Chapter 2
Chapter 2 Literature survey

Scientific literature is the collection of research information and as such, serves as the reservoir of knowledge about a subject. The literature codifies the subject material, maintains a historical record on experimental trials, and aids in problem solving through education and communication about facts and ideas. A close examination of the literature indicates the amount of research on most herbs, spices and medicinal plants remains quite limited. This relatively low average number of published research papers must be viewed with caution, of course, as great variation in economic value and commercial use exists. As the scientific literature on the herbs, spices and medicinal plants develops, more exchange of information should occur, helping to advance the science of these plants. Modern research on herbs, spices and medicinal plants has expanded to study a wide variety of tropical areas connected to botany, horticulture and pharmacology of these plants. With this increased interest in herbs, spices, and medicinal plants, professionals and field specialists associated with trade, horticulture and chemistry have made an ever-increasing demand for recent and accurate information on plant culture, its Pharmacognosy and Pharmacology.

2.1 Plant profile

Introduction to genus Aerva, Family: Amaranthaceae

The Amaranthaceae, a comparatively small family, comprising 65 genera and 850 species was mostly found in tropical and temperate regions. Fairly good number of its representatives is found in India and they include about fifty species. The family is abundant in America and tropical Africa. The common Indian genera include (Dhami et al., 1996).

1) Achyranthes aspera

2) Aerva lanata and Aerva tomentosa

3) Alternanthera sessis

4) Celoisa argentea

5) Cyathula tomentosa

6) Deeringia amaranthoides
7) *Gomphrena globosa*

8) *Bosia amhersiana* and

9) *Pupalia lappacea*

*Aerva* is a genus of erect, prostrate, or climbing herbs or under shrubs, which is distributed in temperate and tropical Africa and Asia. Three species are reported from India. They are

1. *Aerva lanata*

2. *Aerva tomentosa*

3. *Aerva sanguinolenta*

*Aerva lanata* is officially recognized in Indian medical literature (Chopra *et al.*, 1956)

### 2.2 Taxonomical name

*Aerva lanata* (Linn) Juss

Family: Amaranthaceae

### 2.3 Synonym

*Aerva floribunda* Wight.

### 2.4 Vernacular names (Guha Bakshi *et al.*, 1999)

<table>
<thead>
<tr>
<th>Language</th>
<th>Vernacular Names</th>
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<tbody>
<tr>
<td>Tamil</td>
<td>Sirupulai, Cerupulai</td>
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<td>Bhadra</td>
</tr>
<tr>
<td>Hindi</td>
<td>Astmabayda, Gorakhganja</td>
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<tr>
<td>Punjabi</td>
<td>Buikallan</td>
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<tr>
<td>Oriya</td>
<td>Paunsia</td>
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</tbody>
</table>

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2.5 Distribution

Plant is distributed throughout tropical India as a common weed in fields and is also found to be growing in Arabia, Tropical Africa, Srilanka, Phillipines and Java (Guha Bakshi, 1984). *Aerva lanata* is an erect or prostrate herbaceous common weed found at waste places (David, 1963) in the hotter parts of India almost all over the plains up to an altitude of 3000 m. In India it is especially found in the states of Punjab, Uttar Pradesh, Tamil Nadu, Andhra Pradesh and Karnataka.

2.6 General morphology

*Aerva lanata* is an erect or prostate herb with a long tap root which is branched from near the base.

Branches: are many, terate, pubescent or woolly tomentose, striate 30 – 60 cm in height.

Leaves: simple, alternate, 2 – 2.5 by 1 – 1.6 cm on the main stem, 6 – 10 by 5 – 6 mm on the branches, elliptical or obviate or sub orbicular shape, small petioled, obtuse or acute, entire pubescent above more or less white with cottony hairs beneath.

Petioles: 3 – 6mm long, often obscure. Usually smaller in the flowering branches.

Flowers: greenish white, very small, sessile, often bisexual in small dense sub sessile auxiliary heads or spikes 6 – 12mm long, often closely crowded and forming globose clusters, filaments of the five stamens connect at the base with alternating linear staminodes.

