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A review on *Aerva lanata*: An herbal medicine

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Abstract
Plants have been an incredible reservoir of remedy for multitudinous of times. It has been recognized by researchers as an ancient form of medicine to cure common population. About four billion population of the world, i.e., 80% of the total world population presently use the traditional system of medicine or herbal drugs for primary health care. In India, > 65% of the total population use herbal medicinal products for the treatment of diseases. Over the eras, many plant species have been investigated for possible medical applications. It has been trusted in all cultures and communities throughout the world due to their lesser side effects, higher safety and efficacy against health illness. *Aerva* plants are known widely for their exceptional medicinal uses. They have been employed conventionally for their medicinal properties by the common folk in several regions of the world. This indicates the efficacy of these remarkable herbs. They are also known for their multiple biological activities such as anti-oxidant, anti-bacterial, anti-lithiatic, Hepato protective, anti-diabetic, anti-cancer, anti-hyper lipidemic and nephro protective potential. These pharmacological actions are associated with the presence of valuable nutrients and biochemical compounds such as sterols/terpenes, flavonoids, alkaloids, phenolics and sugars. This review article includes the detailed exploration of the morphology, phyto chemistry and pharmacological aspects of *Aerva lanata* in an attempt to provide a direction for further research.

Keywords: *aerva lanata*, anti-lithiatic, aervine, phytochemicals, anti-neurotoxicity

Introduction
Herb is an immeasurable wealth of nature not only from the global environmental perspective but also from the medicinal point of view. It plays a significant role in ameliorating the disease resistant ability and combating against various unfavourable metabolic activities within the living system. Ayurveda, the ancient healing system of India, grow luxuriantly from the Vedic period in India. In history, the classical texts of Ayurveda like Charaka Samhita and Sushruta Samhita were written around 1000 BC. Medicinal plants were applied for the treatment various diseases throughout the world. Medicinal plants contain various ranges of chemical molecules with pharmacological applications. In recent years, botanists, ethno pharmacologist and natural-product chemist are analyzing the available medicinal plants for extracting various phytochemicals in the light of emerging various drug-resistance fungi and bacteria. More than 1000 bioactive principles have been identified from various medicinal plants and are referred to as phytochemicals. The most important of these bioactive constituents of plants are alkaloids, tannins, flavonoids, steroids, terpenoids, glycosides and phenolic compounds [1, 2]. These phytochemicals are responsible for various bioactive potentials. Anti-microbial activities of medicinal plants formed on the basis for their application in developing various drugs, alternative to various synthetic drugs. Infectious diseases are the important cause of death among populations. About 70% of hospital deaths are mainly due to various infectious diseases caused by bacteria, fungi or viruses [3, 4].
The proper utilization of the substances obtained from these plants can enhance the finesse of the capabilities of these plants. These plants are not only medicinally important but are significantly serving several other scientific purposes. In the prospect of medicinal, scientific uses and the bioavailability of precious chemicals of *Aerva* species, a comprehensive review is compiled, which focuses on the detailed profile of biochemical compounds, pharmacological functions and biological activities of *Aerva* plants [5].

Habitat
Aerva lanata is distributed throughout the plains of tropical India as a common weed, which grows wild on the mountain slopes, fields and bare patches of ground up to an altitude, 900m in the hills and a native of Asia, Africa and Australia [6].

Table 1: Vernacular names

Ayurvedic	Paashaanabheda, Gorakshaganjaa, Aadaanpaaki, Shatkabhedi
Telugu	Pindiconda, Pindicettu
Hindi	Gorakhganja, Kapurijadi
Tamil	Sirupulai, Cerupulai
Bengali	Chaya
Gujarati	Gorakhaganjo
Sanskrit	Bhadra
Marathi	Kapurmadhura, Kapurimadhuri, Kapurphuti, Kumra
Panjabi	Bui-kallan
Kannada	Bilihindisoppu
Oriya	Paunsia
Malayalam	Cherula
Rajasthani	Bhui

Table 2: Taxonomical classification

Kingdom	Plantae - Plants
Subkingdom	Viridiplantae - Green plants
Infrakingdom	Streptophyta - Land plants
Super division	Embryophyta
Division	Tracheophyta - Vascular plants
Subdivision	Spermatophytina - Seed plants
Class	Magnoliopsida
Superorder	Caryophyllanae
Order	Caryophyllales
Family	Amaranthaceae - Pigweed, amaranthes
Genus	*Aerva*
Species	*A. lanata*
Binomial name	*Aerva lanata* (L.) Juss. Ex Schult.

