

**Review article****Medicinally important *Leucas zeylanica* (L.) R. Br.: A review****P. W. H. K. P. Daulagala**Department of Botany, Faculty of Natural Sciences, Kandy Regional Centre,
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Abstract: Medicinal plants have been used for treatment of many diseases among human beings. Drugs obtained from plants are easily available, less expensive, safe and rarely cause undesirable side effects. *Leucas zeylanica* (Family: Lamiaceae) commonly known as ‘Ceylon Slitwort’ is one such plants that is being used traditionally as herbal medicine, since it contains a diverse range of phytochemicals with promising biological activities. This plant has been investigated for its phytochemicals such as alkaloids, steroids, flavonoids, other phenolic compounds and terpenoids which are responsible for antifungal, antioxidant, antibacterial, antidiabetic, larvicidal and antihelminthic activities. Further, in future, extensive scientific research and commercial exploitation of these phytochemicals have to be performed in the direction of preparation of drugs for treatment of a variety of diseases in humans. This review describes the taxonomic classification, botanical description, distribution, phytochemistry, pharmacological properties and biological activities of phytochemicals extracted from *L. zeylanica*, which will hold its prestigious position in the field of indigenous medicine in future.

Keywords: Antimicrobial - *Leucas zeylanica* - Medicinal plants - Pharmacology - Phytochemistry.

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INTRODUCTION

Medicinal plants are gifts of nature and are of great importance to human health. They have been used to cure a vast number of diseases among human beings all over the world (Kumar & Devanna 2016, Geethika & Kumar 2017). For the past few decades, there has been a global awareness about the cultivation, conservation as well as research of traditionally important medicinal plants (Larsen & Olsen 2007). The basis of this interest lies in their economic feasibility, less toxicity and various pharmacological activities (Samani *et al.* 2016). Herbs and different drugs derived from plants have been extensively used as traditional medicine all over the world and are popular as alternatives to produce new prospective natural drugs for many aggressive diseases (Rai *et al.* 2005). According to the data provided by the World Health Organization (WHO), approximately 80% of the world population is using herbal medicine for some aspects of their primary health care by manipulating nearly 70,000 different plant species (Foster *et al.* 2005).

Research findings indicate that many disease-causing microorganisms have developed resistance to some commercial antibiotics due to the unselective use of antimicrobial drugs. This situation has created immense clinical problems in treatments of many infectious diseases. The development of antibiotic resistant microorganisms and their distribution in microbial world encouraged scientists to search for new antimicrobial agents from plants (Davis 1994). Several medicinal plants have been investigated against mitigation and cure of a variety of devastating human diseases such as cancer (Desai *et al.* 2008). The medicinal importance of these plants is increasing rapidly nowadays and depends upon their chemical constituents that produce marked healing action on the human body. The most important of these agents are alkaloids, flavonoids, phenolic compounds and tannins (Hill 1952, Edeoga *et al.* 2005). These chemical constituents that produce definite physiological actions in the human body are important sources of antimicrobial agents and of many pharmaceutical drugs.

Leucas zeylanica (L.) R. Br., (syn. *Phlomis zeylanica* L., *Leucas sericea* Elm.) commonly known as Ceylon Slitwort, is a species within the genus *Leucas* and belongs to one of the largest and most distinguished families of flowering plants, the Family Lamiaceae (Li & Hedge 1994) which is commonly known as the mint family.

Throughout the world, hundreds of Lamiaceae species are used as medicinal and aromatic plants (Zielinska & Matkowski 2014). In Sri Lanka, there are 63 plant species of family Lamiaceae belonging to 12 genera and out of these 63 species, 51 of them are indigenous and the remaining 12 are endemic (Dassanayake & Fosberg 1981).

