Aerva lanata: A review on phytochemistry and pharmacological aspects

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ABSTRACT

Aerva lanata (L.) A. L. Juss. ex Schultes. (Amaranthaceae) locally known as 'bui' is an erect or prostrate undershrub with a long tap-root and many wolly-tomentose branches, found in the wild, throughout India. In traditional medicine the plant is used in cough, strangury (slow to be and painful discharge of urine), headache and urolithiasis. The photochemical constituents present in the plant include alkaloids (ervine, methylervine, ervoside, aervine, methylaervine, aervoside, ervolanine, and aervolanine), flavanoids (kaempferol, quercetin, isorhamnetin, persinol, persinosides A and B), methyl grevillate, lupeol, lupeol acetate benzoic acid, β-sitosteryl acetate and tannic acid. Pharmacological studies reported diuretic, anti-inflammatory, hypoglycemic, anti-diabetic, antiparasitic, antimicrobial, hepoprotective, anti-urolithiasis, antiasthmatic, antifertility and hypolipidemic properties of *Aerva lanata*. This review article includes the detailed exploration of the morphology, phytochemistry, and pharmacological aspects of *Aerva lanata* in an attempt to provide a direction for further research.

Key words: Aerva lanata, ervine, ervoside, methylervine

INTRODUCTION

Aerva lanata Juss. (Amaranthaceae) locally known as 'bui' is an erect, prostrate undershrub and occurs throughout India as a common weed in fields and waste places. The plant is diuretic, used in lithiasis. The root is demulcent, diuretic, useful in strangury (slow to be and painful discharge of urine). The roots are used in the treatment of headache. The plant is regarded as a demulcent on the Malabar Coast.[1,2] It is valued for cough in Ceylon; also as a vermifuge for children. The Meena tribals of the Sawaimadhopur district of Rajasthan give orally the juice of the roots to patients of liver congestion, jaundice, biliousness and dyspepsia. They also give decoction of the whole plant to cure pneumonia, typhoid and other prolonged fevers.[3]

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Taxonomy

Kingdom: Plantae (Plants)
Sub-kingdom: Tracheobionta (Vascular plants)
Division: Magnoliophyta (Angiospermes, flowering plants)
Class: Magnoliopsida (Dicotylédones)
Subclass: Caryophyllidae
Order: Caryophyllales
Family: Amaranthaceae
Genus: Aerva
Species: *Aerva lanata* (L.) A. L. Juss. ex Schultes

Common name

Ayurvedic: Paashaanabheda, Gorakshaganjaa, Aadaanpaaki, Shatkabhedi
Bengali: Chaya
Rajasthani: Bhui
Sindhi: Bhui, Jari
Punjabi: Bui-kaltan
Hindi: Gorkhabundi, Kapurijadi
Marathi: Kapurmadhura, Kapurimadhuri, Kapurphuti, Kumra

Morphology

Herb, erect or prostrate with a long tap-root, branched from near the base; branches many, pubescent or wolly- tomentose, striate.

Leaves alternate, 2-2 x 1-1.6 cm on the main stem, 6-10 x 5-6 mm on the branches, elliptic or obovate, or subotbicular, obtuse or acute, entire, pubescent above, more or less white with cottony hairs beneath; petioles 3-6 mm long, often obscure.

Flowers greenish white, very small, sessile, often bisexual, in small dense subsessile axillary heads or spikes 6-13 mm long, often closely crowded and forming globose clusters; bracteoles 1.25 mm, long, membranous, broadly ovate, concave, apiculate. Perianth 1.5-1.25 mm long; sepals oblong, obtuse, sometimes apiculate, silky-hairy on the back. Utricle broadly ovoid, acute; stigmas two, seed 0.85 mm in diameter, smooth and polished, black.[1]