Fig 1: Aerva lanata leaves

Fig 2: *Aerva lanata* flower

Fig 3: Aerva lanata plant

Botanical description

It is an erect or prostrate dioecious herb which grows up to 80cm in height with cylindrical and branched tap root with a length of 7-2cm and thickness of 2-8mm with numerous fibrous lateral roots possessing a camp horaceous odour, yellowish brown from outer side and whitish from inner side. It is branched at the base with the branches being pubescent or woolly-tomentose, striate. Shoots are covered with smooth hairs. Leaves are simple and alternate with lamina being elliptic or obovate or sub orbicular, along with obtuse or acute apex and tapering base and have white cottony hairs underneath. The inflorescence consists of axillary heads or spikes. Flowers are bisexual, small, sessile, greenish white with spikes. Perianth is 1.5-1.25mm in length and petals are silky-hairy on the back, oblong and obtuse and the fruit is ovoid in shape with shining black and kidney bean like seed [7].

Traditional uses

The plant is used for arresting hemorrhage during pregnancy burn healing, as an anti-inflammatory, headache, skin disease, 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 sting, fractures and spermatorrhoea. *Aerva lanata* serves as a purpose of anthelmintic and medication that soothes inflamed and injured skin. The people of Bihar use the plant as a treatment of diarrhea, cholera and dysentery. The roots also used for diuretic and demulcent, and are credit with tonic properties [8].

Cultivation

The cultivation of *Aerva lanata* is by seed propagation. Each plant is planted with the space of 30cm in a row. Sun light is needed for the growth of the plant. These plants are cultivated during September month. First year of cultivation it will flower. To prevent attacking of foreign substances like microorganism, weed, insect etc. during the cultivation inorganic, organic and synthetic fertilizers are used. Animal waste, plant waste (organic fertilizers), cow dung are also used. Peat improve the absorbing properties of the plant other than this have no nutritional value [9].

Microscopic properties

The leaves consist of anomocytic stomata with the epidermal cells being smooth and curved and a vein termination number of 6-7. It shows the presence of multicellular uniseriate warty trichomes, rosette type calcium oxalate crystals (sphaeraphides), starch grains and rhomboidal crystals of calcium oxalate as evidenced from the powder study of the plant. The leaf shows the presence of isodiametric cells in the upper and lower epidermis, rectilinear cell walls, conic multicellular hairs in the indumentum, unsubmerged stomata of anomocytic and hemiparasitic nature, dorsoventral mesophyll, palisade cells, spongy parenchyma with chlorophyll, conducting bundles and 8-10 radial chains of vessels.

Uniseriate trichomes having spiculated surface, multi articulate and tapering at the end are also found in the leaves. The transverse section of the roots contain 5-7 rows of cork cells with secondary cortex showing the presence of thin walled parenchymatous cells containing rosette crystals of calcium oxalate, 3-4 alternating rings of secondary xylem and phloem with pitted vessels, circular pith cells with rosette crystals of calcium oxalate. Powdered roots show the presence of lignified and non-lignified cylindrical

fibers, lignified xylem vessels having bordered pits, calcium oxalate crystals, simple, oval or rounded starch grains, trichosclereid, cork cells, parenchyma cells and secondary phloem. The stem shows the presence of thick-walled and small-celled epidermis, thick-walled collenchyma cells below the epidermis, cortex consisting of parenchyma, groups of pericyclic fibres, primary xylem vessels, and radial chains of secondary xylem vessels, resin ducts, and small rounded cells in the medulla [10-13].