TAXONOMY AND DESCRIPTION

Kingdom: Plantae

Subkingdom: Tracheophyta

Super division: Spermatophyta

Division: Angiospermae

Class: Dicotyledonae

Order: Lamiales

Family: Lamiaceae

Subfamily: Lamioideae

Genus: *Leucas*

Species: *Leucas zeylanica*

Botanical description

Leucas zeylanica is a terrestrial, erect and annual herbaceous plant of about 30–60 cm in height (Fig. 1). The stems are quadrangular, succulent and sub-glabrous. Leaves are simple, packed at the apex of the stems, 3.0–7.5 cm × 0.5–1.5 cm, without stipules and decussate. The petiole is indistinct. The blade is lanceolate, sub-glabrous and shows ably 4–6 pairs of secondary veins which are sunken above and raised below. The margin is laxly lobed and recovered. The inflorescences are dense few-flowered terminal heads. The flowers are pure white and hairy at the base. The corolla is bi-lobed with the lower lobe much larger and indistinctly bifid. The calyx is tubular, sub-glabrous and shows eight tiny lobes. The androecium consists of two pairs of stamens. The fruit consists of four tiny nutlets packed in an accrescent calyx (Wiert 2006).

Distribution

Leucas zeylanica is native to Southeast Asian countries (Hossain *et al.* 2004) and found in China, India, Sri Lanka, Nepal, Bangladesh, Myanmar, Thailand, Malaysia, Indonesia, New Guinea and Philippines. It grows in various habitats including weedy and sunny localities, often on sandy soils, paddy dams, wastelands, open grasslands and road-sides (Li & Hedge 1994).



Figure 1. Habit of *Leucas zeylanica* (L.) R. Br. [Source: Geethika & Kumar 2017]

PHYTOCHEMISTRY

Phytochemicals are biologically active, naturally occurring chemical compounds found in plants, which provide more health benefits for humans than those attributed to macronutrients and micronutrients (Hasler & Blumberg 1999). These compounds are known as secondary plant metabolites and some of them are tannins, alkaloids, terpenoids, steroids, phenolic compounds, polyphenolic compounds and flavonoids, which provide definite physiological actions on the human body (Hill 1952). Each of these secondary metabolites have one or

more of the biological properties such as antioxidant activity, antimicrobial activity, modulation of detoxification of enzymes, stimulation of the immune system, decrease of platelet aggregation, modulation of hormone metabolism and anticarcinogenic property (Rao 2003) and an individual compound may have one or more of these biological properties. These phytochemicals can accumulate in different parts of the plants, such as in the roots, stems, leaves, flowers, fruits or seeds (Costa *et al.* 1999).

Leucas zeylanica is used traditionally to treat various diseases but not scientifically well justified. The leaf extracts of six *Leucas* species including *L. zeylanica* were screened by Geethika & Kumar (2017) for the qualitative analysis of various phytoconstituents such as alkaloids, flavonoids, phenols, tannins, terpenoids, saponins, carbohydrates, proteins and amino acids and glycosides in aqueous, methanol, ethanol and chloroform extracts. The methanolic leaf extract of *L. zeylanica* was found to possess a high amount of phenolics and a minimum quantity of tannins. The results showed that the leaf extracts were poor in alkaloid composition and could be detected only in methanol extracts similar to the tannins. Of the four types of extracts tested, methanol extracts showed the presence of most of the phytochemicals analysed *i.e.*, alkaloids, phenolics, tannins, terpenoids, carbohydrates and glycosides, except flavonoids, saponins, proteins and amino acids. The leaf extract of *L. zeylanica* showed a high degree of composition of carbohydrates in all four extracts. The results depicted above revealed that the phytochemical composition of the extract varied with the solvent used for the extraction of the leaf samples.

Another study based on the phytochemical analysis was carried out by Manoranjan *et al.* (2018) using the seed, leaf and stem extracts of the plant and found that only the crude ethanol extracts of stem and leaves of *L. zeylanica* contained tannins, and the flavonoids were the common constituent detected in extracts obtained from all three plant parts. Similar to tannins, alkaloids were found only in leaves and stems of *L. zeylanica* and absent in seeds. Further, it was observed that phlobatannins were found only in leaves of *L. zeylanica* but not in other parts of the plant and saponins were not detected in any part of the plant tested.

The phytochemical studies carried out by Mian *et al.* (2017) using the whole plants of *L. zeylanica* also found the presence of steroids, alkaloids, tannins, phenolic compounds and flavonoids in ethanolic extract used for screening.

