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Leucas aspera: A wild traditional green leafy vegetable with immense pharmacological properties

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Abstract

The use of plants in the treatment of various diseases was as old as mankind. They were an important part of traditional medicine in different places of the world. *Leucas aspera* was a very common weed in Africa, Asia, temperate and tropical countries. Due to its potential medicinal properties whole plant was used in traditional medicine to treat various health problems. Plant had antimicrobial, antioxidant, Larvicidal, Antinociceptive, hepatoprotective, anti-hyperglycemic, anticancer, Anti-inflammatory, wound healing and antiulcer activities. Roots, stems, leaves and flowers of *Leucas aspera* were found to have high antibacterial activity against various bacteria. Different extracts of leaves had an anabolic effect and hepatoprotective activity, antidiabetic and anti-venom activity; roots had analgesic activity, aerial parts exhibit ulcer protective and anti -arthritis effect and the whole plant had the potential of anthelmintic activity, cytotoxic activity. The plant is also had food value and is used during festivals like Vinayaka Chavithi. Lack of awareness on the uses and importance, the plant is treated as underutilised.

Keywords: *Leucas aspera*, antimicrobial, antioxidant, Antidiabetic, antiarthritis

Introduction

The use of plants in the treatment of various diseases was as old as mankind [Sabri and Vimala, 2015] [27]. Plants were used as most potent and powerful drugs in traditional medicine in different parts of the world [Nirmala and Kanchana, 2018] [20]. The term medicinal plants mean that plants contribute various therapeutic and pharmacological benefits to human body. Medicinal plants include multiple plant types, and they serve as a rich source of ingredients which were used in the development of the drug [Hossain *et al.*, 2011] [12].

In the last few decades, studying medicinal plants and their value in different countries was increasing. The increased interest was due their potent pharmacological benefits, low cost and no toxicity [Chew *et al.*, 2012] [6]. Nowadays, the term Alternative medicines were more common, based on the idea of use of plants for medicinal purposes [Hassan, 2012] [11]. According to WHO, medicinal plants were good source of variety of drugs and almost 80% of people from developing countries use medicinal plants in traditional medicine [Latha *et al.*, 2013] [17].

In India there were about 45000 medicinal plants and these were mostly present in the Eastern Himalayas, Andaman and Nicobar Islands and Western ghats region. Even though 3000 plants were officially documented, but the traditional practitioners used more than 6000 plant species. India was the Botanical Garden of the world as it was the largest medicinal plant producer [Patro, 2016] [21].

Leucas aspera belongs to the genus leucas and the family Lamiaceae available in India from the Himalayas to down Ceylon [Prajapati *et al.*, 2010] [23]. *Leucas aspera* was an aromatic plant commonly grown as a widespread weed in Africa, Asia, temperate and tropical countries. Due to potential medicinal properties, whole plant was used in traditional medicine to treat various health problems [Chew *et al.*, 2012] [6].

Botanical information

Leucas aspera was an annual herb and grows up to the height of 15-60 cm with quadrangular stem and branches.

Leaves of *Leucas aspera* was yellowish green, obtuse or petiolate, pungent and can reach up to length of 8.0 cm and width of 1.25 cm. flowers of *Leucas aspera* were small, white in colour and directly attached to base without peduncle. Auxiliary whorls held all the flowers together. It has tubular shaped calyx with bottom half looks like membranous and upper half was ribbed and hispid. Calyx also had a small oblique mouth and short triangular teeth. Fruits of *Leucas aspera* were oblong in shape, brown in colour and smooth [Jayakumar *et al.*, 2015] [13].