Growth and propagation

Propagation is done through seeds. Thidiazuron is an efficient growth regulator for promoting shoot proliferation and adventitious shoot regeneration from leaf explants of *A. lanata* helps for micropropagation of this plant. *In-vitro* shoot culture was attained from the seeds of *A. lanata* with α-Naphthalene acetic acid; Indole-3-butyric acid, Indole-3-acetic acid in different concentration could provide optimum callus and multiple shoot initiation from leaf explants. Application of inorganic fertilizer and plants planted in 30cm spaced rows gave high dry matter yields. Adequate sunlight was essential for higher yields and reduced light affected dry matter yields. Shade and age affected the composition of plant parts and those harvested at 140 days after planting contained more stems and flowers, and less leaves [14, 15].

Phytochemical constituents

Aerva lanata is loaded with a diverse range of phytoconstituents. Phytochemical screening showed the presence of numerous classes of phytochemicals such as alkaloids, steroids, flavonoids, tannins, amino acids and proteins, carbohydrates, cardiac glycosides, saponins and terpenoids. The four different flavonols identified were quercetin, kaempferol, 4'-methoxy kaempferol and 4',7-dimethoxy kaempferol. It also revealed the presence of phenolic acids such as vanillic acid, syringic acid, *p*-hydroxy benzoic acid, *p*-coumaric acid, ferulic acid and melilotic acid and the betacyanin named betanin was also identified. Isorhamnetin-3-O-β-D-glucoside and narcissin were isolated from the ground and air-dried material. The FTIR analysis of the roots, stems, leaves and flowers showed the presence of various functional groups such as amide, alcohols, aldehydes, carboxylic acids, nitro compounds, ethers, amines, phenols, alkyl halides, ethers, etc. thus indicating the diversity of the chemical constituents in it. It also contains phytoecdysteroids and water soluble polysaccharides, an acid polysaccharide, starch and hemi celluloses were isolated from the leaves and flower heads. The leaves are a reservoir of minerals such as K, Na, Ca, Mg, Zn, Fe, Mn. Canthin-6-one alkaloids such as 10-methoxycanthin-6-one, aervine, methergine, aervoside and β-carboline alkaloids such as 3-β-carbolin-1-yl-propionic acid, aervolanine have also been isolated from the herb. Other alkaloids isolated are canthin-6-one alkaloids such as ervine, methylervine, ervoside and β-carboline alkaloid ervolanine. And β-sitosterol, daucosterol, ferulo yltyramine, feruloyl vanillylamine have been found in the plant. The whole plant also contains essential trace elements such as calcium, silicon, magnesium, potassium, chloride, carbon, oxygen. The roots possess good amount of gallic acid as shown in ethanolic extract by HPTLC analysis. Phytochemical screening of the roots extract also revealed the presence of quinones, phenols, triterpenoids, phytosterols and phlobatannins. Aqueous extract of the stem showed the presence of 3, 4, 5-OH (gallic acid), apigenin-7-O-glucoside (apigetrin), quercetin-3-O-rutinoside (rutin) and 3, 5, 7, 3, 4, 5-OH (myricetin) when analysed by HPLC. The white and yellow coloured variants of *Aerva lanata* werefound to contain methoxy kaempferol, total chlorophyll content, chlorophyll a and chlorophyll b. The GC-MS analysis of leaves, stems, roots, flowers and seeds displayed a plethora of compounds such as pyridine, hydroquinone monobenzyl ether, docosane, dotriacontane, (R,Z)-12-hydroxy-9- octadecenoic acid, 2-isopropyl 2,5-dihydrofuran and a vast range of other compounds [16-21].

Miscellaneous phytoconstituents: *Aerva lanata* also contains methyl grevillate, lupeol, lupeol acetate benzoic acid, β-sitosterol acetate and tannic acid [21].

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) [21].

