elevated activities of liver marker enzymes and also enhanced the antioxidant enzyme activities. The extract also reduced hepatic lipid peroxidation and the serum total protein and albumin/globulin ratio. Preliminary phytochemical analysis of petroleum ether fraction showed the presence of alkaloids. The hepatoprotective activity of hydro alcoholic extract of *A. lanata* was evaluated against paracetamol induced liver damage in rats. The hydro/alcoholic extract treatment significantly (*P* < 0.01) reversed the levels of AST, ALP and bilirubin (*P*<0.01) and ALT (*P*<0.001) when compared to paracetamol alone treated rats.

Lithiatic

Administration of *A. lanata* aqueous suspension (2 g/kg body weight) for 28 days to Ca Ox urolithic rats had reduced the oxalate synthesizing enzymes such as glycolic acid oxidase (GAO) in liver and lactate dehydrogenase (LDH) in liver and kidney and also diminished the markers of crystal deposition in the kidney. Administration of *A. lanata* (3.0 mg/kg body weight) and Vediuppu chunnam (3.5 mg/kg body weight) orally for 28 days increased the urinary excretion of calcium, oxalate, uric acid, phosphorus, protein and decreased magnesium excretion in hyperoxaluric rats.

The hypolipidemic activity of *A. lanata* aqueous suspension on ethylene glycol induced calcium oxalate urolithiasis in rats was assessed. The levels of total lipids, total cholesterol and triglycerides in urolithic rats were minimized to near normal in *A. lanata* treated group and also the phospholipids level was diminished in liver and kidney.

Anti-inflammatory

The anti-inflammatory activity was evaluated in benzene and alcoholic extracts of *A. lanata* by
carageenan induced rat hind paw edema method. Alcoholic extract (800 mg/kg) produced inhibition of rat paw edema \((P<0.05)\)\(^7\).

**Nephroprotective**

The ethanol extract of the entire plant at dose levels of 75, 150, and 300 mg/kg showed dose-dependent reduction in the elevated blood urea and serum creatine and normalized the histopathological changes in the curative regimen. In the gentamicin model the rat in the preventive regimen also showed good response to the ethanol extract at 300 mg/kg suggested that the ethanol extract of \(A.\ lanata\) possesses marked nephroprotective activity with minimal toxicity and could offer a promising role in the treatment of acute renal injury caused by nephrotoxins like cisplatin and gentamicin\(^53\).

**Antidiabetic**

The effect of an alcoholic extract of \(A.\ lanata\) was evaluated and the extract was found to reduce the increase of blood sugar in alloxan induced diabetic rats (42% at 375 mg/ kg and 48% at 500 mg/kg body weight). Chronic administration of the extract significantly \((P<0.001)\) reduced the blood sugar for 2 weeks, prevented a decrease in body weight and reduced the lipid peroxides in alloxan induced diabetic rats\(^54\). The alcoholic extract of leaves on serum glucose levels and on the oral glucose tolerance test (OGTT) in alloxan induced diabetic mice was evaluated and the extracts at the dose (100, 200 and 400 mg/kg) and glyburide (10 mg/kg) were administered orally in alloxan (70 mg/kg i.v) induced diabetic mice significantly reduced serum glucose levels at 2, 4, 6 h after administration. The onset of antihyperglycaemic effect of alcoholic extract (400 mg/kg) was at 4 h, the peak effect was at 6 h but the effect waned at 24 h. In the OGTT, the extract at the dose (400 mg/kg) increased the glucose threshold at 60 min after the administration of glucose and showed more antihyperglycaemic activity than extract at the dose (100 and 200 mg/kg)\(^55\). Preliminary phytochemical analysis indicated that the leaf extract contains sterols, glycosides, flavonoids, carbohydrates and tannins. Flavonoids are reported to regenerate the damaged \(\beta\)-cells in alloxan diabetic rats\(^53,56\).

**Antimicrobial**

The whole plant showed significant antimicrobial activities against Gram positive and Gram negative organism and the activity is due to the presence of steroids, terpenes and flavonoids in ethyl acetate extracts and steroids and glycosides in the methanol extracts\(^57\). In vitro studies show that 80% of ethanolic extract of the leaves and stem did not show any inhibition against *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis* and *Staphylococcus aureus*\(^58\). The aqueous extract of the leaves was found devoid of any antibacterial activity against alkali genes *Viscomactis*, *Aeromonas hydrophilla*, *Cytophaga sp.*, *Klebsiella aerogenes*, *Vibrio parahaemolytica*, *Vibdansela*, *Bacillus cereus*, *Streptococcus pyrogenes*, *Escherichia coli* and *Pseudomonas aeruginosa*\(^59\).

**Antifungal**

The whole plant possesses significant antifungal activities against the fungi like, *Aspergillus fumigatus*, *A. niger*, *Candida albicans*, *Hensinela californica* and *Rhizopus oligosporum*. Among the extracts the ethyl acetate and methanol extracts showed interesting antifungal activities against the standard Clotrimazole. The activity is due to the presence of steroids, terpenes and flavonoids in ethyl acetate extracts and steroids and glycosides in the methanol extracts\(^57\).

**Antitumour**

The partially TLC purified fraction (PEF) of petroleum ether extract at the dose of 50 \(\mu\)g/ml was proved to be more cytotoxic since PEF produced 100% cell death in Dalton’s Lymphoma Ascites (DLA) cell lines, 80% cell death in Ehrlich ascites (EA) cell lines and 75% cell death in B16F10 cell lines and also the intramuscular administration of PEF 24 h after cell line injection considerably reduced the tumour volume in mice\(^60\). It was found that the activity is due to the presence of alkaloids like canthin-6-one and \(\beta\)-carboline in \(A.\ lanata\) which act on the mitotic stage of the cell by causing crystallization of microtubular protein and interfering with cell division\(^38\). Petroleum ether, ethylacetate and methanol extracts of the whole plant showed significant cytotoxic properties. The activity is due to presence of steroids and flavonoids in petroleum ether extract, steroids, terpenes and flavonoids in ethyl acetate extracts and steroids and glycosides in the methanol extracts\(^58\). The partially purified fraction of petroleum ether (PPF) showed significant cytotoxicity against Daltons Lymphoma Ascites tumour cell lines in vitro and showed increase in life span compared to normal animals. The lipid, haemoglobin and WBC levels were normal and low proliferation of tumour cells in peritoneal activity. Preliminary phytochemical
analysis showed the presence of alkaloids which indicate that the PPF contains non-toxic immunomodulatory compounds.61.

Conclusion
A. lanata is an interesting example of a plant, used in traditional medicine for many years and the reported phytochemical and pharmacological studies supports its traditional uses and proved to be useful for clinical studies and development of commercial drugs.

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