Table 1: Showing the Vernacular names [Sabri and Vimala, 2015; Kumar *et al.*, 2019] [27, 16]

Telugu	Thummichittu
Hindi	Goma madhupati
Sanskrit	Dronapushpi, chitrapathrika, chitrakshup
Bengali	Darunaphula, hulkasha
Maharashtra	Bahuphul
Bombay	Tumba
Gujarati	Kulnphul
Punjabi	Guldor
Sindhi	Kubo

Table 2: Taxonomical classification [Kumar *et al.*, 2019] [16]

Kingdom	Plantae, plant
Subkingdom	Tracheobionta, vascular plant
Super division	Spermatophyta, seed plant
Division	Angiosperma
Class	Dicotyledonae
Sub-class	Gamopetalae
Series	Bicarpellatae
Order	Tubiflorae
Family	Labiatae or lamiaceae
Genus	<i>Leucas</i>
Species	<i>L. aspera</i>



Fig 1: *Leucas aspera*

Nutritional and anti-nutritional composition of *Leucas aspera*

Chemical composition of *Leucas aspera* per 100 gm on dry weight basis was: calcium-1.08 mg, magnesium-0.12 mg, potassium-0.04 mg, phosphorous-0.32mg, sodium-0.03mg, iron-2.78 mg, zinc-5.60 mg, ascorbic acid-22.50 mg, riboflavin-0.25mg, thiamine-0.15 mg, niacin-0.07 mg, alkaloids-1.25 mg, flavonoids-1.75 mg, phenols-1.64mg and tannins-0.55 mg [Bhardwaj and Yadav, 2016] [3].

Nutritional and antinutritional composition of *Leucas aspera* per 100 gm on dry weight basis was: dietary fiber-7.90gm, Ash-2.35 gm, iron-70.19 mg, calcium-1147.30 mg, zinc-4.40 mg, copper-1.40 mg, tannin-996.60mg and oxalate content-127.80 mg [Pattan and Devi, 2013] [22]. Nutritional composition of fresh leaves of *Leucas aspera* was: moisture-21.6 ±7.8%, crude protein- 26.17 ±1.26 mg/gm, total sugars-57.32 ±1.50 mg/gm, total lipid- 0.002 ±0.001 mg/gm and vitamin C- 0.296 ±0.01 mg/gm [Mishra and Mishra, 2014] [18].

Babu *et al.* evaluated the elemental concentration (P, S, Cl, K, Ca, Mn, Fe, Cu, Zn, Br, Se, Rb, and Sr) of *Leucas aspera* by using Energy dispersive X-ray fluorescence. Mineral concentration of plant was: P- 2569±80, S- 1355±82, Cl- 15545±50, K- 11940.7±175, Ca- 13928.6±90, Mn- 205±5, Fe- 609±9, Cu- 11.2±1.7, Zn- 29.6±0.6, Se-1.21±0.8, Br- 320.5±2.5, Rb- 76.7±1 and Sr- 59.3±1 ppm [Babu *et al.*, 2015]. Heavy metal composition of *Leucas aspera* collected from different locations was tested by atomic absorption spectrophotometer. Among the analyzed five common heavy metals Fe, Zn, Cr, Cu and Pb, Fe was found higher and other were in the normal range in all locations [Dalvi *et al.*, 2007] [7].

Biological activities of *Leucas aspera*

It was reported that all parts of the plant had pharmacological properties and were useful to various fields of medicine. The entire plant was used as antipyretic in fever conditions, and to treat cold, scabies, psoriasis and chronic skin infections. Juice extracted from leaves was used in case of psoriasis, painful swelling, skin infections, in jaundice, asthma, oedema and also used as cold drops. Flowers of the plant were valued as insecticide, stimulant, diaphoretic and emmenagogue [Jayakumar *et al.*, 2015] [13]. Different solvent extracts of leaves had anabolic effect and hepatoprotective activity, antidiabetic and anti-venom activity; roots had analgesic activity, aerial parts exhibit ulcer protective and anti-arthritis effect and the whole plant had potential of anthelmintic activity, cytotoxic activity. Several researchers reported use of *Leucas aspera* in treatment of various disease conditions in traditional medicine. Presence of trace and phytochemical compounds in the plant was responsible for the medicinal properties of the plant [Kumar *et al.*, 2019] [16] and no harmful metals were detected in the *Leucas aspera* [Nirmala and Kanchana, 2018] [20].

