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Review Article

Pharmacology Section

Pharmacological Properties of the Plant *Aerva lanata*-A Narrative Review

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ABSTRACT

Aerva lanata (Linn.) Juss.ex Schult is a woody, succulent, perennial herb belonging to the family *Amaranthaceae* commonly found in Asia and Africa. It is a common weed that grows everywhere in the plains of Asia. It is locally called 'bui' or 'polpala'. It is familiar in the name of knot grass. These are branching shrubs. This plant is included in Dasapushpam, the ten sacred flowers of Kerala. The different parts of the plant have different functions. It belongs to the group Pashanabheda used to cure urinary stone. This is a traditional plant in India used for many purposes including antibacterial, antiparasitic, antiasthmatic, antioxidant, anti-infertility, antihypoglycaemic, antidiabetic, antilipidemic, antitumour, hepatoprotective, diuretic and anti urolithiatic, and immunomodulatory. *Aerva lanata* plant comprises of many phytochemicals including alkaloid, flavanoid, phenol, tannin, protein, amino acid and carbohydrate, which are responsible for the pharmacological activity. This review focuses on the general information regarding the pharmacological value of the plant *Aerva lanata*.

Keywords: Diuretic, Immunomodulatory, Mucronate, Pashanabheda, Polpala

INTRODUCTION

Aerva lanata, commonly referred to as Gorakha Ganga, is a member of the *Amaranthaceae* family and falls under the genus *Aerva* and species *lanata*. Its native origins can be traced back to India, Africa and Australia [1]. This medicinal plant has been used for centuries in traditional system of medicine. It has gained significant attention in recent years due to its pharmacological properties. In India, Ayurveda, Siddha and Unani treatment use different varieties of plants for treating many diseases with no or minimum side-effects [2]. Many infections have been cured with herbal remedies from very ancient times. Plants have been used for pharmaceutical purposes both in ancient and modern era. Because of the lower side-effects of plants compared to the synthetic drugs, nowadays pharmacological studies on plants have increased [3]. The effectiveness, low cost and widespread availability of plants also increased their popularity [4]. Nowadays, many health issues are due to high stress and change in lifestyle. Infectious disease is very common cause of death. More and more new infections are emerging and bacteria gaining resistant to commonly used antibiotics. The crude cancer rate has also increased in the country. In order to find new remedy for it, researchers should focus their attention in folk medicines. The world is a reservoir of plants which can be used for many illnesses. The World Health Organisation (WHO) encourages research studies on plants aiming to ensure that the therapeutic effects of plants can be applied to treat or cure diseases without causing serious damage to health. *Aerva lanata* is traditionally regarded as a valuable medicine for many diseases. The plant *Aerva lanata* has a wide variety of medicinal activities like antimicrobial, hepatoprotective, antiurolithiatic, antidiuretic, anti-inflammatory, immunomodulatory, antihelminthic, anticancerous, antiinfertility, antiHIV, antidiarrhoeal, nephroprotective, antidiabetic, antiulcerative, and antiasthmatic activity [5]. This paper aims to discuss and draw conclusions based on the available scientific literature regarding the pharmacological properties of *Aerva lanata.*

Scientific Classification

Kingdom: Plantae (plants).

Sub kingdom: Tracheobionta (Vascular plants).

Division: Magnoliophyta (Angiosperms, flowering plant).

Class: Magnoliopsida.

Subclass: Caryophyllales.

Family: *Amaranthaceae*.

Genus: *Aerva*.

Species: *lanata* (L.)A.L Juss. Ex Schultes.

Common name in Ayurveda: Paashaanbheda, Gorakshanganjaa, Aadaanpaaki, Shatkabhedi.

Morphology

The plant is an erect prostrate or succulent under shrub with a long tap root and branches starting from near the base [6]. It can be stiff or weak and grows from 30-200 cm in length. Leaves of *Aerva lanata* are 3-4×3 cm, simple, alternate and are lance-shaped, orbicular to ovate, apex obtuse, mucronate, have serrated margins and covered with small hairs. The plant has small, inconspicuous hermaphrodite flowers which are greenish white coloured. These plants are self-pollinated. The flowers are arranged in dense, elongated spikes or clusters [7].

Cultivation

The plant is cultivated from seeds. It requires sunlight for its growth. The seeds are planted in April half or May first half. The buds appear after 5-6 days. During cultivation organic and inorganic and synthetic fertilisers can be used to prevent insects, weed etc., [8].