PHYTOCHEMISTRY

Alkaloids: Plant contains biological active canthin-6-one alkaloids such as 10-methoxy-canthin-6-one, 10-hydroxy-canthin-6-one, 10-O-β-D-glucopyranosyloxycanthin-6-one, 10-hydroxycanthin-6-one (ervine), 10-methoxycanthine-6-one (methylervine), 10-β-D-glucopyranosyloxycanthin-6-one (ervoside), aervine (10-hydroxycanthin-6-one), methylaervine (10-methoxycanthin-6-one) and aervoside (10-β-D-glucopyranosyloxycanthin-6-one). Plant also contains alkaloids like β-carboline-1 -propionic acid, 6-methoxy-β-carboline-1-propionic acid, 6-methoxy-β-carbolin-l-ylpropionic acid (ervolanine), and aervolanine (3-(6-methyoxy-β-carbolin-1-yl) propionic acid).[4-6]

Flavanoids

Aerva lanata is a rich source of flavanoids such as kaempferol, quercetin, isorhamnetin, isorhamnetin 3-O-β-[4-p-coumaroyl-α-rhamnosyl(1→6) galactoside and flavanone glucoside persinol, persinosides A and B, 5, 4'-hydroxy-3, 6, 7-trimethoxyflavone, 5-hydroxy-3, 6, 7, 4-tetramethoxyflavone, 5-hydroxy 2', 3,5',6,7-pentamethoxyl flavone, 3,3',5,7-trihydroxy-4'-methoxyflavone, apigenin 7-O-β-D- glucoside and 7-O-β-D-glucopyranoside.[7-9]

Miscellaneous phytoconstituents

Aerva lanata also contains methyl grevillate, lupeol, lupeol acetate benzoic acid, β-sitosteryl acetate and tannic acid.[10]

Nutritive content

Leaves of *Aerva lanata* were found to be high in carbohydrate (26.6 g/100g), crude protein (22.6 g/100g) and ash (31.2 g/100g). Mineral composition (mg/100g) revealed that the leaves were high in PO_4 (187), and moderately high in other minerals such as K (47.9), K (Poatssium) (39.4), Ca (Calcium) (51.7), Mg (Magnesium) (41.5), Zn (Zinc) (44.7), Fe (Ferrous) (11.0) and low in Mn (Manganese) (1.04).[[10]

PHARMACOLOGICAL STUDIES

Antimicrobial

Aerva lanata whole plant ethyl acetate and methanol extracts showed interesting antimicrobial activities against *Bacillus subtilis, Bacillus cereus, Staphylococcus aureus, Escherichia coli, Shigella dysenteriae, Shigella shiga, Shigella sonnei, Shigella flexneriae, Shigella boydii, Klebsiella, Aspergillus fumigatus, Aspergillus niger, Candida albicans, Hensinela californica and Rhizopus oligosporum* and petroleum ether, ethyl acetate and methanol extracts showed significant cytotoxic properties.[11]

Antiparasitic

The antiparasitic activity of the seed and leaf extracts of *Aerva lanata* were tested against a tapeworm and an earthworm, particularly the ethanolic extract proved to be better against tapeworms and earthworms than the Albendazole, which is used for treating parasite infections.[12]

Diuretic and anti-urolithiasis

The alcoholic extract of *Aerva lanata* was tested for diuretic activity. The study indicated that the alcoholic extract at a dose of 800 mg/kg acted as a diuretic, with respect to control. *Aerva lanata* aqueous suspension (2 g/kg body wt/dose/day for 28 days) to CaO_2 urolithic rats had reduced the oxalate-synthesizing enzymes, and diminished the markers of crystal deposition in the kidney. The results of the study confirmed that *Aerva lanata* can be used as a curative agent for urolithiasis.[13,14]

Acute renal failure

The ethanol extract of the entire plant of *Aerva lanata* was studied for its nephroprotective activity in cisplatin- and gentamicin-induced acute renal injury in albino rats of either sex. In the curative regimen, the extract at dose levels of 75, 150 and 300 mg/kg showed dose-dependent reduction in the elevated blood urea and serum creatinine and normalized the histopathological changes. In the gentamicin model the rats in the preventive regimen also showed good response to the ethanol extract at 300 mg/kg. The findings suggest that the ethanol extract of *Aerva 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.[15]

Antiasthmatic

The ethanolic extract of the aerial parts of *Aerva lanata* showed antiasthematic at 100 μg/ml in the isolated goat tracheal chain preparation. When administered orally 30 and 60 mg/kg of extract demonstrated antiastmatic activity against clonidine -induced catalepsy and it also inhibits mast cell degranulation in mice.[16]

