Nephrotoxicity is one of the most common kidney problems and occurs when body is exposed to a drug or toxin. A number of therapeutic agents can adversely affect the kidney resulting in acute renal failure, chronic interstitial nephritis and nephritic syndrome because there is an increasing number of potent therapeutic drugs like amino glycoside antibiotics, chemotherapeutic agents and NSAIDs. Exposure to chemical reagents like ethylene glycol, carbon tetrachloride, sodium oxalate and heavy metals such as lead, mercury, cadmium and arsenic also induces nephrotoxicity. Prompt recognition of the disease and cessation of responsible drugs are usually the only necessary therapy. Nephroprotective agents are the substances, which possess protective activity against Nephrotoxicity. Medicinal plants have curative properties due to the presence of various complex chemical substances. Early literatures have prescribed various herbs for the cure of renal disorders. Co-administration of various medicinal plants possessing nephroprotective activity along with different nephrotoxic agents, which may attenuate its toxicity. The term renal failure primarily denotes failure of the excretory function of kidney, leading to retention of nitrogenous waste products of metabolism in the blood. In addition to this, there is a failure of regulation of fluid and electrolyte balance along with endocrine dysfunction. The renal failure is fundamentally categorized into acute and chronic renal failure. Acute renal failure (ARF) refers to the sudden and usually reversible loss of renal function, which develops over a period of days or weeks. There are many causes for ARF, which includes acute tubular necrosis that commonly accounts for 85% of incidence. Mostly acute tubular necrosis occurs due to either ischemia or toxins. The toxins may be exogenous or endogenous. The exogenous agents are radio contrast agents, cyclosporine, antibiotics, chemotherapeutic agents, organic solvents, acetaminophen and illegal abortifacients. Chronic renal failure (CRF) is an irreversible deterioration in the renal function, which classically develops over a period of years, leading to loss of excretory metabolic and endocrine functions. Various causes of renal failure has been recognized like hypertension, diabetes mellitus, antineoplastic agents like cyclophosphamide, vincristine, cisplatin etc.

Ancient literature has prescribed various herbs for the cure of kidney disease. The term “Pasananbhedha” has been cited in the literature to identify the group of plants, which extensively used in the indigenous system of medicine to dissolve urinary calculi and stones like Coleus aromaticus, Aerva lanata, Aerva javanica, Rotula aquatica, Kalanchoe pinnata, Ocimum basilicum.

The present review is about the one of the Pasananbhedha category plant, Aerva javanica possessing nephroprotective activity. The plant Aerva javanica belonging to the family Amaranthaceae is a tall and woolly undershrub found plentiful in rainy season. This plant is used as Pasananbhedha means one, which breaks the kidney stone. Therefore, in Gujarati it is commonly known as Patharphod. Roots and flowers are reported to possess medicinal properties against rheumatism and kidney troubles.

The plant Aerva javanica belonging to the family Amaranthaceae is a tall and woolly undershrub found plentiful in rainy season in Bhavnagar district of Gujarat state in India. Any drug used as Pasananbhedha means which breaks the kidney stone. Roots and flowers of Aerva javanica are reported to possess medicinal properties against rheumatism and kidney troubles.
**Aerva javanica** is reported as anthelmintic, diuretic, demulcent. It is used for the treatment of headache. The decoction of the plant is administered to remove swellings.

- **Taxonomic classification**
  - Division: Magnoliophyta
  - Class: Dicotyledoneae
  - Subclass: Monochlamydeae
  - Series: Curvembryeae
  - Family: Amaranthaceae
  - Genus: Aerva (Forsk.)
  - Species: javanica (Burm.f.)

- **Floral Formula**
  - Male flower: Br, brl, ♂, P₅, A₅, G₀
  - Female flower: Br, brl, ♀, P₅, A₀, G₂

- **Morphology of Aerva javanica plant**
  - **Habit**: A perennial, suffruticose, hoary-tomentose, erect to scandent dioecious conspicuous under shrub, 0.6-1 m tall found almost throughout plains of India.
  - **Stem**: Terete, much branched, as thick as goose-quill, covered with a thick, easily detachable stellate tomentum, woolly at the base, herbaceous above, tomentose.
  - **Leaves**: Opposite or alternate exstipulate leaves
  - **Inflorescence**: Stalked, spikes 2.5-18 cm long, white, woolly, elongate, linear or oblong; often forming leafless terminal paniculate up to 5 cm.
  - **Flowers**: Unisexual, dense, usually dioecious, dull white, sessile
  - **Bracts and bracteoles**: Broadly ovate, white, 3 mm long, apex acute, hyaline.
  - **Male flowers**: Seems to be very rare, perianth rather more than 1.5 mm long, elliptic-oblong, sub obtuse, wooly at the back.
  - **Female flowers**: Tepals 5, perianth 2.5 mm long, obovate-oblancoeolate or spathulate, base sub acute, apex apiculate, tomentose without; outer 2 larger with ceasing midrib below the apex, inner 3 smaller with thick green midrib. Filaments reduced, anthers absent
  - **Tepals 4 or 5, usually sepaloid
  - **Stamens 1-5, anteposed
  - **Gynoecium 2-3 carpellary, syncarpous, superior, unilocular with indefinite to one ovule.