Antimicrobial activity

Detergent properties of phenols and flavonoids present in the plant may be reasonable for the membrane damage in bacteria and leakage of cellular contents [Nirmala and Kanchana, 2018] [20]. Roots, stems, leaves and flowers of *Leucas aspera* found high antibacterial activity against various bacterial types like *E. Coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella typhimurium*, *Shigella flexneri* and *Salmonella choleraesuis*. Volatile oils extracted from *Leucas aspera* exhibited good antibacterial activity. Methanol extract of leaves observed high antibacterial activity against *Pseudomonas aeruginosa* whereas ethanolic extract against *Shigella dysenteriae* [Sabri and Vimala, 2015] [27]. Chloroform and petroleum extracts of plants reported high antifungal activity against *Trichophyton* and *Microsporum gypseum* at a concentration of 5 mg/ml [Kumar *et al.*, 2019] [16]. Root extracts had high

antimicrobial activity followed by flower, leaf and stem [Chew *et al.*, 2012] ^[6]. Volatile constituents of *Leucas aspera* exhibited good microbial activity against *S. aureus*, *B. cereus*, and *A. niger* [Satyal *et al.*, 2012] ^[30]. Nickel oxide nanoparticles developed from *Leucas aspera* leaves and flowers exhibited good antimicrobial activity against gram positive and gram-negative bacteria at 1000 µg/ml concentration [Priya *et al.*, 2020] ^[24].

Antioxidant activity

Oxidative stress led to many degenerative diseases and other health problems like cardiovascular diseases, cancers and neurodegenerative diseases. Many studies reported antioxidant activity of leaves of *Leucas aspera* and found that ethanol and petroleum ether extracts exhibited high antioxidant activity [Nirmala and Kanchana, 2018] ^[20]. Root extracts of plant had high free radical scavenging activity (32.6%), flower (26.39%), leaf (17.04%) and stem (13.42%). Antioxidant enzymes like catalase, superoxide dismutase, glutathione increased and lipid peroxidation levels in the liver were decreased by extracts of *Leucas aspera*. Total phenolic content was 28.33 gallic equivalents mg/gm and flavonoid content was 3.96 Rutin equivalents mg/gm of extract. *In vitro* antioxidant analysis reported IC₅₀ values of DPPH antioxidant activity was 150 µg/ml, total phenol 131.15 mg/ml and flavonoid 135.85 mg/ml [Sabri and Vimala, 2015] ^[27]. DPPH evaluation of plant was 24 µg/ml, total flavonoid 184 mg/ml, total phenol 172 mg/ml and FRAP assay was 27.88% [Suruthi *et al.* 2016] ^[31]. Phenol content of *Leucas aspera* in methanol, ethanol and hexane was 167, 193 and 131.1 µg/ml of extract respectively [Sahu *et al.*, 2013]. IC 50 values for DPPH free radical scavenging activity (35.335µg/ml), superoxide scavenging activity (1887.132µg/ml), nitric oxide scavenging activity (3460.854µg/ml), iron chelating activity (146.425 µg/ml). The total phenol 80.249mg/g and phenolic acid 2.394 mg/g, total flavonoid content 0.927mg/g, vitamin E 645.69mg/g on dry weight basis and glutathione content 6022.972µM/g, vitamin C 0.084mg/gm in fresh samples [Borah *et al.*, 2011]. Impact of digestive enzymes on the antioxidant activities of *Leucas aspera* observed that *in vitro* digestion of leaves exhibited decrease in phenol and flavonoid content by 14.73% and 17.76%, respectively. And there was no significant decrease was found in free radical scavenging activity of both leaves [Chakraborty *et al.*, 2020] ^[5].

Larvicidal activity

Larvicidal Activity against *Aedes aegypti* and *Culex quinquefasciatus* was observed by leaf extracts of *Leucas aspera* at lethal concentration LC₅₀ of 77.4 ppm and 1222.2 ppm respectively. Compared to ethanol and chloroform extracts, hexane had high larvicidal Activity [Kumar *et al.*, 2019] ^[16]. *Leucas aspera* was used as a mosquito repellent and extracts of plant was very effective against 1st, 2nd, 3rd and 4th stage instar larvae of *Culex quinquefasciatus* [Sabri and Vimala, 2015] ^[27].

