

# An Update on the Medicinal uses, Phytochemistry and Pharmacology of *Leucas Aspera*, A Medicinally Important Species

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**Abstract** – The current study presents the biological nature and phytochemistry of *Leucas aspera* (Lamiaceae) based on the available reports. Abundant phytochemicals have been extracted from *L. aspera* including oleanolic acid, ursolic acid and 3-sitosterol, leucasperones A and B, leucasperols A and B, isopimarane as the major active ingredients. The range of compounds extracted from this plant has been investigated to substantiate its pharmacological property. Medicinally, it has been proven to possess various pharmacological activities like antifungal, antioxidant, antimicrobial, antinociceptive and cytotoxic activity. There is enormous potential for the discovery of new medicinal compounds in this species and an immediate need for techniques to facilitate the production of high quality, chemically consistent plant material for drug development and clinical trials. The purpose of this review is to summarize the information concerning the occurrence, botanical description, pharmacological significance and biological activities of *L. aspera*.

**Keywords** – *Leucas Aspera*; Medicinal Plant; Phytochemicals; Pharmacology.

## I. INTRODUCTION

There has been a great awareness about medicinally important traditional plants worldwide since past few decades. The root of this interest lies in their economic feasibility, less toxicity and various pharmacological activities [1]. Moreover, the current widespread belief among the people about green medicines to be safer and more dependable than expensive synthetic drugs with adverse side effects [2] has added an extra bonus towards marketing value of herbal medicines. The World Health Organization (WHO) estimated that nearly 80% of the population depends on herbal medicines to meet primary health care needs due to their low cost and accessibility [3]. The plant genus *Leucas* belongs to *Lamiaceae* family and embraces about 80 species, which are widely employed to cure many diseases by the traditional healers worldwide. Among these diverse species, *L. aspera* is a small herbaceous erect plant with a free blooming nature and flowering in the months of August to September. It is pungently aromatic herb and grows abundantly in the high land crop fields, roadsides, homesteads and fallow lands all over India. The oral consumption of the whole plant is been practiced for antipyretic, analgesic, anti-inflammatory, anti-rheumatic and antibacterial treatment and its paste is applied topically to inflamed areas [4]. It is a traditional remedy for colds, coughs, chronic skin eruption, painful swelling, wound healing and even used as an insecticide [5]. Different types of chemical compounds used in pharmaceutical drugs such as linoleic acid, glucosides, linolenic acid, oleanolic acid, nicotinic

acid, oleic acid, palmitic acid, saponins, sterols, stearic acid, tannins, ursolic acid etc. have already been isolated from the leaves, roots, flower and seeds of his plant [6], [7].

### Vernacular Names

Sanskrit: Dronapushpi, Chitrapathrika, Chitrakshup

Punjabi: Guldor

Bengali: Darunaphula, Hulkasha

Gujarati: Kulnphul

Hindi: Goma madhupati

Sindhi: Kubo

Maharashtra: Bahuphul

Telugu: Thummichittu.

### Taxonomy

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

Genus: *Leucas*

Species: *Leucas aspera*

## II. DISTRIBUTION

It is found in Africa, Asia, Pacific Islands, South America and China. It is distributed throughout India from the Himalayas down to Ceylon [8]. In India and the Philippines *L. aspera* is a very common weed.

## III. BOTANY

### A. Macroscopic Characters

*L. aspera* is an annual herb of 15-60 cm height with stout, erect and acutely quadrangular stem and branches. The leaves are shortly petiolate, linearly lanceolate and pubescent up to 8.0 cm long and 1.25 cm broad with entire or crenate margin; petioles are 2.5-6 mm long. Flowers are white, sessile small, terminal or axillary whorls; bracts 6 mm long, linear, acute, bristle-tipped and ciliate with long slender hairs. Calyx is tubular in shape, 7-15 mm long, curved, contracted above the nutlets. The apical portion is ribbed and hispid; mouth small, very oblique, not villous whereas, the lower half usually glabrous and membranous. Corolla is about 1 cm in length with 5 mm long tube and pubescent above, annulated in the middle. The densely white-woolly upper lip is 3 mm long and lower lip is about twice as long. The middle lobe is obviate and the lateral

lobes are sub acute. Fruit type is nutlet that is of 2.5 mm length, brown in colour, smooth surface, outer and inner face are rounded and angular respectively [9].