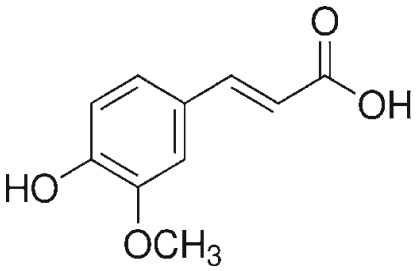

Fig 4: Chemical structure of ferulic acid

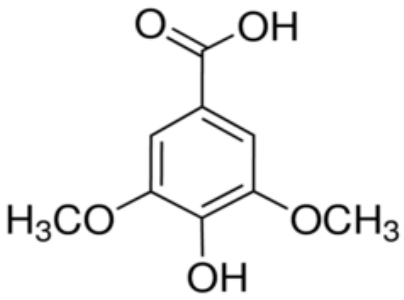

Fig 5: Chemical structure of syringic acid

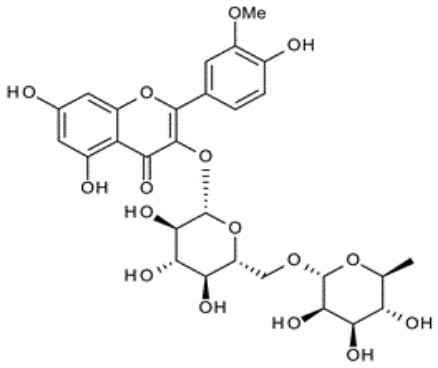

Fig 6: Chemical structure of narcissi

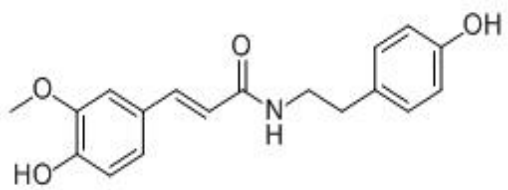

Fig 7: Chemical structure of feruloyl tyramine

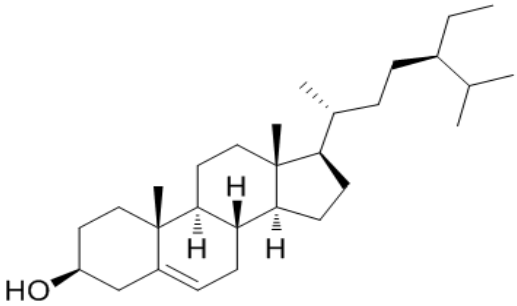

Fig 8: Chemical structure of β-sitosterol

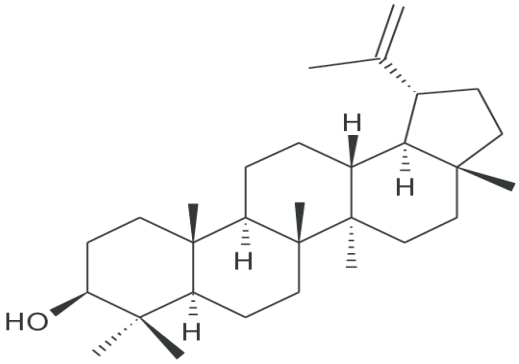

Fig 9: Chemical structure of lupeol

Pharmacological value

The plant is known to possess various biological and pharmacological activities and the various active compounds responsible for the activities are specified in Table 4.

Anti-urolithiatic activity: Urolithiasis is the stone formation in the urinary bladder or in urinary tract. It is common in age of 20-40 in both male and female. The suspension used to reduce oxalate synthesizing enzyme. The aerial part of aqueous extract of *Aerva lanata* shows urolithiasis activity, the dose usually 2g/kg. Different *in-vivo* and *in-vitro* methods are used. *In-vitro* used to study the renal stone formation and prophylactic management and *in-vivo* used to detect the pathological effect. Calcium oxalate stone is detected by 0.75% of ethylene glycol in water for 28 days. On 29th day for 28 days the suspension of *Aerva lanata* is treated with calcium oxalate rat. At the end of the experiment, found that the *Aerva lanata* suspension will not form free radical and the rat is protected from the renal cell injury [22].