Antinociceptive activity

Acetic acid induced gastric pain in mice was administered with *Leucas aspera* reported Antinociceptive Activity. The activity was found high in methanol extracts and even at low concentrations compared to aspirin drug [Kumar *et al.*, 2019] ^[16].

Hepatoprotective activity

Methanol extracts of *Leucas aspera* found a good hepatoprotective activity against carbon tetrachloride induced liver damage in Rats [Kumar *et al.*, 2019] ^[16]. Fresh juice from leaves of *Leucas aspera* had high liver protective activity [Sabri and Vimala, 2015] ^[27]. Effect of *Leucas aspera* on CCL4 induced hepato-carcinogenesis in rats was studied by Gupta *et al.* On administration with ethanolic and aqueous extracts of *Leucas aspera* exhibited the decreased hepatic cell proliferation and nodulogenesis in tested rats [Gupta *et al.*, 2014] ^[9]. Hydroalcoholic extracts of *Leucas aspera* leaves at a dose of 400mg exhibited hepatoprotective activities in male albino rats exposed to lead acetate at a dose of 50mg/kg. The study found that there was a significant reduction in liver enzymes in a dose dependent manner ($p < 0.05$) [Thenmozi *et al.*, 2013] ^[32].

Antihyperglycemic activity

Kumar *et al.* reported that there was dose dependant decrease in serum glucose levels in mice when fed with methanol extracts of stem and leaves of *Leucas aspera* at concentration of 400 mg/ kg body weight. When compared to stems, leaves exhibited high potential in reducing glucose levels [Kumar *et al.*, 2019] ^[16]. There was decreased blood glucose levels in dose dependant manner by feeding of leaves of *Leucas aspera* to experimental rats with type 1 diabetes [Sabri and Vimala, 2015] ^[27].

Anticancer activity

Ethanolic and aqueous extracts of *Leucas aspera* demonstrated the decreased hepatic cell proliferation and nodulogenesis in CCl₄ induced hepatocarcinoma in rats [Gupta *et al.*, 2014] ^[9]. Impact of nanomedicine developed from *Leucas aspera* on prostate cancer cells was developed by Mohan *et al.* Methanolic extracts of plant was used for the preparation of nanoparticles and studies for cytotoxic effects in normal and prostate cancer cells. It was found that plant nanoparticles activity was dependent on concentration and time in *in vitro* cytotoxic studies [Mohan *et al.*, 2014] ^[19].

Anti-inflammatory Activity

Extracts of *Leucas aspera* exhibited anti-inflammatory activity towards acute, sub-acute and chronic inflammation. Compared to acetyl salicylic acid and phenyl butazone, *Leucas aspera* was very effective in acute inflammatory conditions [Sabri and Vimala, 2015] ^[27]. Extracts of *Leucas aspera* inhibited prostaglandin E₁ and E₂ induced contractions in guinea pigs [Sadhu *et al.*, 2003] ^[28]. Adjuvant induced arthritic rats was administered orally with hydroalcoholic extracts of *Leucas aspera* at a dose of 100 mg/kg bodyweight for 21 days and inflammatory markers were assessed. The study found that rats fed with plant extract exhibited significant anti-inflammatory and antioxidant activity and no mortality was found up to 2000mg/kg body weight. It was also found that rat fed with extract found cartilage regeneration and near joint in histopathological studies [Kripa *et al.*, 2010] ^[15].

Antivenom Activity

Triterpenoid extracted from *Leucas aspera* Linn. was tested for antivenom activity against *Naja naja* induced toxicity in mice by Venkatesan *et al.* 1-hydroxytetraatriacontane-4-one (C₃₄H₆₈O₂), was isolated from methanol extracts of *Leucas aspera* plant was compared with commercial

antiserum. It was observed that triterpenoid significantly reduced the venom induced antioxidant status at a dose of 75mg per mice [Venkatesan *et al.*, 2014] ^[10].

Wound healing activity

Baicalein-7-O- β -D-glucuronide (baicalin) isolated from methanol extracts of *Leucas aspera* flowers was investigated for wound healing activity in albino rats. And it was found that earlier there was slow healing process but after the 12th day rapid healing process was observed. Baicalin isolated from flowers of *L. aspera* has better wound healing activity [Kalaivanan *et al.*, 2013] ^[14].