Habitat

Aerva lanata is native to tropical Africa, South Africa, Madagascar, Saudi Arabia, and tropical Asia. *Aerva lanata* is found throughout tropical India as a common weed [9], which is wildly growing on the mountain slopes, fields and patches of ground up to an altitude, 90 m in the hills, native of Asia, Africa and Australia [10].

PHARMACOLOGICAL PROPERTIES

Antimicrobial Activity

Nowadays the overuse of antimicrobials cause the emergence of multidrug resistant organisms. Many studies on the action of medicinal plants against bacteria are conducted in different parts of the world [11]. The whole plant *A. lanata* has significant antimicrobial

activity against both Gram positive and Gram negative bacteria [12]. The antibacterial effect of the plant may be due to the presence of one or more bioactive compounds like alkaloids, glycosides, flavonoids, steroids, saponins etc., [13]. The ethyl acetate and methanol extract of the plant showed antibacterial activity against a number of bacteria [14] such as *Bacillus subtilis, Bacillus aureus, Staphylococcus aureus, Escherichia coli, Shigella dysenteriae, Shigella sonnei, Shigella flexneri, Shigella boydii, Klebsiella* and was also active against *Aspergillus fumigatus, Aspergillus niger, Candida albicans, Hensinela californica* and *Rhizopus oligosporum* [15]. Another study conducted on the antibacterial effect of the plant showed that the acetone, ethyl acetate and ethanol extract of *Aerva lanata* leaves exhibited highest antibacterial activity against *Proteus mirabilis, Staphylococcus aureus, Salmonella typhi, Bacillus subtilis, Pseudomonas aeruginosa, Klebsiella pneumoniae* and *Escherichia coli* [16].

Anthelmintic Activity

The aqueous and alchoholic extract of leaves and stems from *Aerva lanata* exhibit very good anthelmintic activity. Studies showed that it is active against tapeworm and earthworm. Compared to albendazole, it is more active against *Taenia solium* [17].

Hepatoprotective Activity

Aerva lanata has been found to have much hepatoprotective activity. It can prevent liver damage. Studies showed that the hydro alchoholic extract of *Aerva lanata* has hepatoprotective activity against paracetamol induced liver damage in rats diagnosed by the decreased serum enzymes Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Alkaline Phosphatase (ALP), and bilirubin [18]. Hepatoprotective effect was also studied by ethanol extract of *Aerva lanata* which prevents acetaminophen induced liver toxicity in Sprague Dawley rats in vivo and in isolated primary hepatocytes in vitro [19].

Antiasthmatic Activity

The antiasthmatic effect of *Aerva lanata* may be due to the suppression of oedema, proinflammatory cytokines and IgE antibodies and increase in aquaporin expression levels [20]. The aerial parts of the ethanolic extract of *Aerva lanata* stabilises mast cells and showed significant dose dependent antiasthmatic activity in vivo and in vitro animal models [21].

Urolithiatic Activity

Urolithiasis is the formation of stone in urinary bladder or urinary tract. Pashanabheda (stone breaking) is the Ayurvedic name of *Aerva lanata* which is used as antiurolithiatic drug by Ayurvedic practitioners [22]. The plant suspension reduces oxalate synthesising enzyme. Quercetin and betulin isolated from *Aerva lanata* have been found to be active against ethylene glycol induced calculi in male Wistar albino rats. The plant extract significantly reduce the size of the stone and improve the excretion of calcium phosphate, oxalate levels and the magnesium level is maintained which is reported to be one of the kidney stone inhibiting factors [23,24]. Anti urolithiatic effect also evaluated by the single diffusion gel growth technique using the shoot extract of *Aerva lanata* [25].

Antioxidant Activity

In recent years, people are leading a restless life in a very stressful atmosphere. This leads to release of free radicals resulting in oxidative stress. Dietary antioxidants help to overcome this. But sometimes it will not be sufficient, so we have to take synthetic antioxidants [26]. Many plants possess natural antioxidant activity with minimum or no side-effects. *Aerva lanata* showed antioxidant activity [27]. Compared to other solvents, ethanolic extract of the plant showed maximum antioxidant activity and scavenging activity and gave protection against free radicals to the cells [28]. In a study conducted using the aqueous, ethanol and hydroethanol extracts of *A. lanata*, the hydroethanolic extract, inhibited the free radical scavenging activity and showed more antioxidant activity [29].

