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Therapeutics potential and pharmacological properties of *Leucas indica*: A review

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Abstract
Leucas indica belongs to the family Lamiaceae commonly known as Guma, Tumba, Dandokalos. Traditionally, it is used in Garhwal region of Uttarakhand as a wound healer. The leaves of this plant are squeezed and placed on wounds to obtain wound healing. Leaves are also used as vermifuge, stomachic, sedative and in sores. This plant is widely used in psoriasis, chronic skin eruptions and painful swellings. The herb is also used in jaundice, inflammation, asthma, dyspepsia, fever and cold, snake bites and scorpion stings.

Keywords: *Leucas indica*; Phytochemistry; Pharmacology; Wound healing

Introduction
India is the country where herbal medicines are popular over allopathic medicines. Genus *Leucas* was first described by Robert Brown containing more than 200 species [1]. This article reviews the qualities and current research on medicinal plant *Leucas indica*. It belongs to family Lamiaceae and is commonly known as Guma, Tumba, Dandokalos. It is distributed all over India along with road-side waste-land, river banks and rocky hills [1, 2]. It is an erect herb with pubescent branching. The leaves of this plant are linear lanceolate in nature while the flowers are white with four stamens. Traditionally, it is used in Garhwal region of Uttarakhand as a wound healer. The leaves of this plant are squeezed and placed on wounds to obtain wound healing [4]. Leaves are also used as vermifuge, stomachic, sedative and in sores. This plant is widely used in psoriasis, chronic skin eruptions and painful [5, 6].The herb is also used in jaundice, inflammation, asthma, dyspepsia, fever and cold, snake bites and scorpion stings [7, 8]. The phytochemicals like phenylethanoid, glycosides were isolated from the aerial parts of *Leucas indica* having antioxidant property [2, 3]. The antimicrobial activity of crude aerial part extract of plant was studied, the aerial part extract in chloroform, methanolic fraction showed enough positive results against *Staphylococcus aureus, Bacillus subtilis, Salmonella typhi, Pseudomonas aeruginosa* and *Escherichia coli* whereas the aqueous fraction inhibited the growth of *Staphylococcus aureus, Bacillus subtilis* and *Salmonella typhi* significantly [3].

Botany
Taxonomy
Kingdom - Plantae
Phylum - Tracheophyta
Class - Magnoliopsida
Order - Lamiales
Family - Lamiaceae
Species - *indica*

Botanical description
Leucas indica is erect or diffuse, aromatic annual herb having length 16-60cm. Leaves of this plant contain 0.5 - 1.0 cm long petiole having lamina 6.0 - 9.0 x 0.5 - 2.5 cm which is linear or narrowly oblong-lanceolate or elliptic-lanceolate. The shape of the leaves is acute having a narrow base, margin entire or obscurely crenate, more or less pubescent on both surfaces. Inflorescence whorls of this herb are terminal and axillary, often the whorls of the successive nodes join to form a cylindrical spike. Bract 0.6 cm long, almost equalling the calyx, tip spinulose, pubescent. Calyx 0.8 cm long, tubular, curved, constricted above the nutlets, usually smooth and glabrous below, ribbed and scabrid above, mouth very oblique, produced on the

upper side, teeth short, triangular, spinulose, the upper one longest, pubescent within only above the nutlets. Nutlets 0.3 x 0.1 cm, obovoid-oblong, angular on the inner face, rounded on outer, smooth, brownish black [9]. Flowering and fruiting is almost throughout the year, but especially during September to March [9, 10].

Ecology and Distribution

It is distributed in South Asia among Bangladesh, India and Myanmar. In India it is distributed almost in every state along with road-side waste-land, river banks and rocky hills [9, 2, 3].

Taxonomic history

The genus *Leucas* is one among the 250 genera of the family Lamiaceae which is distributed throughout the tropical regions of the earth. Its immediate ancestor is not known and the phylogenetical relations are not clearly expressed or easily understood [11]. The genus contains several shrubby species, the leaves are (bracts) subtending the verticillasters are not bracteose. Its inflorescence more often not separated from the vegetative parts and also not formed to a condensed spike-like or head like false inflorescence. The number of flowers in the genus is not fixed. This genus can be distinguished from other members of the family Lamiaceae by its 6-10 toothed calyx and white flower with lower lip of corolla longer than the bearded upper lip. It shows similarity to *Anisomeles* but the latter has a calyx, which is equally five-lobed and nerved [12].