Angiosuppressive Activity

Angiogenesis promotes growth of tumours by providing nutrients and oxygen, and facilitating tumour invasion and metastasis. So, it was a target for cancer chemotherapy. Different solvent extracts of *Leucas aspera* leaf and stem was studied for Angiosuppressive activity using Chicken Chorioallantoic Membrane (CAM). Methanol extract of leaf revealed high Angiosuppressive activity. By this the plant can be used in designing the drugs to cure anti-angiogenesis [Devi *et al.*, 2012] ^[8].

Antiulcer activity

Alcoholic extracts of *Leucas aspera* were tested for anti-ulcer activity revealed significant reduction in free and total acid secretion at 100 and 200 mg/kg of *Leucas aspera* extract treatment [Reddy *et al.*, 1992] ^[26].

Miscellaneous Activity

Leucas aspera provides protective role against snake venom poisoning in rats. Due to stabilisation of mast cells and inhibition of platelet activating factor section and histamine increases survival time [Sabri and Vimala, 2015] ^[27].

Source of Essential oils

Essential oils were from aerial parts of *Leucas aspera* by hydro-distillation for isolation of essential oil and chemical composition of oil was done by gas chromatography. It was identified 43 compounds, accounts for 98.1% of total oil. β -caryophyllene (34.2%), epi- α -bisabolol (4.6%), 1-octen-3-ol (14.8%), α -humulene (6.3%), α -pinene (5.8%), and limonene (4.5%) were the main constituents of the oil. The oil was also rich in sesquiterpene hydrocarbons (47.7%), followed by others (long chain hydrocarbons (LCH), oxygenated LCH and phenyl derivative constituents) (20.2%), monoterpene hydrocarbons (14.8%), oxygenated sesquiterpenes (14.8%) and oxygenated monoterpene (0.6%) [Reddy *et al.*, 1992] ^[26].

Phytochemical compounds found in *Leucas aspera*

Phytochemical screening of *Leucas aspera* revealed the presence of alkaloids, phenols, tannins and terpenoids [Basarkar, 2014] ^[2]. Bioactive compounds like Glycerin, 1-(3 methyl butyryl) pyrrolidine, Benzene acetaldehyde, Propane, 1,3-triethoxy-, Thymine, 2,3-dihydro-3,5-dihydroxy-6-methyl, 4H-Pyran-4-one, 3,5-dihydro-2-methyl, 2-Furan carboxaldehyde, 5-(hydroxymethyl)-, Caryophyllene, A-Caryophyllene (Humulene), Azulene, Caryophyllene oxide, 4-Hydroxy-2-methoxycinnamaldehyde, Tetradecanoic acid, Phytol, flavonoids, alkaloids, lignin, phenolic compounds and tannins were found in the *Leucas aspera* plant [Priya *et al.*, 2018] ^[25]. Phytochemical screening of *Leucas aspera* found

presence of sterols, flavonoids, galactose, ursolic acid, oleanolic acid, Beta-sitosterol, alpha -sitosterol, cardiac glycosides, saponins and tannins. Total antioxidant and phenol were 190.00 ± 7.95 mg/g and 15.36 ± 0.512 GAE/g dry weight of extract respectively [Latha *et al.*, 2013] ^[17].

Conclusion

Medicinal plants were an important part of the traditional medicinal system. The development of drugs from plants prevents side effects caused by other chemical drugs. *Leucas aspera* was an important medicinal plant available in India. The plant was a good source of minerals, antioxidants and essential oils. Every part of *Leucas aspera* had pharmacological activities and provides protection against cancer, cardiovascular diseases, arthritis, oral disorders, ulcer, hepatic cancers and other inflammatory diseases. Sustainable harvesting and various conservation techniques has to be followed to conserve threatened species.

Future scope of the study

The use of the plant is only restricted to pharmaceutical purposes. There are knowledge gaps between the plant chemical importance, cultivation practices and their value addition to various foods helps to provide health, food and nutritional security.

Conflict of interest

No conflict of interest to declare.

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