**Genus: Aerva (Forsk.)**

**Species: javanica (Burm.f.)**
**Ovary:** - 0.5 mm, style 1.8 mm, stigma deeply forked, as long as style.

**Fruit:** - Utricle orbicular-ovoid, very thin.

**Seed:** - Minute with 0.85 mm. diameter, ovoid, lenticular with brown-black shining.

**Flowering period:** - July-September

**Plant Review**

**Ethnomedicinal Review**

Payal Chawla has reported approximately 28 species of Aerva genus and reported that Aerva plants are used to cure ulcer, lithiasis, dropical affections, eye affection, toothache, headache, in disorders of abdomen and inflammation of internal organs. Roots and flowers are reported to possess hypoglycaemic, antioxidant, anthelmintic, analgesic, antimalarial, antivenin activities and medicinal properties against rheumatism and kidney troubles.¹³

Bhasker punjani has reported that alcoholic extract of leaf of Aerva javanica given orally twice a day for 10 days to cure urinary disorders. This plant is diuretic, useful in strangury.¹⁸

Roots and flowers are reported to possess medicinal properties against rheumatism and kidney troubles.⁷

Plant reported as anthelmintic, diuretic, demulcent. It is used for the treatment of headache.⁶

The decoction of the plant is administered to remove swellings.⁹

**Pharmacognostical Review**

Hussien alwadie has studied morphological characteristics of four species (Aerva javanica, A. lanata, Pupalia lappacea and Achyranthes aspera) representing three genera of the family Amaranthaceae and their distribution in relation to some environmental parameters.¹⁹

Pharmacognostical studies on aerial parts of Aerva javanica revealed the presence of branched trichome, rosette type calcium oxalate crystals in lamina and midrib of leaf, anomocytom stomata and anomalous growth in transverse section of the stem.²⁰

Pharmacognostical studies on roots of Aerva javanica revealed the presence of cork, phellogen and phelloderm in the periderm with stellar region in the root. In the crude powder structures mainly observed were cork, fibre, calcium oxalate crystals, vessels with bordered pits and ray cells.²¹

**Phytochemical Review**

Muhammad samejo has estimated essential oils from leaves and stems of Aerva javanica extracted through dry steam distillation and the chemical composition of the oil determined by Gas Chromatography-Mass Spectrometry (GC-MS). The essential oil of Aerva javanica leaves was found to be rich in hentriacontane (21.48%), nonacosane (20.59%), heptacosane (19.78%), pentacosane (5.58%), octacosane (3.47%), triacatone (2.81%) and hexacosane (2.04%), whereas the essential oil of stems was determined to be rich in nonacosane (23.26%), heptacosane (22.48%), hentriacontane (18.32%), octacosane (3.42%), triacatone (2.24%) and squalene (2.07%).²²

Abdul wajid Khan has performed Phytochemical analysis and revealed the presence of three compounds, 3-hydroxy-4-methoxybenzaldehyde, ursolic acid and (E)-(4-hydroxy-3-methoxyphenethyl)-3-(4-hydroxy-3-ethoxyphenyl) acryl amide.²³

Nabil has performed isolation of new flavonol, isorhamnetin 3-O-β[4′′-p-coumaryl-α-rhamnosyl (1→6) galactoside], has been isolated from Aerva javanica along with it’s an acylated derivative, its kaempferol analogue and various common kaempferol, quercetin and isorhamnetin glycosides.²⁴

Aerva persica burm.f, contains kaempferol, sterol, triterpenes, flavonoids, β-sitosterol, α-amyrin, palmitic acid, stearic acid, linoleic acid, myristic, oleic acid, palmitic acid, eervanon, alkaloids, Chrysín-7-O-galactosidem.²⁵

Various chemical constituents including steroids, triterpenes, lipids, flavonoids, tannins, saponins, alkaloids, sulphates, carbohydrates and glycosides have been isolated from this plant.²⁶

Four new ecdysteroids (1-4), along with three known steroids, β-ecdysone (5), 5-β-2-deoxyintegristerone A (6) and 24-epi-makisterone A (7), were isolated from
the methanolic ext. of the flowers of Aerva javanica by using normal and reverse phase chromatog. All isolates were evaluated for their inhibitory activities against the enzymes acetylcholinesterase (AChE), butryryl-cholinesterase (BChE) and lipoxygenase (LOX).  