Chemistry

This plant has been widely studied for its chemical constituents. Chemical analysis of various parts of the plant showed the presence of carbohydrates, alkaloids, steroids, flavonoids, Triterpenoids, Fatty alcohol etc. [1]. A new phenylpropanoid glycoside was reported by Mostafa *et al.*, 2014. During their work they found α-L- rhamnopyranosyl-(1→3)-*O*-α-L- rhamnopyranosyl-(1→6)-1-*O*-caffeoyl-β-D-glucopyranoside (1) along with two known phenylethanoid glycosides, β-(3-hydroxy-4-methoxy-phenyl)-ethyl-*O*-(β-D-glucopyranosyl)-(1→2)-*O*-(α-L-rhamnosyl) (1→3)-6- *O*-*E*-feruloyl-β-D-glucoside(2)(incanoside A) and β-(3,4-dihydroxy-phenyl)-ethyl-*O*- (α-L-rhamnosyl)-(1→3) *O*-(β-D-glucoside)- (1→6)-4-*O*-*E*-caffeoyl-β-D-glucoside (3). The detailed account on the chemistry of essential oil isolated from *Leucas indiaca* was given by Rosamma (2002). During the study he found that the characteristic odour of the plant is due to the presence of hexane and octane derivatives. Moreover, the main aroma in the fresh plant is due to the presence of 1-octen-3-ol (Table- 1)

Table 1: Constituents of *Leucas indica* essential oil and their aroma [14].

S. No.	Compounds	Aroma type
1	*trans*-2-Hexyl butyrate	green fruity
2	Methyl nonanoate	Wine-like
3	Carveol	Spearmint odour
4	Decanol	Floral- Fruity
5	Octyl isobutyrate	Fruity
6	Undecanol	Citrus - orange
7	Geranyl acetate	Rose like
8	Ethyl Octanoate	Banana, pineapple, pear
9	Eugenol	Strong spicy
10	Pulegone	Mint, camphor
11	α- Terpineol	Floral
12	Heptyl butyrate	Sweet
13	Benzyl butyrate	Fruity
14	2-phenylethy acetate	Rose like
15	Palmitic acid	Odourless
16	α-Farnesene	Mildly sweet
17	Decyl acetate	Orange, pineapple like
18	Nonyl acetate	Fruity
19	*trans*-2-Hexenyl hexanoate	No aroma data available
20	Benzyl benzoate	Faint sweet
21	Octyl butyrate	Musty-fruity
22	*cis*-3-Hexanoate	Fruity
23	α-Humulene	Weak woody
24	α-Copaene	Weak woody
25	Octyl acetate	Fruity
26	Dodecane	No aroma data available
27	α-Muurolene	No aroma data available
28	Nerolidol	Rose like
29	Valencene	Woody
30	*cis*-3-Hexenyl octanoate	No aroma data available
31	δ-Cadinene	Woody
32	*cis*-3-Hexenyl benzoate	Herbaceous
33	α-Bergamotene	Weak bergamot like
34	Tridecane	No aroma data available
35	β-Myrcene	Sweet - balsamic
36	*trans*-Linalool oxide	Powerfull sweet-woody
37	*cis*-3-Hexenyl isobutyrate	Sweet green
38	Ethyl benzoate	Floral- Fruity
39	Terpinen-4-ol	Spicy