Antidiuretic Activity

The antibiotics used for the treatment of diuresis usually causes lowering of blood sugar level, heart diseases, hypertension etc. An alcoholic extract of *Aerva lanata* showed considerable increase in the urine volume output and also urine sodium, potassium and chloride levels [30]. Another study, comparing the diuretic activity of concentrated ethanolic extract of *Aerva lanata* and *Aerva tomentosa* on healthy albino rats showed increased urine output with ethanolic extract of *Aerva lanata* only. Here, the control drug used was frusemide, but the diuretic activity was slightly lesser compared to frusemide [31].

Antidiabetic Activity

Diabetes Mellitus (DM) is a metabolic disorder affecting many people. DM treatment is mainly based on oral glycaemic drugs and insulin [32]. The Partially Purified Alkaloid Basified Toluene Fraction (PPABTF) of the roots of *Aerva lanata* showed antihyperglycaemic activity against type 2 diabetes induced by Streptozotocin nicotinamide in rats [33]. Dose dependent oral administration of ethanolic extract of *Aerva lanata* improved blood glucose level, which was comparable to standard drug metformin in four weeks treatment in alloxan induced diabetic rats [34].

Anticancer and Antitumour Activity

Cancer is a dreadful disease causing millions of deaths every year. Chemotherapy and radiation always causes many side-effects and researchers are very keen to find something which can alleviate the side-effects. The ethanolic extract of *Aerva lanata* showed reduction in the number of metastases caused by the venous injection of highly metastatic malignant murine melanoma cells, B16F-10 in the tail of male mice [35].

Anti-infertility Activity

Various plant extracts have been tested for anti-infertility activity, but very few have shown a positive result. For women who cannot use the chemical drugs for contraception, herbs are alternatives [36]. Only a few studies have explored the potential effect of *Aerva lanata* on reproductive parameters, mainly focusing on male infertility. Administration of crude extract of the plant at different doses at the critical period of organogenesis at the time of gestation showed good impact on testicular health [37]. However, it's important to conduct further research, including human trials.

Anti-ulcerative Activity

Aqueous extract of the *Aerva lanata* stem showed considerable anti-ulcerative activity in gastric mucosal lesions in rats caused by ethanol pyloric ligation, indomethacin and cysteamine. The drug omeprazole was used as reference standard [38].

Anti-inflammatory, Analgesic and Anti-nociceptive Activities

The plant extract prepared using petroleum ether, ethyl acetate and ethanol showed analgesic and anti-inflammatory activity on Wistar rats using diclofenac sodium and indomethacin as standard drugs. The study showed significant analgesic activity by tail immersion method and anti-inflammatory activity by carrageenan induced paw oedema method. Compared to other extracts, ethanol extract showed more effective action [39]. Anti-inociceptive activity study conducted on male swiss albino mice with aqueous ethanolic extract of the aerial part of *Aerva lanata* on acetic acid induced writing and hot plate test. Here, aspirin and morphine were used as standard drugs [40].

Nephroprotective Activity

Ethanolic extract of *Aerva lanata* contains various phytochemicals, such as steroids, flavonoids cardioglycosides, alkaloids, tannins, carbohydrates, and terpenoids. This may contribute to the nephroprotective activity against nephrotoxicity in male albino rats induced by mercuric chloride [41]. Methanol flower extract of *Aerva lanata* showed nephroprotective activity on cisplatin exposed HEK 293 cell lines [42]. Another study on albino rats showed raised blood urea and serum creatinine levels and histological features of acute tubular necrosis after inducing renal injury with cisplatin and gentamicin. The ethanol extract of *Aerva lanata* was found to normalise the blood urea and serum creatinine levels and bring about normal recovery of kidney as evidenced microscopically [43].

Immunomodulatory Activity

Our immune system plays an important role in preventing infections. Immunomodulation means the enhancement of immune function of the body. Many immunomodulatory drugs are available. But recently there is a trend to use plant material due to their low side-effect and high medicinal value. The petroleum ether extract of *Aerva lanata* Partially Purified Fraction (PPF) shows significant cytotoxicity against Daltons Lymphoma Ascites (DLA) tumour cell lines in vitro and stimulate lymphocyte proliferation in vitro and in vivo [44]. A study conducted in Swiss albino mice using the ethanol extract of the plant increased total WBC count, proliferation and differentiation of bone marrow cells [45].

Anti HIV Activity

Anti HIV activity of the plant *Aerva lanata* root was done using the extracts prepared from hexane, chloroform, ethyl acetate, acetone, and methanol. All the extracts showed anti HIV activity and the chloroform extract of *Aerva lanata* showed considerably high anti retroviral activity (91%). The plant is a rich source of secondary metabolites [46]. The plant possesses its anti HIV activity by inhibition of HIV reverse transcriptase enzyme [47].