PHARMACOLOGICAL PROPERTIES

The world is blessed with amusing prosperity of medicinal plants. Human beings have used plants directly or with some modifications as medicine for various health issues for thousands of years. Herbal plants are an integral part of traditional medicine worldwide and most researchers are more focused on natural chemicals in plants than man-made synthetic chemicals due to their environmental, economic and health benefits. Herbal plants are a natural source of numerous important phytochemicals and they are extensively used in many pharmaceutical industries worldwide.

Leucas zeylanica is a medicinally important plant and used in countries such as India, Bangladesh, Sri Lanka as a treatment for coughs, cold and headache, toothaches, abdominal pain, scabies, scorpion and snake bites (Caius 1998) and in addition to treat convulsions caused by fever (Yusuf *et al.* 2007). The fresh juice of leaves is used as a remedy for headache and cold (Chopra *et al.* 1996). It is also applied to skin diseases. The flowers are used for cough and cold. Further, it is used effectively in the treatment of worm infections by Sri Lankan traditional and ayurvedic physicians. It is also documented that a decoction of *L. zeylanica* can be used as an antihelminthic drug for *Enterobius vermicularis*, a common parasite that lives in the human digestive system (Ediriweera & Rajapaksha 2014). In Malaysia, the leaves are used in wound healing and also taken as a sedative.

BIOLOGICAL PROPERTIES

Antioxidant activity

Oxidative stress has been related increasingly to the onset and/or progression of various human diseases such as Parkinson's disease, Alzheimer's disease, amyotrophic lateral sclerosis, multiple sclerosis, depression, memory loss, lung and kidney disorders, liver and pancreatic diseases, cancer, ageing, diseases of the reproductive system including the male and female infertility *etc.* (Rahman *et al.* 2012). The phytochemical evaluation data of the extracts obtained from the whole plants and the leaves of *Leucas zeylanica* revealed the presence of many phytochemicals (Geethika & Kumar 2017, Mian *et al.* 2017, Manoranjan *et al.* 2018), and out of which, flavonoids and phenols are strong antioxidants and have an important role in the human health care system.

Antibacterial activity

According to a study carried out by Rajakaruna *et al.* (2002), a total of six bacteria, *i.e.* Gram-positive *Staphylococcus aureus* (methicillin-resistant), *Bacillus subtilis*, *Enterobacter faecalis*, Gram-negative *Escherichia coli*, *Pseudomonas aeruginosa* H187 (wild type) and a non-acid fast bacterium *Mycobacter phlei* were screened against some medicinal plant extracts including *L. zeylanica* for antibacterial activity using disc diffusion assay. The results showed that the extract of *L. zeylanica* produced the largest zones of inhibition against the two bacteria *Staphylococcus aureus* and *Bacillus subtilis* and the activity of the extract was either light induced or light enhanced.

Abdullah *et al.* (2019) tested the potential of *L. zeylanica* leaf extract to eliminate *Escherichia coli* and *Staphylococcus aureus* in *Corbicula fluminea* (“Etak”), a freshwater mollusc species regularly consumed as a popular snack among the Kelantanese in Malaysia. The antibacterial properties of methanolic leaf extract of *L. zeylanica* was tested using disc diffusion assay and the results obtained exhibited that 70 µg µl⁻¹ of *L. zeylanica* extract was the optimum concentration to give the effect of 10.6 mm and 14.8 mm inhibition zones for *Escherichia coli* and *Staphylococcus aureus* respectively.

Antifungal activity

In an investigation carried out by Babu *et al.* (2016), the antifungal activities of methanol extract of *L. zeylanica* leaves was tested against a group of different dermatophytes named *Candida tropicalis*, *Candida albicans*, *Trichophyton mentagrophytes*, *Microsporum gypsum*, *Microsporum nanum*, *Aspergillus flavus*, *Epidermophyton floccusum* and *Penicillium sp.* using agar well diffusion assay. Out of those fungi tested, some were susceptible to leaf extracts of *L. zeylanica* (except *Microsporum gypsum*, *Microsporum nanum* and *Epidermophyton floccusum*) with the highest activity against *Penicillium sp.* with a zone of inhibition of 10 mm, which is nearer to control where the control clotrimazole showed an inhibition zone of 10.5 mm. *L. zeylanica* leaf extract showed the minimum activity against *Candida tropicalis* (inhibition zone of 0.45 mm), but a considerably reduced activity against the yeast *Candida albicans* was recorded with 4 mm diameter of an inhibition zone.