Nephroprotective activity: The ethanolic extract showed nephro protective activity against mercuric chloride induced nephrotoxicity in male albino rats. A dose of 200 mg/kg and 400 mg/kg decreased the serum levels of urea, uric acid, creatinine, SGPT, SGOT, alkaline phosphatase and cholesterol whereas, the protein levels increased. There was also an increase in the vitamin C, glutathione content and antioxidant enzymes such as glutathione peroxidase, superoxide dismutase, catalase, glutathione S-transferase in the kidneys and livers of extract treated groups. This was further confirmed by histopathology of the liver and kidneys showing the absence of fatty infiltration, fatty degeneration and necrosis [23].

Anti-cancer and anti-tumor activity: The methanolic extract of the aerial parts were evaluated for its anticancer activity against Ehrlich Ascites Carcinoma (EAC) cells in Swiss albino mice. The various parameters checked were tumor weight measurement, survival time and tumor cell growth inhibition. Brine shrimp lethality bioassay was carried out to test the *in vitro* cytotoxicity and it exhibited moderate cytotoxic activity (LC50=23.06 µg/ml).A dose of 40 mg/kg/day (i.p) of the extract decreased the tumor weight, increased the life span and reduced the tumor cell growth rate compared to animals receiving no extract [24].

Hepatoprotective activity: Hydro alcoholic extract of *Aerva lanata* is used against para cetamol induced liver damage in rats. The hydro alcoholic extract of *Aerva lanata* (600 mg/kg) was administered orally to the animals with hepatotoxicity induced by para cetamol (3 gm/kg). Silymarin (25 mg/kg) was used as the standard. All the test drugs were administered orally by suspending in 0.5% carboxy methyl cellulose solution. The plant extract was effective in protecting the liver against the injury induced by para cetamol in rats. This is due to significant reduction in serum enzymes alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphates (ALP) and bilirubin [25].

Table 3: Ethno medicinal importance

Sl. No.	Pharmacological activity	Reference
1	Immuno modulatory activity	26
2	Anti-inflammatory, analgesic and anti-nociceptive activity	27,28
3	Anti-diarrhoeal activity	29
4	Anthelmintic activity	30
5	Anti-fertility activity	31
6	Anti-ulcer activity	32
7	Anti-asthmatic activity	33
8	Anti-HIV activity	34
9	Diuretic activity	35,36
10	Anti-oxidant activity	37,40
11	Anti-hyperglycaemic activity	38
12	Anti-bacterial activity	39
13	Anti-neurotoxicity	41

Plant tissue culture studies

An efficient procedure was set for large scale micropropagation and conservation of *Aerva lanata*. A complete regeneration of the plant was observed after successive subculture in L2 media. Callusing, shoot multiplication and rhizogenesis occurred when leaf segments and shoot tips were used as explants. The medium which was standardized to be most reasonable for maximum shooting and rooting were L2 media supplemented with 2,4-dichloro phenol xyacetic acid (2.5mg/L) and benzylamino purine (1.5 mg/L) and half strength L2 media with naphthalene acetic acid (2mg/L) respectively. An adequate and simple method was developed for using nodal explants for propagation of the plant. Multiple shoot induction through direct organogenesis was perfectly attained with an amalgamation of N6-benzyladenine and kinetin (3mg/L each) in Murashige and Skoog's medium.

Maximum shoots were generated through callus mediated organ oogenesis by supplementing the medium containing the ideal blend of N6-benzyladenine and kinetin with α- naphthalene acetic acid (1.0 or 1.5mg/L). The medium at half the strength containing indole butyric acid was used for rooting the shoots produced. A survival rate of 72 ± 4% was obtained, when the plantlets thus regenerated were implanted in the soil. An effective protocol for micro propagation of *Aerva lanata* was developed. Murashige and Skoog medium fortified with thidiazuron (0.25–2.0 mg L-1), sucrose (3 %) and agar (0.8 %) was employed for deriving *in vitro* plantlets whose leaf segments were used for regeneration. The medium containing thidiazuron (1.0mg L-1) produced the maximum shoot development which generated flowers *in-vitro* on a medium consisting of thidiazuron (1.0mg L-1) combined with α-naphthalene acetic acid (0.25-0.5 mg L-1). A high percentage of the regenerated shoots (86%) formed roots and plantlets when shoot lets were shifted to half strength MS medium with indole-3-butyric acid (1mg/L) [42,43].