40	*trans*-2-Octen-3-ol	Earthy
41	β-Selinene	Mild- warm- woody
42	*cis*-1,3,5-Hexatriene	No aroma data available
43	*cis*-3-Hexen- 1-ol	Fresh grass like
44	*trans*-3-Hexen-1-ol	Intense green with bitter fatty side notes
45	*trans*-2-Hexen-1-ol	powerfull green leafy with wine like
46	Hexanol	Alcoholic, Etheral
47	*cis*-3-Hexenyl formiate	Green with a vegetable note, slightly sweet
48	Isohexanol	Alcoholic, medicinal etheral
49	γ-Cadinene	mild, dry woody
50	1-Octen-3-ol	Intense mushroom like
51	3- Octanone	Herbaceous
52	Hexyl-2-methylbutyrate	Sweet fruity
53	Linalyl butyrate	Fruity
54	3-Octanol	Oily- nutty
55	*trans*-2-Octen-1-ol	Herbaceous
56	*trans*-3-Hexenoic acid	Mildly fruity
57	*cis*-4-Hexenoic acid	Fatty
58	α- Terpinene	Weak fresh lemon like
59	*trans*-2-Hexenoic acid	Fruity
60	Benzyl alcohol	Faint aromatic
61	Acetophenone	Sweet
62	Nonanoic acid	Cheese like
63	*γ*-Terpinene	Herbaceous
64	Ocimenol	Lime like
65	Guajacol	Burnt
66	Terpinolene	Sweet- piney
67	Boronyl acetate	camphoraceous
68	β-Bourbonene	Vetiver notes
69	3- Methyl-1-hexanol	Slightly fruity
70	Linalool	Citrus lemon-orange
71	2-Phenylethy alcohol	Rose like
72	2-Methyl-1-octanol	Fruity green
73	Geraniol	Sweet-floral
74	Benzyl acetate	Sweet
75	*trans*-2-Nonenal	Fatty - wax
76	β-Caryophyllene	Terpene odour
77	Isoborneol	camphoraceous
78	Borenol	camphoraceous
79	*cis*-3-Hexenyl butyrate	Wine-like
80	Hexyl benzoate	Woody
81	Isopropyl methyl ketone	Fruity
82	cis-3-Hexenyl acetate	powerfull green
83	*cis*-Linalool oxide	Sweet-woody
84	β- Bisabolene	Pleasant- worm
85	Thymol	Woody
86	Camphene	camphoraceous

Pharmacology

Anthelmintic property

Ramalingam *et al* studied antihelmintic properties of *Leucas indica* on earthworms. Antihelmintic activity was evaluated for petroleum ether, chloroform, methanol and isolated tannins extract. They found that methanolic extract had paralysed earthworms at different concentrations [15].

Anti-inflammatory activity

The ethanolic leaves extract of *Leucas indica* at concentrations of 75, 150 and 300 mg/ml to carrageenin induced paw oedema in Wistar Albino rats was orally administered for screening anti-inflammatory activity. Administration of 150 mg/ml and 300 mg/ml showed significant activity [16]. Chandrashekhar and Prasanna, 2010 isolated flavones glycoside (chrysoeriol-4'-*O*-α-L-rhamnopyranosyl (1>2) β- D-glucopyranoside) from ethanolic extract and tested on carrageenin induced paw oedema in albino rats at the dose of 300mg/ml. They found that 62.5% of oedema was inhibited within 3 hours [17].

Antimicrobial activity

The antimicrobial activity of the crude aerial part extract of *Leucas indica* in chloroform and methanolic fraction showed positive results against *Staphylococcus aureus*, *Bacillus subtilis*, *Salmonella typhi*, *Pseudomonas aeruginosa* and *Escherichia coli* whereas the aqueous fraction inhibited the growth of *Staphylococcus aureus*, *Bacillus subtilis* and *Salmonella typhi* significantly. Its antimicrobial property is due to the presence of flavonoids, total phenolic compounds, saponins and tannins [3]. Babu *et al* reported that ethanolic extract of aerial part of the plant gives very good antimicrobial activity against *Staphylococcus aureus* and *Pseudomonas* sp [18].

Antioxidant activity

Vinayagam and Sudha performed the experiment for the DPPH radical scavenging assay, nitric oxide scavenging assay

and superoxide scavenging assay from the methanolic leaves extract of *Leucas indica*. The results showed excellent antioxidant activity due to the presence of phenolic components [19]. Ramani *et al* performed several tests to study the antioxidant potential of petroleum ether and ethanolic extracts of whole plant and found that the reducing power of the antioxidants of the extracts was somehow equal to the ascorbic acid. Free radical scavenging activities were also found but significantly less than the standard curcumin, whereas superoxide radical scavenging activities of both extracts were concentration dependent [20].

Antiulcer properties

The gastric ulcers were produced by the oral suspension of indomethacine in male Wistar Albino rats and Swiss Albino mice. Both were grouped as control, standard, extract 100 mg/ml and extract 200 mg/ml. The control group was treated with the ulcerogenic drug for 3 consecutive days and standard group with ulcer-preventive drug misoprostol. Similarly, rest of the groups were treated with 100 mg/ml and 200 mg/ml methanolic extract of the plant. Results showed that methanolic extract gives antiulcer activity and was dose-dependent as compared to standard [21].

Hepatoprotective activity

Ethyl acetate extract of aerial part of the *Leucas indica* with 5% gum acacia was used to study the hepatoprotective activity of the plant on CCl_4 treated albino male rats. It was observed that the extract decreased the CCl_4 induced elevated enzymes level which indicated the regeneration of the hepatic cells which were earlier damaged by the CCl_4 treatment [22].