Bracteoles: 1.25 mm long, membranous, broadly ovate, concave, apiculate.

Perianth: 1.25 – 1.5 mm long.

Sepals: oblong, obtuse, sometimes apiculate; silky hairy on the back. Utricle broadly ovoid, acute, stigmas.

Fruits: ovoid, acute, greenish, compressed utricle.

Seeds: black, 0.85mm diam., smooth, polished (Warrier, 1994).
2.7 Ethno medical uses

In the Traditional System of Medicine, the plant is being used as diuretic and anthelmintic (Gupta and Neeraj, 2004; Chopra et al., 1956; Sankaran et al., 1995; Das, 1995; Tripathi et al., 1996), anti diabetic, expectorant and in the treatment of lithiasis (Chopra et al., 1956; Anonymous, 1985). The plant is used for arresting haemorrhage during pregnancy (Yoga Narasimhan et al., 1979), burn healing (Upadhay et al., 1998), as an anti-inflammatory, headache, skin diseases (Singh and Pandey, 1980), to dissolve kidney and gall bladder stones (Chetty and Rao, 1989; Vedavathy and Rao, 1990; Sudhakar and Chetty, 1998), for uterus clearance after delivery and to prevent lactation (John, 1984). The plant extract is used to treat nasal bleeding, cough, scorpion stings, fractures and spermatorrhoea (Mukerjee et al., 1984; Sikarwar and Kaushik, 1993; Girach, 1994). The flowers are used in dysentery, diarrhoea and Bronchitis (Sudhakar and Chetty, 1998; Shah and Gopal, 1985). The seeds find use in rheumatism (Singh and Pandey, 1980) and bronchitis (Mukerjee et al., 1984). The leaves are used as anti malarial (Singh and Singh, 1992; Ahmad, 1995), fever (Dagar and Dagar, 1991) and to expel stones from kidney (Vijaya kumar and Pullaiyah, 1998) and also as an antidote for scorpion sting, spermaorrhoea (Sikarwar and Kaushik, 1993), urinary troubles (Hemadri et al., 1980) and as an antirheumatic (Kakrani and Saluja, 1994). The roots were used in headache, scabies, cough (Bedi, 1978; Raj and Patel, 1978; Singh, 1993), as demulcent, diuretic (Tripathi et al., 1996; Yoga Narasimhan et al., 1979; Kapoor and Kapoor, 1980), to cure diarrhoea jaundice (Mohanty et al., 1996), cholera, dysentery (Sahoo and Mudkal, 1993) and in snake bite (Joshi, 2007).

2.8 Pharmacological activities reported

2.8.1 Diuretic activity

The aqueous alcoholic extracts of *Aerva lanata* leaf, stem and root are having significant diuretic activity on albino rats. The test extracts of stem, root and leaf were given in the dose of 1600 mg/kg body weight. Sodium (Na⁺) output in urine was markedly increased in case if 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
The activity may be due to presence of mineral salts, different types of sugars, flavanoids which are present in the plant. The alcoholic extract of *Aerva lanata* was tested for diuretic activity in albino rats. The parameters measured for diuretic activity were total urine volume, sodium, potassium and chloride content. The result clearly indicates that the alcoholic extract at the dose of 800 mg/ kg act as diuretic with respect to control (Vetrichelvan *et al.*, 2000).

### 2.8.2 Hepatoprotective activity

Hepatoprotective activity was studied on the aqueous alcoholic extracts of leaf and root 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 hepato protective activity may be due to poly phenolic compounds, tannins, vitamin C etc which are reported to be present in the herb (Majmudar *et al.*, 1999). Partially purified petroleum ether extractable fraction of the whole plant *Aerva lanata* had protective effect against liver damage induced by carbon tetra chloride in Sprague Dawley rats. The extracts were administered at the dose of 50 mg/ kg body weight and 100 mg/ kg body weight for 14 days. The petroleum ether fraction of *Aerva lanata* 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 per oxidation and the serum total protein and albumin/ globulin ratio. Preliminary phytochemical analysis of petroleum ether fraction showed the presence of alkaloids (Nevin and Vijayammal, 2005).