Antifungal activity of ethanolic extracts of leaves, stem and seeds of *L. zeylanica* was detected against *Aspergillus sp.*, *Penicillium sp.*, *Trichoderma sp.*, *Mucor sp.* and *Rhizopus sp.* using the agar streaking assay (Manoranjan *et al.* 2018) and it was found that seed and stem extracts of *L. zeylanica* exhibited the antifungal activity against *Mucor sp.* of the fungi tested.

Larvicidal (mosquitocidal) activity

In work performed by Hung *et al.* (2019), the essential oil obtained from the aerial parts of *L. zeylanica* grown in Vietnam was examined for larvicidal activity against the *Aedes* mosquitos, one of the most important vectors of arboviruses such as dengue (Gubler 1998), yellow fever (Barrett & Higgs 2007) Chikungunya (Dhimal *et al.* 2015) and many other diseases of humans and animals.

The essential oils obtained by hydrodistillation and analyzed by gas chromatography-mass spectrometry were screened against *Aedes aegypti* and *Aedes albopictus*. Mortality of mosquito larvae was recorded after 24 hours and 48 hours of exposure to the *L. zeylanica* essential oil during which no nutritional supplement was added. *L. zeylanica* essential oil showed good larvicidal activity against both *Aedes albopictus* and *Aedes aegypti* with median lethal concentration LC₅₀ (24 hours) values of 67 and 44 µg ml⁻¹ respectively.

Antidiabetic activity

The antidiabetic potentiality of *L. zeylanica* plants was analyzed using a decoction prepared from the leaves and introducing it orally to 30 male Albino Wistar rats (*Rattus norvegicus*) in five experimental groups by Dutta *et al.* (2016). The study was designed to evaluate the blood glucose lowering effect of the aqueous extract of *L. zeylanica* leaves using the alloxan-induced diabetic rats and compared the activity with diabetic control and antidiabetic drug (Glibenclamide). The results showed that the extracts of *L. zeylanica* produced significant changes in serum glucose and cholesterol level in alloxan-induced diabetic rats. The prolonged treatment of the leaf extracts produced a consistent reduction in blood glucose levels. The continuous treatment with the leaf extract of *L. zeylanica* for 10 days produced a significant decrease in the blood glucose levels of the diabetic rats, but not in the normal rats.

Anti-helminthic activity

Radhika & Bindu (2018) tested the leaf extracts of *L. zeylanica* for the anti-helminthic activity using an Indian adult earthworm (*Pheretima posthuma*) which has anatomical and physiological similarity with the intestinal roundworm parasites of human beings. Earth worms were placed in Petri dishes containing two

different concentrations (10 and 20 mg ml⁻¹) of ethanolic and acetone extract of leaves of *L. zeylanica*. Time taken for paralysis or death was noted. The observations showed that the anti-helminthic activity of ethanol extract was more effective compared to the acetone extract. The earthworms were more sensitive to the ethanol extracts at 20 mg ml⁻¹ concentration as compared to the reference drug albendazole.

A decoction prepared from the *L. zeylanica* plants was tested for worm infection with special reference to *Enterobius vermicularis*, a parasite that lives in the human digestive system and is universally common, especially among school-age children (Ediriweera & Rajapaksha 2014). A hundred patients suffering from *E. vermicularis* infections were selected and fifty of them were given 120 ml of decoction of *Leucas zeylanica* twice a day for 7 days. The remaining fifty patients were given 120 ml of placebo twice a day for 7 days as the control treatment. From the results obtained, it was concluded that decoction of *L. zeylanica* can be used as an effective, low-cost, and indigenous treatment for *Enterobius vermicularis* infections among humans.