Adulterants

The adulterant of *Aerva lanata* is *Aerva javanica juss* and no. of plant such as rhizome of Bergenia ciliata sternb, root of Did ymocarpus benth [44].

Toxicity

Oral administration of *A. lanata* ethanolic extract in mice was observed continuously for two hours and then occasionally for further four hours and finally overnight, showed neither any toxic effect nor any lethal effect in the dose range of 100 to 4000mg/kg. Administration of fresh and dried aqueous extract of *A. lanata* (18ml/kg) for a period of one month has no significant toxic effects over the structural and functional aspect of urinary tract of rats [44, 45].

Conclusion

Recently medicinal plants are used to prepare many medicines. *Aerva lanata* is a medicinal plant used for many purposes. The present compilation provides sufficient support with regard to the usefulness of this valuable medicinal plant. The various pharmacological activities are attributed to the boundless coverage of various phytochemicals that the plant possesses. Further research is imperative with respect to the biological activities and possible modes of action of the various isolated phytoconstituents. Additionally, toxicological studies in animals need to be carried out so as to proceed to further clinical studies in humans. There is a further scope of development of formulations that can be marketed and employed effectively in combating various disorders. More studies are strongly recommended to establish the mechanisms are involved and the active constituents which are really responsible for its beneficial pharmacologic actions. Through the ages, folk medicine has established the value of certain foods in human health maintenance. There is now mounting evidence that the healthiest diets are those loaded with plant foods.

Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article the writing of this article.

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Competing interest statement

The authors declare no conflict of interest.

References

1. Selvakumar TA, Rajasekar P. *Aerva lanata* mediated phytofabrication of silver nanoparticles and evaluation of their antibacterial activity against wound associated bacteria. J. Taiwan Inst. Chem. Eng. 2017; 78:539-51.
2. Dubey NK, Kumar R, Tripathi P. Global promotion of herbal medicine: India's opportunity Current Sci. 2004; 86:37-41.
3. Arokiyaraj S, Saravanan M, Badathala V. Green synthesis of Silver nanoparticles using aqueous extract of *Taraxacum officinale* and its antimicrobial activity. South Indian J. Biol. Sci. 2015; 2:115-8.
4. Gnanamani A, Priya KS, Radha krishnan N, Babu M. Antibacterial activity of two plant extracts on eight burn pathogens**.** J. Ethnopharmacol. 2003; 86:59-61.
5. Chawla P, Chawla A, Vasudeva N, Sharma SK. A review of chemistry and biological activities of the genus *Aerva*, A desert plant. Acta Poloniae Pharmaceutica - Drug Research. 2012; 69:171-7.
6. Guptha AK, Neeraj T, Sharma M. Quality standards of Indian Medicinal Plants. ICMR, New Delhi. 2005; 3:9-19.
7. Ranjan RB, Deokule SS. Comparative pharmacognostic study of two species of *Aerva* Juss. Int J Pharm Sci Rev Res. 2013; 22:112-6.
8. Rajesh R, Chitra K, Parakh PM. *Aerva lanata* (Linn) Juss. Ex schult-An overview. Indian journal of natural products and resources. 2011; 2(1):5-9.
9. Athira P, Sreesha N Nair. Pharmacognostic Review of Medicinal Plant *Aerva lanata.* J. Pharm. Sci. & Res. 2017; 9(9):1420-3.
10. Alwadie HM. Morphology and distribution of three genera of Amaranthaceae in the South Western area of Saudi Arabia. J King Saud Univ. 2005; 18:51-62.
11. Mammen D, Daniel M, Sane RT. Identification of Pharmacognostic and Phytochemical Biomarkers to Distinguish between *Aerva lanata* Juss ex Schultes and its substitute, *Nothosaerva brachiata* (L.). W. & A. International Journal of Pharmaceutical Research. 2012; 4:116-9.
12. Izteleuovna TB, Ubaydullaevna MR, Karzhauovna KK. The determination of diagnostic characters of *Aerva* Lana (L.) Juss. Life Sci. 2014; 11:157-9.
13. Vijaya lakshmi R, Ravi ndhran R. Pharmacognostical studies on root of *Diospyros ferrae* (Willd.) Bakh and *Aerva lanata* Linn. A potent Indian medicinal plants. Asian J Pharm Clin Res. 2013; 6:57-62.
14. Kankanamalage T, Dharmadasa R, Abeysinghe D, Wijesekara R. A survey on medicinal materials used in traditional systems of medicine in Sri Lanka. Journal of Ethno pharmacology. 2014; 155:679-91.
15. Alwadie HM. Morphology and distribution of three genera of Amaranthaceae in the south western area of Saudi Arabia. Journal of King Saud University. 2005; 18:51-62.

