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## RESEARCH ARTICLE

### A CONCISE REVIEW ON “MAMAJJAKA” (ENICOSTOMA LITTORALE)

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#### ABSTRACT

Enicostoma littorale (Mamajjaka) is an uncommon drug described in Ayurvedic sculptures as “Rishyagandha” belongs to the family Gentianaceae. In Ayurveda it is used solely or in different medicinal preparations as an ingredient, proven its immense medicinal potential. Though it is a popular drug of Ayurvedic doctors but its detail description found only in Nighantus (Ancient ayurvedic herbal pharmacopeia). Majmajjaka is a very bitter drug prescribed mostly in Madhumeha (Diabetes mellitus), Medoroga (obesity), Jwara (Fever), Kamala (Jaundice), Panduroga (Anaemia) and Amlapitta (Acid peptic disorders) by clinicians. Now scientists try to reestablish all the qualities of Enicostoma littorale on modern parameters as said by Ayurveda. They extracted several chemical constituents from this plant and saw various therapeutic effects of Enicostoma littorale in animal models. Common medicinal properties of Enicostoma littorale which has been established by different preclinical studies are anti-diabetic, antiulcer, anti-oxidant, anti-malarial, anti-inflammatory, anti-cancer, radioprotective, anti-hyperlipidaemic, anti-fungal, anti-bacterial and anti-viral activities. In this presented review summarizes the medicinal property described by Ayurveda and its relevant modern co-relation based on different scientific works.

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#### INTRODUCTION

The allopathic system of medicine is most acceptable and the first line of management in most of the developed countries. It also plays a significant role in the emergency management and surgery which are boon for present world, but it is a big challenge for allopathy to manage the chronic illness like diabetes, obesity, hypertension, rheumatoid arthritis etc. because of the remarkable risk profile of allopathic medicines (Donald *et al.*, 2013). Long-term administration of allopathic drugs causes the ill effect on different systems and organs of the body. Death due to the hazardous effect of allopathic drugs included under top ten leading cause of death in the United States (<http://www.rxmanagement.net>, <http://reset.me/story>) similar condition also observed globally. With these challenges, there is an urgent need to develop eco-friendly, bio-friendly, safe plant based products to replace synthetic allopathic medicines in the management of chronic illness. The traditional system of medicine could play a major role in this regard as it is safe, natural and practiced since a long time of

human civilization. Considering the significance of traditional medical system in health care, WHO has been promoting and encouraging traditional medical practices day by day. Traditional medicine category encompasses a variety of disciplines like Ayurveda, Siddha, Unani, Homeopathy, Chinese medicine, Tribal medicine, biofeedback, aromatherapy and many others (Pizzorno and Murray, 2007). Among them Ayurveda is most ancient and mother of all medical sciences. Ayurveda vividly described various medicinal herbs and formulations which possess potent therapeutic potential with high safety profile. The plant Mamajjaka (*E. littorale* blume) is one of them. Mamajjaka (*Enicostemma littorale* blume) is a relatively uncommon ayurvedic medicine used for the treatment of Madhumeha (Diabetes mellitus), Medoroga (obesity), Jwara (Fever), Kamala (Jaundice), Panduroga (Anaemia) and Amlapitta (Acid peptic disorders) by traditional medical professionals. The available description of Mamajjaka in Ayurveda is not enough to show the multidimensional therapeutic potential of this plant. It possesses hypoglycemic, anti hyperinsulinemic, islet neurogenerative, antidiabetic, antihyperlipidaemic, antiulcer, anti-inflammatory, antitumor, hepatoprotective,

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hepatomodulatory, antifungal, antibacterial, antihelminthic and antinociceptive effect on the body which have been proved by different experimental animal models (Saranya *et al.*, 2013). It has strong antioxidant and free radical scavenging properties which could prevent the occurrence of different disease like ischemic heart disease, diabetes, metabolic syndrome etc. (Vishwakarma *et al.*, 2010).

Medicinal phytoconstituent derived from *E. littorale* blume were considered to be effective and devoid any side effects (Murali *et al.*, 2002) *E. littorale* is a good source of calcium, iron, magnesium, potassium, sodium, silica, chloride, phosphate, sulfate and vitamins (B and C) (Sathishkumar *et al.*, 2009). This review provides a concise description of Mamajjaka (*E. littorale* blume) in ayurvedic as well as modern classics along with their therapeutic effect on the body based on previous studies.