Antidiarrhoeal Activity

Studies showed that *Aerva lanata* has antidiarrhoeal activity. The ethanolic and aqueous extract of *Aerva lanata* exhibited significant antidiarrhoeal activity against castor oil induced diarrhoea in rats [48]. This is due to the effect of alcoholic extracts due to the reduction of gastrointestinal motility, inhibition of prostaglandin synthesis and also may be due to the presence of alkaloids and flavonoids in the extract [49].

TOXICITY STUDY ON *AERVA LANATA*

The plant has many medicinal properties, however, it shows some toxicity reactions after long term usage. Studies conducted on Albino mice showed aqueous extract of *Aerva lanata* is relatively safe for oral consumption. Intraperitoneal administration is moderately toxic. Long term usage will cause cellular damage to organs, dyslipidaemia and also reduces male reproductive capacity [50]. A study conducted in male and female Sprague Dawley rats aged three months, showed no statistically significant effect for one month period. But consumption of the same concentration of *Aerva lanata* extracts thirty days caused ultrastructural changes in the convoluted tubular epithelial cells of rats [51].

The plant possesses a wide variety of pharmacological activities. Different parts of plants have different functions. The phytochemicals present in the plant contribute to a wide variety of therapeutic activities. Different combinations of different parts of plants can be studied and bring out more properties. Further research should be conducted to fully understand the mechanism of action and evaluate its efficacy and how safely it can be applied in humans. To know the therapeutic potential and suitable dosage clinical trials should be conducted.

CONCLUSION(S)

Aerva lanata is a plant having many pharmacological properties and used as a traditional medicine for many years. Studies proved that it can be used for the treatment of many life-threatening illnesses. The efficient extraction of these plants to commercialised drugs may contribute positive effects on human health. Still more in-depth studies are needed to investigate the beneficial effects of plant extracts.