16. Ragavendran P, Sophia D, Arul Raj C, Starlin T, Gopala krishnan VK. Phytochemica screening, antioxidant activity of *Aerva lanata* (L)-An *in vitro* study. Asian J Pharm Clin Res. 2012; 5:77-81.
17. Yuldashev AA, Yuldashev MP, Abdullabekova VN. Components of *Aerva lanata*. Chem Nat Compd. 2002; 38:293-4.
18. Yamunadevi M, Wesely EG, Johnson MA. FTIR spectroscopic studies on *Aerva lanata* (L.) Juss. Ex Schult. Asian J Pharm Clin Res. 2012; 5:82-6.
19. Baltaev UA, Murdakhaev YM, Abubakirov NK. Phytoecdysteroids of *Aerva lanata*. Chem Nat Compd 1992; 28:123-4.
20. Mallabaev A, Rakhimov DA, Murdakhaev YM. Carbohydrates of *Aerva lanata*. Chem Nat Compd. 1989; 25:369-70.
21. Omoyeni OA, Adeyeye EI. Chemical composition, calcium, zinc and phytate interrelationships in *Aerva lanata* (Linn) Juss. ex Schult leaves. Orient J Chem. 2009; 25:485-8.
22. Dr. Swati Mandan. *Aerva lanata*: a blessing of Mother Nature. Journal of Pharmacognosy and Phytochemistry. 2016; 5(1): 92-101.
23. Soumya PS, Poor nima K, Ravi kumar G, Kalaiselvi M, Gomathi D, Uma C. Nephro protective effect of *Aerva lanata* against mercuric chloride induced renal injury in rats. Journal of Pharmacy Research. 2011; 4:2474-6.
24. Raihan O, Brishti A, Bahar E, Islam F, Rahman M, Mohammed Tareq S *et al*. Antioxidant and anticancer effect of methanolic extract of *Aerva lanata* Linn. against Ehrlich Ascites Carcinoma (EAC) *in vivo.* Orient Pharm Exp Med. 2012; 12:219-25.
25. Manokaran S, Jaswanth A, Sengottuvelu S, Nandhakumar J, Duraisamy R, Karthikeyan D *et al*. Hepato protective activity of *Aerva lanata* Linn. against paracetamol induced hepatotoxicity in rats. Research J Pharm Tech. 2008; 1:398-400.
26. Nevin KG, Vijayammal PL. Pharmacological and immuno modulatory effects of *Aerva lanata* in Daltons lymphoma ascites–bearing mice. Pharm Biol 2005; 43:640-6.
27. Vetrichelvan T, Jagadeesan M, Senthil Palaniappan M, Murali NP, Sasikumar K. Diuretic and anti-inflammatory activities of *Aerva lanata* in rats. Indian J Pharm Sci. 2000; 62:300-2.
28. Kamurthy H, Sumalatha C, Sunandan Rao N, Sudhakar M. Antinocieptive activity of stigmosterol-3-glyceryl-2 - linoleiate, campesterol and daucosterol isolated from *Aerva lanata* Linn. aerial parts. Asian J Pharm Clin Res. 2013; 6:149-52.
29. Joanofarc J, Vamsadhara C. Evaluation of antidiarrhoeal activity of *Aerva* species. Natural Product Sciences 2003; 9:177-9.
30. Rajesh R, Chitra K, Padmaa MP. *In vitro* anthelmintic activity of aerial parts of *Aerva lanata* Linn Juss. Int J Pharm Sci Drug Res. 2010; 2:269-71.
31. Savadi RV, Alagawadi KR. Antifertility activity of ethanolic extracts of *Plumbago indica* and *Aerva lanata* on albino rats. Int J Green Pharm. 2009; 3:230-3.