### Mamajjaka (*Enicostoma littorale*) in Ayurvedic literature

Mamajjaka is not mentioned in most ancient literature like Charaka Samhita, Sushrut Samhita, Ashtang Samgraha and Ashtang Hridaye but there are some references found in four nighantus granthas (Ancient ayurvedic herbal pharmacopoeia) which are following:

- In Sodhala Nighantu(12th century AD) described under Lakshamandi Varga.
- In Saligram Nighantu (19th century AD) described under Parishishta Bhaga.
- In Nighantu Adarsh (20th century AD) described under Kiratadi Varga.
- In Priya Nighantu (20th century AD) described under Satapushpadi Varga.

**Sanskrit Names :** Nahi, Katunahi, Nagajihva, Tikshnapatra, Vitikshna (Krishnadash Sri, 1953).

**Regional Name :** White head (English), Karhvinai (Marathi), Vellarugu (Tamil), Vallari (Malyalam), Chikka chiraayuta (Kanada), Mamejavo (Gujarati), Nagajivha (Bengal), Nela-guli (Telugu), Chota chirayata in Hindi

### Ayurvedic Properties

Rasa	Tikta
Guna	Ruksha, Laghu
Veerya	Ushna
Vipaka	Katu
Doshaghnata	Kapha-Pitta Shamaka [10]

**Parts Used :** Whole Plant

**Doses:** **Decoction** - 40-50 ml  
**Powder** - 1-3 gram of dry drug

### Indications in Ayurveda

At present this drug is an important ingredient of most of branded and Anubhoot (Self Discovered) Ayurvedic medicines used for diabetes, obesity, skin disorders, Gastric problems, worm infestation, fever and poisoning.

### Mamajjaka (*Enicostoma littorale*) in Modern literature

**Botanical Name :** *Enicostemma littorale*

### Taxonomy :

Kingdom	Plantae
Subdivision	Angiospermae
Class	Dicotyledonae
Subclass	Gamapetalae
Serius	Bicarpellatae
Order	Gentianales
Family	Gentianaceae
Genus	Enicostemma
Species	Littorale

### Morphology

*E. littorale* is an erect, perennial herb, 5-30 cm tall, simple or branched at the base. Stem cylindric, glabrous with a decurrent ridge below each leaf. Leaves are sessile sometimes narrowed into a petiole-like base, longer than the internodes; lamina(5.0-8.0 to 0.3-1.0) cm, linear to lanceolate or narrowly oblong, entire, obtuse and mucronate at the apex, somewhat narrowing towards the base, 3-nerved from the base, glabrous. Inflorescence in many flowered auxiliary clusters, numerous in the axils of each pair of leaves. Flowers are white with green lines, drying yellowish, sessile or sub sessile; bracts long, shorter than the calyx, lanceolate-acuminate, carinate. Calyx tube 1-2 mm long; lobes usually unequal, (0.7-1.5 to 0.4-0.7) mm, triangular to lanceolate, acute at the apex and narrowly scarious at the margin, or obovate to subcircular, obtuse and mucronate at the apex, with wide scarious margin. Corolla tube 3.5-6.0 mm long; lobes (1.5-2.0 to 0.7-1.0)mm, ovate and abruptly narrowing to an acute or mucronate apex. Stamens inserted below the sinuses, just above the middle of the tube; filaments 1.5-2.3 mm long, with a double hood at the insertion point (Saranya *et al.*, 2013; Gupta and Singh, 2007; Jhan *et al.*, 2009).

### Habitat

*E. littorale* grows in many diverse habitats from savannas, grasslands, forests to beaches, from wet to very dry and also survives in a very saline environment.

### Distribution

This tropical genus is widely distributed in South America, Africa, and East Asia.

**Part Used:** Pulp, Fruit, Root, Bark, Leaf

**Major active Constituents:** Swertiamarin

### Pharmacological activity

Antihelminthic, antinociceptive, antioxidant, antiulcer, hepatoprotective, hepatomodulatory, antihyperlipidaemic, hypoglycemic, antibacterial, antihyperinsulinemic, anti-inflammatory, anti-cancer, antidiabetic, antispasmodic, anticholinergic activity, hypotensive and hypolipidemic (Saranya *et al.*, 2013).

## Phytocostituents of *E. littorale*

*E. littorale* contains several phytoconstituent which are responsible for a number of physiological effect on body. Year wise important works related to phytoconstituent are listed below:

Dymock <i>et al.</i> 1893	Discovered Betulin
Desai <i>et al.</i> 1966	Reported vanillic acid, syringic acid, p-hydroxy benzoic acid, protocatechuic acid, p-coumaric acid and ferulic acid.
Natarajan PN and Prasad S, 1972	Reported the presence of five alkaloids, two sterols and volatile oil.
Ghosal <i>et al.</i> 1974	Reported presence of enicoflavin, apigenin, gentiocrucine, genkwanin, isovitexin, swertisin, saponarin, 5-o glucosylswertisin and 5-o glucosylisoswertisin.
Jahan <i>et al.</i> 2009	Isolated Verticillside first time along with other phytoconstituent like catechins, saponins, steroids, sapogenin, triterpenoids, flavonoids and xanthenes
Tanna <i>et al.</i> 2010	Concluded that different chemical compounds in aerial part of the plant gave 34% of dry alcoholic extract and 15.7% of ash.
Sathiskumar <i>et al.</i> 2010	Reported presence of different amino acid like L-glutamic acid, tryptophane, alanine, serine, aspartic acid, L-proline, L-tyrosine, threonine, phenyl alanine, L-histidine monohydrochloride, methionine, iso leucine, L-arginine monohydrochloride, DOPA, L-Glycine, 2-amino butyric acid and valine.
Jaishree <i>et al.</i> 2010	Listed different crude drug with high swertiamarin content.
Garad <i>et al.</i> 2012	Discovered different minerals like iron, potassium, sodium, calcium, magnesium, silica, phosphate, chloride, sulphate and carbonate.
Leelaprakash <i>et al.</i> 2012	Isolated Swertiamarin from this plant.

## Pharmacological properties of *E. littorale*

*E. littorale* exhibit significant therapeutic activity on different systems of body. Some important research works showing its various positive physiological effect on experimental models are following:

Hypoglycemic	Prince and Srinivasan, 2005[23]	<i>E. littorale</i> significantly decreases the blood glucose, SOD <sup>*</sup> , GPx <sup>**</sup> , CAT <sup>†</sup> and TBARS <sup>††</sup> levels in diabetic animal models. The effectiveness of <i>E. littorale</i> extract was compared with standard drug insulin.
Hypoglycemic	Vishwakarma <i>et al.</i> 2010[6]	<i>E. littorale</i> significantly reduces polydipsia and polyphagia symptoms. It also decreases the serum glucose, serum cholesterol and triglyceride levels in diabetic rats.
Antihyperinsulinemic	Gohil <i>et al.</i> 2008[24]	Administration of aqueous extracts of <i>A. marmelos</i> and <i>E. littorale</i> prevent hyperglycemia and hyperinsulinemia in diabetic rats induced by a high fructose diet.
Islet Neogenesis	Gupta <i>et al.</i> 2010[25]	An active herbal compound SGL-1 present in the extract of <i>E. littorale</i> has ability to regenerate model stem cell lines PANC-1 and NIH3T3 which showed tremendous islet neogenic potential and significant islet yield in diabetic rats.
Diabetic Neuropathy	Bhatt <i>et al.</i> 2009[26]	<i>E. littorale</i> Blume exhibit potent neuroprotective effect in alloxan induced diabetic neuropathy in male Charles foster rats by restoring antioxidant level (SOD <sup>*</sup> , GPx <sup>**</sup> and CAT <sup>†</sup> ) and Na-K ATPase activity also by depleting oxidants. It shows preventive and restorative effect of <i>E. littorale</i> in animal model of diabetic neuropathy.
Antihyperlipidaemic	Gopal <i>et al.</i> 2011[27]	<i>E. littorale</i> reduces the serum cholesterol level in hepatoma bearing rats by esterification of free cholesterol in the HDL <sup>***</sup> through enhancing activity of cholesterol acyltransferase.
Antihyperlipidaemic	Vaidya <i>et al.</i> 2009[28]	Swertiamarin (an active constituent of <i>E. littorale</i> ) has potent lipid lowering effect as compared to atorvastatin.
Antihyperlipidaemic	Gopal <i>et al.</i> 2008[29]	The administration of extract of <i>E. littorale</i> in high carbohydrate and fat fed rats decreases cholesterol levels significantly by reducing oxidative stress in erythrocytes.
Antioxidant	Thirumalai <i>et al.</i> 2011[30]	After administration of aqueous leaf extract of <i>E. littorale</i> in animal models significantly decrease the levels of cholesterol, triglycerides, free fatty acids, activity levels of TBARS <sup>††</sup> and lipid peroxidation. A significant increase also reported in SOD <sup>*</sup> , CAT <sup>†</sup> and GPx <sup>**</sup> level in liver tissue. It shows potent restorative effect on hyperlipidaemic and oxidative stress lowering effect of <i>E. littorale</i>
Antioxidant	Mukundray <i>et al.</i> 2011[31]	<i>E. littorale</i> exhibit potent antioxidant effect in gentamicin induced nephrotoxicity.
Antiulcer & Anti-Inflammatory	Roy <i>et al.</i> 2010[32]	Administration of the aqueous extract of <i>E. littorale</i> reduces the total acidity, free acidity, volume of gastric secretion and elevated the gastric pH in aspirin induced ulcerative gastropathy. It shows a complete antiulcer potential of this plant. Antioxidant potential of <i>E. littorale</i> helps to combat inflammation.
Antitumour	Kavimani <i>et al.</i> 2000[33]	It has been reported that <i>E. littorale</i> possesses potent antitumour effect in Dalton's ascitic lymphoma (DAL) in animal models by reversal in the haematological parameters, protein and PCV consequent to tumour inoculation.
Hepatoprotective	Gite <i>et al.</i> 2010[34]	<i>E. littorale</i> is able to reduce all the elevated biochemical indices in CCl <sub>4</sub> induced liver injury. It shows its potent hepatoprotective property.
Hepatomodulatory	Vaijanathappa <i>et al.</i> 2008[35] Rajasekaran <i>et al.</i> 2010[36] Gupta & Singh, 2007[11]	Swertiamarin which is an active constituent of <i>E. littorale</i> has good antioxidant and hepatoprotective properties which might be due to its antioxidant potential. Hepatoprotective action of <i>E. littorale</i> in different liver disorders. Reported hepatomodulatory effect of <i>E. littorale</i> Blume against oxidative stress induced liver injury in animal models. It has been noted that <i>E. littorale</i> extract significantly increases glutathione, GPx <sup>**</sup> , SOD <sup>*</sup> , CAT and vitamin-C in the liver. It has also reported that there was significant reduction in lipid peroxidation, total cholesterol and triglycerides levels in hepatic cells. SGOT <sup>‡</sup> , SGPT <sup>‡</sup> , alkaline phosphatase, acid phosphatase, gamma glutamyl Further, the hepatic marker levels- transpeptidase, lactate dehydrogenase, sorbitol dehydrogenase, total bilirubin, total protein and albumin in serum were also restored to normal level in carbon tetrachloride (CCl <sub>4</sub> ) induced oxidative stress liver injury. It might be due to its antioxidant potential, free radical scavenging activities and reduction of fat metabolism.
Antifungal	Tanna <i>et al.</i> 2010[18] Praveena and Sudarsanam, 2011[37]	Discovered the antifungal activity of <i>E. littorale</i> blume against <i>Aspergillus niger</i> and <i>C. albicans</i> Reported antifungal activity against <i>Aeromonas hydrophila</i> and <i>C. albicans</i> .
Antibacterial	Praveena and Sudarsanam, 2011[37]	<i>E. littorale</i> exhibit prominent antibacterial activity against <i>Pseudomonasaeruginosa</i> , <i>Salmonella typhi</i> , <i>Staphylococcus aureus</i> and <i>Shigella sonnei</i> .
Antihelminthic	Mishra and Shukla, 2011[38]	Reported significant antihelminthic effects of <i>E. littorale</i> in animal models.
Antinociceptive	Jaishree <i>et al.</i> 2009[39]	Swertiamarin is an active constituent of most of the plant of family Gentianaceae including <i>E. littorale</i> . A swertiamarin isolated from <i>E. axillare</i> possesses potent peripheral and central antinociceptive activity.