CONCLUSION

Presently there is an increasing interest in worldwide on herbal medicines and researches are carrying out to investigate the pharmacological properties of their phytochemical constituents and their use in treating many human diseases. The results of the studies carried out by many researchers revealed that the type and the number of phytochemical constituents obtained from *Leucas zeylanica* plants varied with the method and solvent used during the extraction. Among them, ethanol and methanol were considered as more suitable solvents. Phytochemical and pharmacological investigations revealed the presence of various chemical constituents such as alkaloids, phenolic compounds, steroids, flavonoids and terpenoids which are responsible for antifungal, antioxidant, antibacterial, antidiabetic, larvicidal and antihelminthic activities. Further extensive scientific exploration and commercial utilization of these phytochemicals have to be done in the direction of quality preparation of drugs from *L. zeylanica* in future for the treatment of a variety of disease conditions among humans.

REFERENCES

- Abdullah F, Nasir SNAM, Han DK, Appalasamy S, Nor MM & Rak AE (2019) Potential of *Leucas zeylanica* extract to eliminate *E. coli* and *S. aureus* in *Corbicula fluminea* ("Etak") tissue. *Malaysian Journal of Fundamental and Applied Sciences* 15(4): 597–599.
- Babu A, Mohamed ASN, Jaikumar K, Anand D & Saravanan P (2016) *In-vitro* antifungal activity of leaf extracts of *Leucas aspera* and *Leucas zeylanica*. *International Journal of Pharmaceutical Sciences and Research* 7(2): 752–756.
- Barrett ADT & Higgs S (2007) Yellow fever: a disease that has yet to be conquered. *Annual Review of Entomology* 52(1): 209–229.
- Caius JF (1998) The medicinal and poisonous plants of India. Scientific Publishers, India.
- Chopra RN, Nayar SL & Chopra IC (1996) *Glossary of Indian medicinal plants*. National Institute of Science Communication, New Delhi, India.
- Costa MA, Zia ZQ, Davin LB & Lewis NG (1999) Chapter Four: Toward Engineering the Metabolic Pathways of Cancer-Preventing Lignans in Cereal Grains and Other Crops. In: Romeo JT (ed) *Recent Advances in Phytochemistry, Phytochemicals in Human Health Protection, Nutrition, and Plant Defense*. New York, pp 67–87.
- Dassanayake MD & Fosberg FR (1981) *A Revised Hand Book to the Flora of Ceylon*. Amerind, New Delhi, pp. 108–194.
- Davis J (1994) Inactivation of antibiotics and the dissemination of resistance genes. *Science* 264: 375–382.
- Desai Ag, Qazi GN, Ganju, El-Tamar M, Singh J & Saxena AK (2008) Medicinal plants and cancer chemoprevention. *Current Drug Metabolism* 9: 581–591.
- Dhimal M, Gautam I, Joshi HD, O'Hara RB, Ahrens B & Kuch U (2015) Risk factors for the presence of Chikungunya and dengue vectors (*Aedes aegypti* and *Aedes albopictus*), their altitudinal distribution and climatic determinants of their abundance in central Nepal. *PLoS Neglected Tropical Diseases* 9(3): e0003545.
- Dutta M, Mia MW, Uddin MZ, Sultana S, Tazneen N & Barua S (2016) Antidiabetic potentiality of aqueous leaf extract of *Leucas zeylanica* in alloxan-induced diabetic rats. *Journal of Innovations in Pharmaceutical and Biological Sciences* 3 (4): 121–124.
- Ediriweera ERHSS & Rajapaksha RPVJ (2014) Effect of decoction of *Leucas zeylanica* in worm infestation with special reference to *Enterobius vermicularis*. *Journal of Ayurveda and Holistic Medicine* 2(3): 11–17.