The hepatoprotective activity of hydro alcoholic extract of *Aerva lanata* were evaluated against paracetamol induced liver damage in rats. The hydro alcoholic extract of *Aerva lanata* 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 (Manoharan *et al.*, 2008).
2.8.3 Lithiatic activity

Administration of *Aerva lanata* aqueous suspension (2 g/ kg b. wt.) for 28 days to calcium oxalate 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 (Soundararajan *et al.*, 2006). Administration of *Aerva lanata* (3.0 mg/ kg b. wt.) and Vediuppu chunnam(3.5 mg/kg b. wt.) orally for 28 days increased the urinary excretion of calcium, oxalate, uric acid, phosphorus, protein and decreased magnesium excretion in hyperoxaluric rats (Selvam *et al.*, 2001). The hypolipidemic activity of *Aerva 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 *Aerva lanata* treated group and also the phospholipids level was diminished in liver and kidney (Soundararajan *et al.*, 2007).

2.8.4 Anti inflammatory activity

The anti-inflammatory activity was evaluated in benzene and alcoholic extracts of *Aerva lanata* by carageenan induced rat hind paw oedema method. Alcoholic extract (800 mg/ kg) produced inhibition of carageenan induced rat paw oedema (p < 0.05) (Vetrichelvan *et al.*, 2000).

2.8.5 Nephroprotective activity

The ethanol extract of the entire plant of *Aerva lanata* 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 *Aerva lanata* possessed 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 (Shirwaikar *et al.*, 2004).
2.8.6 Antidiabetic activity

The effect of an alcoholic extract of *Aerva 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 (Vetrichelvan and Jegadeesan, 2002). The alcoholic extract of *Aerva lanata* 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) are administered orally in alloxan (70 mg/ kg i.v) significantly reduced serum glucose levels at 2, 4, 6 hr after administration. The onset of anti-hyperglycaemic effect of alcoholic extract of *Aerva lanata* (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 anti hyperglycaemic activity than extract at the dose (100 and 200 mg/ kg) (Deshmukh et al., 2008). Preliminary phytochemical analysis indicated that the leaf extract of *Aerva lanata* contain sterols, glycosides, flavanoids, carbohydrates and tannins. Flavanoids regenerate the damaged β- cells in alloxan diabetic rats (Shirwaikar et al., 2004; Chakravarthy et al., 1980).

2.8.7 Anti microbial activity

The whole plant of *Aerva lanata* showed significant antimicrobial activities against Gram-positive and Gram- negative organism and the activity is due to the presence of steroids, terpenes and flavanoids in ethyl acetate extracts and steroids and glycosides in the methanol extracts (Chowdhury et al., 2000). *Invitro* 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* (Valsaraj et al., 1997). The aqueous extract of the leaves was found devoid of any anti- bacterial activity against alkali genes *Viscolactis*, *Aeromonas hydrophilla*, *Cytophaga sp*, *Klebsiella*
aerogenes, Vibrio parahaemolytica, Vibdamsela, Bacillus cerus, Streptococcus pyrogenes, Escherichia coli and Pseudomonas aeruginosa (Perumal Samy et al., 1999).

### 2.8.8 Antifungal activity

The whole plant of *Aerva lanata* showed significant antifungal activities against the fungi like *Aspergillus fumigatus*, *Aspergillus 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 flavanoids in ethyl acetate extracts and steroids and glycosides in the methanol extracts (Chowdhury et al., 2000).