- Chemical composition of Aerva javanica seed essential oils obtained by hydro distillation (HD) and dry steam distillation (SD) extracting methods and analyzed by using gas chromatog.-mass spectrometry(GC-MS).

- Chromatographic purification of ethyl acetate soluble fraction of the methanolic extract of the flowers of Aerva javanica yielded three new acylated flavone glycosides: kaempferol - 3-O-β-D-[4”-E-p-coumaroyl-α-L-rhamnosyl (1→6)] - galactoside, kaempferol-3-O-β-D-[4”-E-p-coumaroyl-α-L-rhamnosyl(1→6)]-3”-E-p-coumaroyl) galactoside and kaempferol-3-O-β-D-[4”-E-p-coumaroyl-α-L-rhamnosyl(1→6)]-4”-E-p-coumaroyl) galactoside.

- A new, economic and rapid high performance thin-layer chromatog method developed for alcoholic extract of root of Aerva javanica. The minimum detectable amount of quercetin found to be 0.02196% w/w.

- There are approximately 28 species of Aerva genus, but only a few species are medicinal of which A. persica, A. lanata and A. javanica are of great value. Roots and flowers are reported to possess hypoglycemic, antioxidant, anthelmintic, analgesic, antimalarial, antivenin activities and medicinal properties against rheumatism and kidney troubles.

- Lupeol, mixture of myristic, palmitic, stearic and oleic acid esters, β-amin, β-sitosterol, betulinic acid, phytol, quercetin, quercetin-3-O-rutinoside, quercetin-3-O-xylosyl(1→2) rhamnoside and shikimic acid were isolated from the Aerva javanica.

- The saponin contents in Aerva lanata (L.) Juss ex. Schult and Aerva javanica (Burm. fil) were investigated in Egypt. Three glycosides were isolated. Hydrolysis of glycoside I afforded β-sitosterol and glucose, and saponin glycoside II yielded lupeol, galactose and glucose. Saponin glycoside III gave oleanolic acid, galactose, glucose and rhamnose.

- Qualitative and quantitative analysis of carbohydrates were carried out in the aerial parts of A. lanata and A. javanica by applying PC, GLC and gel filtration method in Egypt. In these species, free arabinoise, rhamnose, xylose, galactose, glucose, mannose and mannitol were revealed, but in variable amounts Mannitol (4.2% in A. lanata and 2.2% in A. javanica) was isolated. Polysaccharides proved of pectic nature (4.8% in A. lanata and 3.25% in A. javanica) and afforded 4 fractions in A. lanata and 3 fractions in A. javanica on gel filtration on Sephadex G-100. A. lanata polysaccharide exhibited more remarkable hypoglycemic activity than that of A. javanica.

- The investigation of the alkaloidal content of the two Aerva species growing in Egypt, namely Aerva javanica (Burm. Fil) and Aerva lanata L. Juss. ex. shult, family Amaranthaceae, revealed the presence of 10-methoxy-canthin-6-one (Methyl aervin) and 10-hydroxy-canthin-6-one (aervin) in the two species, while canthin-6-one was only isolated from A. lanata. This study represents the first isolation of 10-methoxy-canthin-6-one and 10-hydroxy-canthin-6-one from A. javanica.

- The Ethyl acetate extract of the fresh leaves of A. javanica yielded a compound which was identified as β-sitosterol glucoside.

- Hentriacontane, nonacosane, nonacosanol, tritriacontane, tetratriacontane, sitosterol, and oleanolic acid were isolated from the ethyl acetate extract of fresh leaves of A. javanica.

- Several known glycosides of kaempferol were isolated from the leaves of Clitoria ternatea and whole plants of Aerva javanica. Aerva lanata (whole plant) afforded β-sitosteryl palmitate, besides α-amyrin and β-sitosterol.

- Pharmacological Review

- Srinivas has made crude extracts of different parts of Aerva javanica with hexane, chloroform and methanol. Methanolic extract of flower and leaf have shown a wide range of phytochemicals and more anti-bacterial activity. HPTLC separation of extract coupled with bioautography studies revealed that apigenin followed by rutin and kaempferol has shown anti-bacterial activity against more number of bacteria.