Antifertility activity

The ethanolic extract of the aerial parts of *Aerva lanata* were evaluated for antifertility activity using anti-implantation, abortificient, and motility of rat spermatozoa (*in vitro*) models. The anti-implantation effect seems to be dependent on the dose as well as the initiation of treatment on specific days of pregnancy. *Aerva lanata* has shown pre-implantation loss of 20% and 30% against control at the dose of 200 and 400 mg/kg b/w, respectively. Percentage pregnancy failure among the treated groups was 30% and 40% at the dose of 200 and 400 mg/kg b/w, respectively. *Aerva lanata* at a concentration of 10% showed no motility of rat spermatozoa within 60 sec.[17]

Anti-hyperglycemic and anti-diabetic

In the oral glucose tolerance test, *Aerva lanata* (400 mg/kg) increased the glucose threshold at 60 min after the administration

of glucose. The alcoholic extract of *Aerva lanata* was found to reduce the increased blood sugar level of alloxan-induced diabetic rats (42% at 375 mg/kg and 48% at 500 mg/kg body weight). *Aerva lanata* (400 mg/kg) treatment prevented a diabetic mice weight loss in. In the subacute study, repeated administration (once a day for 28 days) of glyburide and *Aerva lanata* caused a significant reduction in the serum glucose level as compared to the vehicle-treated group.[18,19]

Hypolipidemic

The hypolipidemic activity of *Aerva lanata* was assessed on ethylene glycol-induced calcium oxalate urolithic rats. Total lipids, total cholesterol and triglyceride levels were significantly increased in the serum, liver and kidney of calcium oxalate urolithic rats. Besides, phospholipids (PL), high-density lipoproteins (HDL), low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL) levels were altered in calcium oxalate urolithic rats. On supplementation of *Aerva lanata* aqueous suspension, the above changes were reverted to near normal. These results indicate that the *Aerva lanata* aqueous suspension acts as a hypolipidemic agent in calcium oxalate urolithiasis.[20]

Hepatoprotective

Petroleum ether extractable fraction of the whole plant *Aerva lanata* was evaluated for the protective effect against liver damage induced by carbon tetra chloride (CCl_4) in Sprague Dawley rats. *Aerva lanata* administration significantly reversed the histopathological changes, reduced hepatic lipid peroxidation and increased the serum total protein and albumin/globulin (A/G) ratio.[21]

Immunomodulatory and antitumor

Petroleum ether extract of *Aerva lanata* showed significant cytotoxicity against Daltons lymphoma ascites (DLA) tumor cell lines *in vitro* and stimulated lymphocyte proliferation in *in vitro* and *in vivo* conditions. DLA-bearing animals when treated with *A. lanata* showed increase in lifespan compared to control animals. Partially purified fraction was also found to be hepatoprotective as evidenced from the normal levels of liver marker enzymes compared to the elevated levels of these enzymes in DLA alone inoculated animals.

The partially thin layer chromatography-purified fraction of the petroleum ether extract of *Aerva lanata* proved to be cytotoxic to DLA, Ehrlich ascites (EA) and B16F10 cell lines *in vitro*. Since partially TLC-purified fraction was found to be more cytotoxic to DLA cell lines, it was used to study the pharmacological effect and its potential to reduce solid tumor induced by DLA cell lines in mice.[22,23]

Anti-diarrheal

Ethanolic and aqueous extracts of *Aerva lanata* and *A. javanica* were screened for anti-diarrheal activity. All the extracts showed significant anti-diarrheal activity in charcoal meal test. reduction of the intestinal transit is suggested as mechanism of action.[24]

CONCLUSION

Aerva lanata has been ethnomedicinally used as a therapeutic agent for a variety of diseases.[25-28] Moreover, numerous research works have proven its uses beyond the ethnomedicinal ones in experimental animals.[29] Alkaloids and flavonoids which were isolated from this plant may be responsible for its pharmacological activities. The road ahead is to establish specific bioactive molecules, which might be responsible for these actions. Therefore the cultivation, collection, and further pharmacological exploration of *Aerva lanata* are essential.

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