### 2.8.9 Anti tumor activity

The partially TLC purified fraction of petroleum ether extract (PEF) at the dose of 50 µg/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 hours after cell line injection considerably reduced the tumor volume in mice (Nevin and Vijayammal, 2003). They found that the activity is due to the presence of alkaloids like canthin 6–one and β–carboline in *Aerva lanata* which act on the mitotic stage of the cell by causing crystallisation of micro tubular protein and interfering with cell division (Zapesochnaya et al., 1992). Petroleum ether, ethyl acetate and methanol extracts of the whole plant of *Aerva lanata* showed significant cytotoxic properties. The activity is due to presence of steroids and flavanoids in petroleum ether extract, steroids, terpenes and flavanoids in ethyl acetate extracts and steroids and glycosides in the methanol extracts (Chowdhury et al., 2000). The partially purified fraction of petroleum ether (PPF) showed significant cytotoxicity against Daltons Lymphoma ascites (DLA) 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 tumor cells in peritoneal activity. Preliminary phytochemical analysis showed the presence of alkaloids which indicate that the partially
purified fraction of petroleum ether contains non toxic immunomodulatory compounds (Nevin and Vijayammal, 2006).

2.9 Chemical constituents isolated

The *Aerva lanata* plant has many medicinal properties due to the presence of numerous secondary metabolites. Some of the chemical constituents isolated from *Aerva lanata* Linn Juss are β – sitosteryl palmitate, hentriacontane, β – sitosterol and its D – glucoside, α – amyrin and betulin from the whole plant (Aiyar *et al*., 1973; Chandra and Sastry, 1990). The glycosides like kaempferol 3- rhamnogalactoside and kaempferol 3 – (6” p- coumaryl) O – glucoside along with alkaloids, saponins (Chandra *et al*., 1990) and sugar like fructose, galactose, rhamnose and sucrose and also minerals were reported to occur in the plant (Afaq *et al*., 1991). O - acyl glycosides, isorhamnetin 3 – (6”- p- coumaryl) O – glucoside, β – sitosterol, daucosterol, syringic acid, vanillic acid, feruloyl tyramine, feruloyl homo vanillylamine, narcissin and aervitrine were isolated from the aerial part of *Aerva lanata* (Yuldashev *et al*., 2002). Alkaloids like canthin 6 – one and 3 – β-carboline 1- yl propionic acid, 10 – methoxy canthin 6 – one(Methyl- aervine), 10 – hydroxyl – canthin 6 – one (Aervine), 10 – O- β- D – glucopyranosyl oxycanthin 6 – one (Aervoside), 6 – methoxy β carboline 1 – propionic acid (Aervolanine) from the whole plant of *Aerva lanata* (Zapesochnaya *et al*., 1992; Zapesochnaya *et al*., 1991) and flavanoids like tiliroside, coumaryl tiliroside, isorhamnetin glycoside (Pervykh *et al*., 1992) were isolated. Flowering and fruiting parts of the plant contain polysaccharides like starch, hemicelluloses and also monosaccharides like galactose, glucose, mannose, xylose, arabinose and rhamnose (Mallabev *et al*., 1989).β – sitosterol, its palmitate and α- amyrin were isolated from the heartwood of the plant (Ram P Rastogi and Mehrotra, 1970-79). From the Egyptian plant campesterol and chrysin were isolated and monosaccharide content of polysaccharides determined (Ram P Rastogi and Mehrotra BN, 1980-84). Presence of phytoecdysteroids in the herb *Aerva lanata* was studied (Baltaev *et al*., 1992).
2.10 Justification for inclusion in the study

Medicinal value of the plants is generally determined by the presence of biologically active compounds. Such phytocompounds have been characterized as flavonoids, alkaloids, tannins, terpenoids and so on. Standardization of herbal drugs is an important task. The major problems faced by users are non-availability of rigid quality control profile. Proper identification and standardization is a primary condition. *Aerva lanata* Linn Juss has been used in traditional and folklore medicine for the treatment of diabetes, cancer and anthelmintic activity. An attempt have been made to isolate new compounds from aerial parts of *Aerva lanata* Linn Juss and systematic screening of the extracts may result in the discovery of novel and effective compounds. The literature survey revealed that *Aerva lanata* Linn Juss is not much scientifically explored for its folklore claims and phytochemical constituents. Hence in this study, we had investigated the phytochemical characterization of the active principle of *Aerva lanata* Linn Juss and the application of its crude extracts in various pharmacological activities, selected on the basis of ethno pharmacological lead and literature survey.
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