- Abdul wajid khan has performed phytochemical analysis and Enzyme Inhibition Assay of Aerva javanica. Inhibition of urease activity of various fractions revealed that ethyl acetate fraction showed significant activity (P <0.05) as compared to other fractions. (E)-N-(4-hydroxy-3- methoxyphenethyl)-3- (4-hydroxy-3-ethoxyphenyl) acryl amide showed marked anti ulcer activity (P <0.05).

- Farees ud din mufti has evaluated various extracts by using methanol, n-hexane, chloroform, ethyl acetate and aqueous fraction of Aerva javanica and Paeonia emodi for antibacterial activity against Escherichia coli (NCTC 10418), Klebsiella pneumoniae (ATCC 700603), Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella typhi, Staphylococcus epidermidis (NCTC 11047) and Methicillin Resistant Staphylococcus Aureus (MRSA) (NCTC 13143) and antifungal activity against Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger and Fusarium solani.
- Nongyao sawangjaroen and Kitja sawangjaroen have evaluated that dichloromethane and methanol extracts from the Brucia javanica seed and a methanol extract from Quercus infectoria nut gall showed the highest anti-diarrheic activity.\textsuperscript{40}

- Zahid farooq has conducted study on different plants including Aerva javanica to determine the ethno veterinary medicinal (EVM) practices for the treatment of different parasitic diseases of livestock in Cholistan desert, Pakistan.\textsuperscript{41}

- A. javanica also showed antiviral,\textsuperscript{42} antiplasmodial\textsuperscript{43} and antidiabetic activities.\textsuperscript{44}

- Six natural products were isolated from the whole plant of Aerva javanica and were tested for their antimicrobial activity along with different crude extracts (n-hexane, chloroform, ethyl acetate, methanol and water) which displayed moderate to weak inhibitory activity.\textsuperscript{45}

- Aerva species, Aerva lanata and Aerva javanica were screened separately for their anti-diarrhoeal activity. The results illustrate that the ethanolic and aqueous extracts of A. lanata and the ethanolic and aqueous extracts of A. javanica have significant antidiarrhoeal activity and the activity may be attributed to its effect on intestinal transit.\textsuperscript{46}

- The Ethyl acetate extract showed significant antimicrobial activity against G -ve bacteria, yeast and fungi while the isolated flavonoidal compounds, isorhamnetin 3-Orutinoside and chrysoeriol showed marked activity against G -ve bacteria. On the other hand, the fatty acids mixture showed great activity against G -ve and G +ve bacteria, while the fatty alcs. showed significant activity against G +ve bacteria.\textsuperscript{47}

- Treatment of bean plants with hexane and ethanol extracts of Artemisia monosperma and chloroform extract of Aerva javanica have an adverse effect on the biological aspects of Aphis craccivora and was more pronounced in A. monosperma than A. javanica.\textsuperscript{48}

- Phytochemical screening of the aerial parts of Aerva lanata L. Juss ex. Schult and Aerva javanica (Burm. fil) Spring, (Amaranthaceae) growing in Egypt revealed the presence of carbohydrates and/or glycosides, tannins, saponins, alkaloids and/or nitrogenous bases, unsaturated sterols and/or triterpenes and flavonoids in both species. The aqueous extracts of the two species exhibited smooth muscle relaxant effect in a dose dependent manner as well as a significant antispasmodic activity.\textsuperscript{49}

- The nephroprotective activity of aqueous extract of root of Aerva javanica at the dose level 200 mg/kg and 400 mg/kg bodyweight reported by Movaliya V. et al. 400mg/kg body weight dose of aqueous extract showed better result compared to negative control as well as 200 mg/kg body weight dose.\textsuperscript{50}

- The alcoholic and aqueous extract of root of Aerva javanica checked for its nephro-protective effect by Movaliya V. and Zaveri M.\textsuperscript{51}

- Movaliya V. and Zaveri M. evaluated the nephro-protective effect of different fractions of alcoholic extract of root of Aerva javanica. The hexane fraction of alcoholic extract of root of Aerva javanica showed significant effect compared to other fractions as well as negative control.\textsuperscript{52}

Miscellaneous Review

- Soltanian has performed Cytogenetical studies on Aerva javanica. Cytogenetical characters of A. javanica according to chromosomal numbers, SEM indumentums and seed coat sculpture characters were studied.\textsuperscript{53}

- Hussain has performed study to assess the nutritional value and mineral contents of four medicinal plants viz., Aerva javanica Burm.f., Calotropis procera Ait. f., Datura alba Nees, and Nepeta suavis Staph., which are traditionally used as medicine in the Northwest Pakistan. Proximate analysis of plant sample determines that protein (21.353%) and ash (18.803%) was highest in Datura alba, carbohydrate (70.123 %) in Aerva javanica, energy (398.496 Kcal/100g), fats (12.595%) and fiber (40.150%) was highest in Nepeta suavis, while highest moisture (11.255%) was reported in Calotropis procera.\textsuperscript{54}