#### B. Microscopical Characters

The transverse section (TS) of stem is quadrangular with four discrete hairy collenchymatous ridges. The cortex is narrow and the wide stele is encircled by a ring of vascular tissue. TS illustrates that thick cuticle covers the epidermis, interrupted irregularly with stomata and holds simple, multicellular uniseriate trichomes. Cortex is narrow and parenchymatous, but the region near ridges are collenchymatous, endodermis is distinct and contain parenchymatous pericycle; stellar section consists of a circle of vascular bundles associated with interfascicular sclerenchymatous band; phloem is narrow and parenchymatous, radially arranged around xylem. Pith is parenchymatous and surrounded with circular crystals of calcium oxalate. TS of leaf traversing through the midrib is largely convex on the abaxial side and slightly flat or grooved on the adaxial side. It further shows a centrally located conjoint and collateral meristele associated with a parenchymatous pericycle layer on lower side. Epidermis of Lamina is enclosed in a thick cuticle, containing stomata and bears trichomes of the same kind as found on stem. Palisade tissue is one to two layered occupying the main area of the spongy parenchyma.

#### IV. TRADITIONAL USES

It has been accounted that majority of the worldwide population depends upon traditional medicine obtained from medicinal plants for better health-care needs. The flowers are taken with honey to cure cough and cold in teenagers. The leaves juices are effective against

snakebites, poisonous insects or scorpion sting. The leaf extracts are also useful as mosquito repellent and insecticides in some villages [10]. In Indian traditional medicine, the leaf extracts of *L. aspera* is employed to treat chronic skin eruptions, psoriasis, and chronic rheumatism [11].

#### V. PHYTOCHEMISTRY

Prajapati *et al.* [7] reported that the whole plant contains quite a lot of other constituents such as ursolic acid, oleanolic acid and 3-sitosterol. Aerial parts enclose sterols, nicotine, glucoside, galactose, diterpenes, isopimarane glycosides, together with other complexes like maslinic acid, asperphenamate, isololiolide, linifolioside, nectandrin B, chrysoeriol, apigenin, myristargenol B and machilin C. Among the numerous chemical constituents isolated and identified from the leaf juices, menthol (11.3%), xthujene (12.6%) and ufarnevene (26.4%) were the most frequent. The flower extract is found to contain amyl propionate (15.2%) and isoamyl propionate (14.4%) as the dominant components. Furthermore, seed is analyzed to encompass linolenic acid (0.65%), stearic acid (2.84%), palmitic acid (6.25%), oleic acid (42.07%) and linoleic acid (48.11%). Shoots also enclose unusual phenolic compounds (4-(24-hydroxy-1-oxo-5-npropyltetracosanyl)-phenol), aliphatic ketols (28-hydroxypentatriacontan-7-one, 7-hydroxydotriacontan-2-one), longchain compounds (1-hydroxytetratriacontan-4-one, 32-methyltetratriacontan-8-ol),  $\beta$  sitosterol and dotriacontanol. The chemical structures of typical constituents extracted from *L. aspera* have been shown in Fig. 1.