- Edeoga HO, Okwu DE & Mbaebie BO (2005) Phytochemical constituents of some Nigerian medicinal plants. *African Journal of Biotechnology* 4: 685–688.
- Foster BC, Arnason JT & Briggs CJ (2005) Natural health products and drug disposition. *Annual Review of Pharmacology and Toxicology* 45: 203–26.
- Geethika K & Kumar PS (2017) Preliminary phytochemical screening of 6 members of *Leucas* (Lamiaceae). *International Journal of Pharmaceutical Sciences Review and Research* 47(1): 60–64.
- Gubler DJ (1998) Dengue and dengue hemorrhagic fever. *Clinical Microbiology Reviews* 11(3):480–496.
- Hasler CM & Blumberg JB (1999) Symposium on phytochemicals: Biochemistry and physiology. *Journal of Nutrition* 129: 756S–757S.
- Hill AF (1952) *Economic Botany: A Textbook of useful plants and plant products*, 2nd eds. McGraw – Hill Book Company Inc, New York, pp. 32–35.
- Hossain MS, Hossain MA, Islam R, Alam AH, Sarkar S & Farooque MA (2004) Antimicrobial and cytotoxic activities of 2-aminobenzoic acid and 2-aminophenol and their coordination complexes with Magnesium (Mg- II). *Pakistan Journal of Biological Sciences* 7: 7–25.
- Hung NH, Chuong NTH, Satyal P, Hieu HV, Dai DN, Huong LT, Sinh LH, Ngoc NTB, Hien VT & Setzer WN (2019) Mosquito larvicidal activities and chemical compositions of the essential oils of *Leucas zeylanica* growing wild in Vietnam. *Natural Product Communications* 1–7. [DOI: 10.1177/1934578X19842675]
- Kumar GV & Devanna N (2016) An update of *Leucas aspera* - a medicinal plant. *International Journal of Science and Research Methodology* 5(1): 485–503.
- Larsen HO & Olsen CS (2007) Unsustainable collection and unfair trade? uncovering and assessing assumptions regarding Central Himalayan medicinal plant conservation. In: Hawksworth DL & Bull AT (eds) *Plant Conservation and Biodiversity. Topics in Biodiversity and Conservation*, vol. 6. Springer, Dordrecht, pp. 105–123.
- Li H & Hedge IC (1994) Lamiaceae. In: Wu ZY, Raven PH & Hong DY (eds) *Flora of China (Verbenaceae through Solanaceae)*. Missouri, USA: Missouri Botanical Garden Press, St. Louis, pp. 50–299.
- Manoranjan T, Thangarajah R & Thavaranjit AC (2018) Antifungal activity and qualitative phytochemical analysis of some medicinal plants in Jaffna (Sri Lanka). *International Journal of Organic Chemistry* 8: 335–340.
- Mian MM, Redi FF & Rahman A (2017) In vitro antioxidant activity and in-vivo analgesic, cytotoxic and central nervous system depression effects of ethanolic extract of *Leucas zeylanica* (L) W.T. Aiton in Swiss albino mice. *European Journal of Pharmaceutical and Medical Research* 4(2): 104–111.
- Radhika B & Bindu CHS (2018) Anti-helminthic activity of *Leucas zeylanica* Linn leaves. *International Journal of Pharmaceutical & Biological Archives* 9(2): 70–73.
- Rahman T, Hosen I, Islam MMT & Shekhar HU (2012) Oxidative stress and human health. *Advances in Bioscience and Biotechnology* 3: 1–23.
- Rai V, Agarwal M, Agnihotri AK, Khatoun S, Rawat AK & Mehrotra S (2005) Pharmacognostical evaluation of *Leucas aspera*. *Natural Product Sciences* 11: 109–114.
- Rajakaruna N, Harris CS & Towers GHN (2002) Antimicrobial activity of plants collected from serpentine outcrops in Sri Lanka. *Pharmaceutical Biology* 40(3): 235–244.
- Rao N (2003) Bioactive phytochemicals in Indian foods and their potential in health promotion and disease prevention. *Asia Pacific Journal of Clinical Nutrition* 12(1): 9–22.
- Samani MA, Moradi MT, Bahmani, M & Shahrani M (2016) Antiviral medicinal plants of Iran: A review of ethno botanical evidence. *International Journal of Pharmtech Research* 9: 427–434.
- Wiat C (2006) *Medicinal plants of the Asia-Pacific: Drugs for the future?* Hackensack, N.J: World Scientific.
- Yusuf M, Wahab MA, Yousuf M, Chowdhury JU & Begum J (2007) Some tribal medicinal plants of Chittagong hill tracts. *Bangladesh Journal of Plant Taxonomy* 14(2): 117–128.
- Zielinska S & Matkowski A (2014) Phytochemistry and bioactivity of aromatic and medicinal plants from the genus *Agastache* (Lamiaceae). *Phytochemistry Reviews* 13: 391–416.