Anxiolytic activity

Islam *et al* performed the experiment on overnight fasted Swiss albino mice using elevated plus – maze. The maze was constructed according to the description given by Lister. Mice were divided into 4 groups, each having 5 animals. All the groups were administrated by distilled water (10ml/kg, p.o.), methanolic extracts (200mg and 400 mg/kg, i.p.) and diazepam (1mg/kg, i.p.). After 1 hour individually they were placed in the center of the maze and the time spent in the open and closed arms were counted for 5 minutes. In another test i.e. Hole board test which constitutes the wooden box (40×40×25 cm) having 16 holes (3cm each) evenly distributed on the floor. The height of the apparatus was 35cm. After 1 hour the treatment with above given administrations, each mouse was placed at the corner of the board and render them to move and dip their heads into the holes. The number of head dips was recorded for 5 minutes. Results reveal that extract groups with two different concentrations increased the spending time in open arms as compared to the control group. Similarly, in Hole board test extract group seems to have increased level of head dipping activity as compared to the control group. Both the results justified the gradual decline in anxiety level [23, 24].

Thrombolytic activity

For the assessment of thrombolytic activity 5ml venous blood was collected from 3 different healthy individuals and transferred to 5 sterilized and pre-weighed centrifuge tubes (1ml each). The tubes were incubated at 37˚C for 45 minutes. After the formation of clot, serum was completely sucked out without hampering the clot. Tubes were again weighed to know the amount of clot formed. 100µl of methanolic extract of different concentrations (2, 4, 6, 8 and 10mg/ml) were inoculated in the tubes and the tubes were kept for incubation for 90 minutes at the same temperature to observe the clot lysis and again weighed after incubation. Streptokinase and distilled water were used as positive and negative controls. Clot lysis can be calculated by given equation:

$$\text{Percentage of clot lysis} = \frac{weight\ of\ released\ clot}{Clot\ weight} \times 100$$

Results showed that all the five concentrations (2, 4, 6, 8 and 10mg/ml) lysed clot at the rate of 23.57%, 25.65%, 31.03% 39.93% and 47.77% [23].

Wound healing activity

Saha *et al* studied the wound healing activity of *Leucas indica* (*Leucas lavandulaefolia*). They performed the experiment on Wistar albino rats. They anaesthetized 6 groups having 6 animals in each and wound was excised by cutting away a 500mm^2 full thickness and left in the open environment. All the groups were administrated with 0.2% nitrofurazone ointment, simple ointment, methanolic extract of the plant at the dose of 200mg/ml and 400mg/ml. They found that wound closure time of extract at the dose 400mg/ml was 16±2 was better than nitrofurazone ointment, simple ointment, and extract at the dose of 200mg/ml which were 18±2 [25]. In another experiment by Shankar *et al* similar results were obtained which proves that this plant has very good wound healing capacity [3].

Discussion

Due to the side effects of synthetic products, the popularity of natural products and their derivatives increases worldwide because of their efficiency and fewer side effects [26]. Present article consists of qualities of herb *Leucas indica* which includes its chemistry and medical importance based on the data provided by a number of studies. Its flavones glycoside (chrysoeriol-4'-O-α-L-rhamnopyranosyl (1>2) β- D-glucopyranoside) isolated from ethanolic extract is capable of inhibiting oedema by the virtue of which we can call it as a good anti-inflammatory agent [22]. On the other hand, this herb also has good antimicrobial activity its methanolic as well as chloroform extract shows a broad spectrum of antimicrobial activity against selective bacterial strains even at the dose of 50mg/ml [3]. This herb shows intermediate antioxidant property because as per observation of Ramani *et al* its extracts of petroleum ether and ethanol are able to reduce antioxidants but free radical scavenging is not so good which is either less than the standard used while superoxide radical scavenging activity was dose-dependent. This herb shows strong wound healing as well as anti-ulcer activity at the dose 0f 200 - 400mg/ml concentration [21, 25]. This herb also serves as a good anticoagulant because, at the concentration of 10mg/ml, it lysed the clot nearly 50% [23]. It is also helpful to reduce the anxiety level on the oral dose of 200- 400mg/ml as per findings of Islam *et al*., 2017 in two different experiments.

Conclusion

Overall it can be concluded that the *Leucas indica* is very important medicinal herb gifted us by nature which can strongly serve as a great wound healer as well as a good antibacterial agent due to the presence of flavonoids and phenolic compounds. Therefore, it can be used as effective and safe medicine for wound infection.

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