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REFERENCES

[1] Athira P, Nair SN. Pharmacognostic review of medicinal plant Aerva lanata. J Pharm Sci Res. 2017;9(9):1420.
[2] Ragavendran P, Sophia D, Arul Raj C, Gopalakrishnan VK. Functional group analysis of various extracts of Aerva lanata (L.,) by FTIR spectrum. Pharmacologyonline. 2011;1:358-64.
[3] Adepu A, Narala S, Ganji A, Chilvalvar S. A review on natural plant: Aerva lanata. Int J Pharma Sci. 2013;3(6):398-402.
[4] Bitasta M, Madan S. Aerva lanata: A blessing of mother nature. J Pharmacogn Phytochem. 2016;5(1):92-101.
[5] Sharif M, Anjum I, Shabbir A, Mushtaq MN. Immunomodulatory and anti-inflammatory effects of Aerva lanata in ovalbumin induced allergic asthmatic mice. J Ethnopharmacol. 2022;289:115087.
[6] Subramanian A, Raman N, Dhasarathan P. Study on antibacterial activity of phytochemicals obtained from Aerva lanata. Asian J Pharm Pharmacol. 2019;5(4):721-27.
[7] Musaddiq S, Mustafa K, Ahmad S, Aslam S, Ali B, Khakwani S, et al. Pharmaceutical, ethnopharmacological, phytochemical and synthetic importance of genus Aerva: A review. Nat Prod Commun. 2018;13(3):1934578X1801300326.
[8] Mamykova RU, Ibragimov TS, Pernebekova RK. Study of onthogenesis of Aerva lanata (L.) Juss. Life Sci J. 2014;11(SPEC. ISS. 2):128-31.
[9] Mariswamy Y, Gnaraj WE, Johnson M. Chromatographic finger print analysis of steroids in Aerva lanata L by HPTLC technique. Asian Pac J Trop Biomed. 2011;1(6):428-33.
[10] Nagaratna A, Prakash LH, Harini A. A pharmacological review on gorakha ganja (Aerva lanata (Linn) Juss. ex. Schult). J Pharmacogn Phytochem. 2014;3:253-57.
[11] Ravikumar K, Rajamalar P, Krishna Vignesh L. A review of the importation of medicinal plants and clinical indication, in Asia. Int J Pharma Biosci. 2014:5(4):B221-30.
[12] Rajesh R, Chitra K, Paarakh PM. Aerva lanata (Linn.) Juss. ex Schult.-An overview. Indian J Nat Prod Resour. 2011;2(1):05-09.
[13] Murugan M, Mohan VR. Phytochemical, FT-IR and antibacterial activity of whole plant extract of Aerva lanata (L.) Juss. Ex. Schult. J Med Plant Stud. 2014;4(3):51-57.
[14] Chowdhury D, Sayeed A, Islam A, Bhuiyan MS, Khan GA. Antimicrobial activity and cytotoxicity of Aerva lanata. Fitoterapia. 2002;73(1):92-94.
[15] Goyal M, Pareek A, Nagori B, Sasmal D. Aerva lanata: A review on phytochemistry and pharmacological aspects. Pharmacogn Rev. 2011;5(10):195.
[16] Thangavel A, Balakrishnan S, Arumugam A, Duraisamy S, Muthusamy S. Phytochemical screening, gas chromatography-mass spectrometry (GC-MS) analysis of phytochemical constituents and anti-bacterial activity of Aerva lanata (L.) leaves. Afr J Pharm Pharmacol. 2014;8(5):126-35.
[17] Anantha D, Kumar TI, Kumar MS, Reddy AM, Mukharjee NS, Rao AL. In vitro anti helmintic activity of aqueous and alcoholic extracts of aerva lanata seeds and leaves. J Pharm Sci Res. 2010;2(5):317.
[18] Manokaran S, Jaswanth A, Sengottuvelu S, Nandhakumar J, Duraisamy R, Karthikeyan D, et al. Hepatoprotective activity of Aerva lanata Linn. against paracetamol induced hepatotoxicity in rats. Res J Pharm Technol. 2008;1(4):398-400.
[19] Anusha CS, Sini H, Prakashkumar B, Nevin KG. Mechanism of protection of rat hepatocytes from acetaminophen-induced cellular damage by ethanol extract of Aerva lanata. Interdiscip Toxicol. 2019;12(4):169-79.
[20] Sharif M, Anjum I, Shabbir A, Mushtaq MN. Immunomodulatory and anti-inflammatory effects of Aerva lanata in ovalbumin induced allergic asthmatic mice. J Ethnopharmacol. 2022;289:115087.
[21] Kumar D, Prasad DN, Parkash J, Bhatnagar SP, Kumar D. Antiasthmatic activity of ethanolic extract of Aerva lanata Linn. Pharmacologyonline. 2009;2:1075-81.
[22] Prasad KVSRG, Sujatha D, Bharathi K. Herbal drugs in urolithiasis-a review. Pharmacogn Rev. 2007;1(1):175-78.
[23] Dinnimath BM, Jalalpure SS, Patil UK. Antiurolithiatic activity of natural constituents isolated from Aerva lanata. J Ayurveda Integr Med. 2017;8(4):226-32.
[24] Soundararajan P, Mahesh R, Ramesh T, Begum VH. Effect of Aerva lanata on calcium oxalate urolithiasis in rats. Indian J Exp Biol. 2006;44(12):981-86.
[25] Varghese GK, Diana KJ, Habtemariam S. In vitro studies on indigenous medicine for urolithiasis: Efficacy of aqueous extract of Aerva lanata (Linn.) Juss. Ex Schult on growth inhibition of calcium hydrogen phosphate dihydrate. Pharm Innov Int J. 2014;3(1):92-100.
[26] Prajapati GM, Kadam RS, Ghuge DR. Aerva lanata: A comprehensive profile in the pharmaceutical and food industries. Int J Pharmacogn Chem. 2022:72-82.
[27] Kumar G, Karthik L, Rao KV. Phytochemical composition and in vitro antioxidant activity of aqueous extract of Aerva lanata (L.) Juss. ex Schult. Stem (Amaranthaceae). Asian Pac J Trop Med. 2013;6(3):180-87.