- Tailings, soils and wild plants (Acea Raddiena and Aerva Javanica) were sampled from gold mine, at Allaqi Wadi Aswan, Egypt and analyzed for toxic metals (Hg, Cd, Pb and As) and associated heavy metals (Cr, Ag, Ni, Au, Mo, Zn, Mn and Cu) using ICP-MS, ICPOES, CVAAS and FAAS techniques. The present work concerns the distribution and mobility of these metals from tailing to the surrounding soils and wild flora. The results reveal that Cr, Cu, Zn, Ni, Ag, Au, Mn, Hg, As, Ag, Au and Pb in soil decreased as far away from the tailing, after then irregular trends as a result of input from surrounding rocks. Acia Raddiena plant accumulated As, Cd and Pb in higher levels than Aerva Javanica.\textsuperscript{55}

- The effect of air pollution on the amino acid content of plants growing in Karachi area was studied. High amino acid contents were observed in Aerva javanica, Alstonia scholaris, Cassia holosericea, Ficus benghalensis, F. religiosa, Guaiacum officinale, Mangifera indica, Murraya paniculata, Nerium oleander, Polyalthia longifolia, Prospis juliiflora, Samanea saman, and Trachospermum luminum growing at Gurumandir and Cement Factory areas as compared to those growing at Karachi University Campus. Eucalyptus and Prosopis glandulosa showed a minimum difference in amino acid content suggesting some mechanism of resistant against pollution.\textsuperscript{56}
• Outbreaks of small round-structured viruses have been associated with contaminated drinking water and food. Samples were collected from three wastewater treatment plants in Cairo. The collected samples were concentrated and detoxified. All concentrated samples were inoculated in three cell culture types, Vero, BS-C-1, and Huh-7 cells. To enhance virus isolation and propagation, the cells were treated for 2 hr at 37°C with 40 mg of the water extract of Aerva Javanica (Burm.F.), Juss. Ex Schult plant. The main conclusion of this study is that SRSVs may be isolated by propagation in cell cultures previously treated with the water ext. of Aerva Javanica plant, which facilitate this propagation.

• A new and distinct Aerva javanica plant with a tall stem and light grey-green leaves suitable for cut flower production.

• The study assesses the plant communities and environmental factors that govern species, abundance and distribution in Taif area, western Saudi Arabia, using TWINSPLAN analysis. Twenty three vegetation groups were identified visual, seven groups dominated by Aerva lanata, Pergularia tomentosa, Arnebia hispidissima, Salsola spinescens, Capparis decidua, Aizoon canariense and Blepharis ciliaris in the sand plains, Calotropis procera, Dipterygium glaucum, Bassia muricata, Haloxylon scoparium, Aerva javanica, Anthemis melopodina and Coccinea grandis in the valleys.

• A number of water samples (24) were collected from wells, water pumps, natural and artificial depressions from Naukot, Vajuto, Mithi, Islamkot, Virawah and Nagarparkar area and analyzed on the site and at the laboratories for 18 different parameters. There was a wide variation in water quality and total dissolved solids. The highest values were observed at Virawah area and lowest at an artificial depression of rainwater within Nagarparkar town. The higher vegetation of Thar region consists mainly of thorny or prickly shrubs and perennial herbs capable of drought resistance as Calligonum polygonoides, Aerva javanica, Salvadoria oleoides, Acacia Senegal, Capparis decidua, Tamarix aphylla, Prosopis spicigera, Leptadenia pyrotechnica and Zizyphus nummularia.

CONCLUSION

Hence, it can be concluded that, the present review is about the one of the Pasanabheda category plant, Aerva javanica belonging to the Amaranthaceae family, possessing nephroprotective activity. Ethnomedicinally, this plant is used as Pasanabheda means one, which breaks the kidney stone. Roots and flowers are reported to possess medicinal properties against rheumatism and kidney troubles. This review article provides the phytocstituents isolated from various parts of Aerva javanica, which may be helpful in bioinformatics to design novel drug against various diseases. So, there is good scope to investigate and characterize active phytocstituents, their mode of action and the effective dose of plant extracts for development of poly-herbal formulation. Therefore, the information summarized in this review is intended to serve as reference to many researchers. There is enormous scope for the future research to be carried on Aerva javanica considering its wide pharmacological profile.

REFERENCES


Source of Support: Nil, Conflict of Interest: None.