\*SOD=Superoxide dismutase, \*\*GPx=Glutathione peroxidase, \*\*\*HDL=High-density lipoprotein, †CAT=Catalase, ††TBARS=Thiobarbituric acid reactive substances, ‡SGOT=Serum glutamic oxaloacetic transaminase, ‡SGPT= serum glutamic-pyruvic transaminase.

## Conclusion

*E. littorale* (Mamajjaka) is a relatively uncommon plant described in Ayurveda. Our ancient scholars and saints were well aware of its medicinal qualities. *E. littorale* (Mamajjaka) used by Ayurvedic physicians since a long time as a single herbal medicine or as an ingredient of medicinal preparations for the treatment of diabetes, obesity, liver disorders, acid peptic disorders, skin disorders and fever showed its immense therapeutic values. *E. littorale* contains a number of active phytoconstituent but out of them, Swertiamarin is major one. Previous ethnopharmacological studies showed *E. littorale* (Mamajjaka) exhibit a potent hypoglycemic, anti hyperinsulinemic, islet neurogenerative, antidiabetic, antihyperlipidaemic, antioxidant, antiulcer, anti-inflammatory, antitumor, hepatoprotective, hepatomodulatory, antifungal, antibacterial, antihelminthic and antinociceptive effect in different experimental animal models. Unfortunately, apart from Swertiamarin most of other bioactive ingredients are unexplored and there is only limited knowledge of mechanisms of action of bioactive compounds present in *E. littorale* (Mamajjaka). Hence, extensive preclinical and clinical studies are required to find out the exact mechanisms of action and bioactivity of the various phytochemicals to re-establish the traditional therapeutic potential on the scientific ground to serve the mankind.

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