[28] Krishnamoorthi R. Phytochemical analysis and antioxidant property of Aerva lanata. Int J Pharmacogn. 2015;2(8):426-29.
[29] Akanji MA, Olukolu SO, Kazeem MI. Leaf extracts of aerva lanata inhibit the activities of type 2 diabetes-related enzymes and possess antioxidant properties. Oxid Med Cell Longev. 2018;2018:3439048.
[30] Vetrichelvan T, Jegadeesan M, Palaniappan SM, Murali NP, Sasikumar K. Diuretic and antiinflammatory activities of aerval lanata in rats. Indian J Pharm Sci. 2000;62(4):300.
[31] 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. Anc Sci Life. 2005;25(2):66.
[32] Vetrichelvan T, Jegadeesan M. Anti-diabetic activity of alcoholic extract of Aerva lanata (L.) Juss. ex Schultes in rats. J Ethnopharmacol. 2002;80(2-3):103-07.
[33] Agrawal R, Sethiya NK, Mishra SH. Antidiabetic activity of alkaloids of Aerva lanata roots on streptozotocin-nicotinamide induced type-II diabetes in rats. Pharm Biol. 2013;51(5):635-42.
[34] Appia Krishnan G, Rai VK, Nandy BC, Meena KC, Dey S, Tyagi PK, et al. Hypoglycaemic and antihyperlipidaemic effect of ethanolic extract of aerial parts of Aerva lanata Linn. in normal and alloxan induced diabetic rats. Int J Pharm Sci Drug Res. 2009;1(3):191-94.
[35] Siveen KS, Kuttan G. Inhibition of B16F-10 melanoma-induced lung metastasis in C57BL/6 mice by Aerva lanata via induction of apoptosis. Integr Cancer Ther. 2013;12(1):81-92.
[36] Yadav RC, Mariam G, Garghe V, Kaur N, Kakade P. Medicinal plants with antifertility effects: A review. World J Pharm Sci. 2014:1384-89.
[37] Uwejigho RE, Iteire KA, Enemali FU. Anti-fertility effect of Aerva lanata crude extract in male dams offspring: An experimental study. Int J Reprod Biomed. 2023;21(3):237.
[38] 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 Pharm Res. 2013;3(12):1702-08.
[39] Sharma A, Tanwar M, Nagar N, Sharma AK. Analgesic and anti-inflammatory activity of flowers extract of Aerva lanata. Adv Pharmacol Toxicol. 2011;12(3):13.
[40] Venkatesh S, Yanadaiah JP, Zareen N, Reddy BM, Ramesh M. Antinociceptive effect of Aerva lanata ethanolic extract in mice: A possible mechanism. Asian J Pharmacodyn Pharmacokinet. 2009;9:58-62.
[41] Soumya PS, Poornima K, Ravikumar G, Kalaiselvi M, Gomathi D, Uma C. Nephroprotective effect of Aerva lanata against mercuric chloride induced renal injury in rats. J Pharm Res. 2011;4(8):2474-76.
[42] Narayanan M, Krishnan L, Natarajan D, Kandasamy S, El Askary A, Elfasakhany A, et al. Evaluation of antibacterial, antioxidant, and nephroprotective proficiency of methanol extract of Aerva lanata. Process Biochem. 2021;109:98-103.
[43] Shirwaikar A, Issac D, Malini S. Effect of Aerva lanata on cisplatin and gentamicin models of acute renal failure. J Ethnopharmacol. 2004;90(1):81-86.
[44] Nevin KG, Vijayammal PL. Pharmacological and immunomodulatory effects of aerva lanata in daltons lymphoma ascites-bearing mice. Pharm Biol. 2005;43(7):640-46.
[45] Siveen KS, Kuttan G. Immunomodulatory and antitumour activity of Aerva lanata ethanolic extract. Immunopharmacol Immunotoxicol. 2011;33(3):423-32.
[46] Gujjeti RP, Mamidala E. Anti-HIV activity and cytotoxic effects of Aerva lanata root extracts. Am J Phytomedicine Clin Ther. 2014;2(7):894-900.
[47] Gujjeti RP, Namthabad S, Mamidala E. HIV-1 reverse transcriptase inhibitory activity of Aerva lanata plant extracts. BMC Infect Dis. 2014;14(3):1.
[48] Joanofarc J, Vamsadhara C. Evaluation of antidiarrhoeal activity of Aerva species. Nat Prod Sci. 2003;9(3):177-79.
[49] Sunder S, Rai AK, Praveen S, Singh PA, Singh S. Antidiarrhoeal activity of Aerva lanata in experimentally induced diarrhoea in rats. Pharmacologyonline. 2011;2:921-28.
[50] Omotoso KS, Aigbe FR, Salako OA, Chijioke MC, Adeyemi OO. Toxicological evaluation of the aqueous whole plant extract of Aerva lanata (l.) Juss. ex Schult (Amaranthaceae). J Ethnopharmacol. 2017;208:174-84.
[51] Gunatilake M, Lokuhetty MDS, Bartholameuz NA, Edirisuriye DT, Kularatne MU, Date A. Aerva lanata (Polpala): Its effects on the structure and function of the urinary tract. Pharmacognosy Res. 2012;4(4):181-88.

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