32. Indukuri R, Prakash B, Priyadarshini RL, Vattipalli M, Rajukumar PB. Evaluation of anti-ulcer activity of *Aerva lanata* stem extract in rats. Indo Am J Pharma Res. 2013; 3:1702-8.
33. Kumar D, Prasad DN, Parkash J, Bhatnagar SP, Kumar D. Anti-asthmatic activity of ethanolic extract of *Aerva lanata* Linn. Pharmacology online. 2009; 2:1075-81.
34. Gujjeti RP, Mamidala E. Anti-HIV activity and cytotoxic effects of *Aerva lanata* root extracts. Am J Phyt Clin Ther. 2014; 2:894-900.
35. Kumar D, Prasad DN, Bhatnagar SP. Comparision of Diuretic activity of ethanolic extract of *Aerva lanata* (linn.) juss. ex. Schult & *Aerva tomentosa* forsk. Family: Amaranthaceae. Ancient science of life. 2005; 25(2):66-8.
36. Herath MDR, Gunatilake M, Lokuhetty D, Wijaya bandara J. A preliminary investigation on the effects of Polpala (*Aerva lanata*) on the structure and function of urinary tract of rats. The Ceylon Journal of Medical Science. 2005; 4(8):33-41.
37. Rama chandra YI, Raja HJS, Guru murthy H, Ashajyothi C, Rai PS. Evaluation of antioxidant activity of *Aerva lanata* and *Boerhavia diffusa* plant extracts in CCl_4 toxicated rat. International Journal of Drug formulation and Research. 2013; 4(1):1-8.
38. Deshmukh TA, Yadav BV, Badole SL, Bodhankar SL, Dhaneshwar SR. Anti-hyper glycaemic activity of alcoholic extract of *Aerva lanata* (L.) A. L. Juss. Ex J. A. Schultes leaves in alloxan induced diabetic mice. Journal of Applied Biomedicine. 2008; 6:81-7.
39. Narender Boggula, Narender Bojjala, Thriveni Mandula, Shangati M Priyanka, Krishna Mohan Chinnala. Phytochemical investigation and *in-vitro* anti bacterial activity of dried leaves of *Aerva lanata*. Indo American Journal of Pharmaceutical Sciences, 2016; 3(6):637-43.
40. Narender Boggula. *In vitro* evaluation of anti-oxidant activity of different extracts of *Aerva lanata* leaves. World Journal of Pharmacy and Pharmaceutical Sciences. 2016; 5(8):756-61.
41. Rao MA, Palaksha MN, Sirisha KN, Bhargavi VL, Manikandhar P. Effect of *Aerva lanata* on cisplatin induced Neurotoxicity in rats. World Journal of Pharmacy and Pharmaceutical Sciences. 2014; 3(2):2431-51.
42. Varutharaju K, Soundar Raju C, Thilip C, Aslam A, Shajahan A. High efficiency direct shoot organogenesis from leaf segments of *Aerva lanata* (L.) Juss. Ex Schult by using thidiazuron. Sci World J. 2014; 2014:1-6.
43. Mandal Bitasta, Dr. Swati Madan. *Aerva lanata:* A blessing of Mother Nature. Journal of Pharmacognosy and Phytochemistr y. 2016; 5(1): 92-101.
44. Orient longman. Indian medicinal plants, a compendium of 500 species, 5, 13-15.
45. Herath MDR, Gunatilake M, Lokuhetty D, Wijayabandara J. A preliminary investigation on the effects of Polpala (*Aerva lanata*) on the structure and function of urinary tract of rats. The Ceylon Journal of Medical Science. 2005; 4(8):33-41.