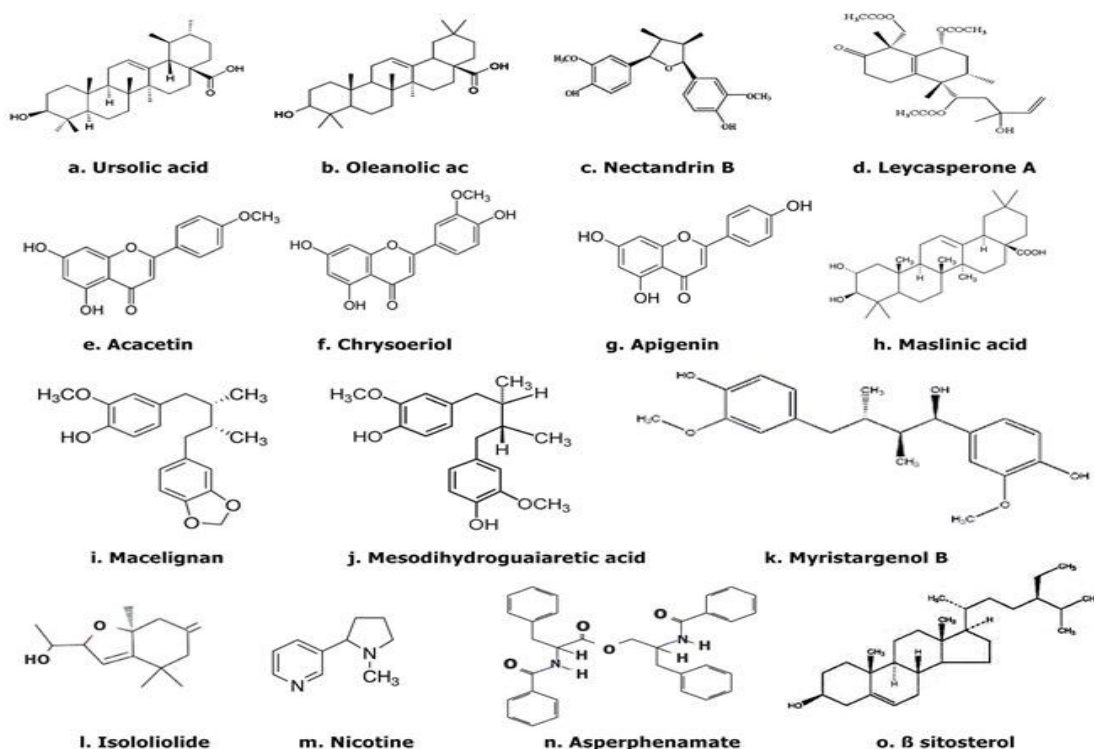


Fig. 1. Chemical Structures of major phyto-constituents found in *L. aspera* extracts

## VI. PHARMACOLOGY

### A. Antioxidant Activity

The free radicals which interact with biomolecules by electron pairing and induce oxidative stress are often found associated with diseases like atherosclerosis, aging, cancer, diabetes and neurodegenerative disorders [12]. These free radicals get trapped by antioxidants and the oxidative stress is neutralized which in turn cures many chronic diseases. Leucasin, a strong bioactive compound exhibited strong radical-scavenging prospective as well as inhibition of lipid peroxidation at a concentration of 40 ppm [13]. Ethanolic extract at the dose of 19.588 mM of ascorbic acid/g of sample was found to contain higher antioxidant property followed by methanol extract. Vitamin C and vitamin E were also estimated to contain antioxidant properties at the dosage of 0.084 mg/g fresh wt. and 645.69 mg/g fresh wt., respectively [14].

### B. Hepatoprotective Activity

Latha *et al.* [15] reported hepatoprotective activity of *L. aspera* methanolic extract through carbon tetrachloride (CCl<sub>4</sub>) induced hepatotoxicity model. Ethanol extracts of *L. aspera* leaves (400 mg/kg) showed significant hepatoprotective activity against simvastatin (20 mg/kg.p.o) induced hepatotoxicity similar to standard drug silymarin (20 mg/kg) [16].

### C. Anti-Inflammatory Activities

Anti-inflammatory activity of several aerial parts of *L. aspera* has been accounted [17]. The juice extracted from the leaves of *L. aspera* is used as local application for psoriasis, chronic skin eruptions and chronic rheumatism [18]. Patil *et al.* [19] reported significant ( $p < 0.001$ ) anti-inflammatory activity of *L. aspera* leaf ethanolic extract at different doses in both acute as well as chronic inflammation.

### D. Antibacterial Activity

The antibacterial activity of *L. aspera* was analyzed employing double diffusion method and the effect was studied against the human pathogens like *Klebsiella pneumoniae*, *Bacillus cereus*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Enterobacter faecalis*. The organic leaf extracts from methanol, hexane, ethylacetate and dichloromethane showed prominent antibacterial activity. Among them, hexane and methanol extracts evidenced to be more effective against *Escherichia coli* and *S. aureus* pathogenic strains [20]. Root, stem, leaf and flower extract of *L. aspera* showed antibacterial activity of *L. aspera* against *E. coli*, *S. aureus*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Shigella flexneri*, *Salmonella choleraesuis* [21]. Also, ethyl acetate extract and methanolic extract resulted in a prominent antibacterial activity against *S. aureus*, *Bacillus subtilis*, *E. coli*, *Klebsiella pneumonia* and *Proteus vulgaris* [22].

### E. Antifungal Activity

*In vitro* study of chloroform and ether extracts of *L. aspera* revealed its antifungal activity against *Trichophyton* and *Microsporum gypseum* with minimum inhibitory concentration of 5mg/mL. Mohana and Raveesha [23] found a significant inhibition of 48% mycelial growth of *F. solani* in CDA media added with

5% aqueous extract of *L. aspera*. Babu *et al.* [24] assayed the *in-vitro* anti-dermatophytic activity of leaves methanol extracts by agar well diffusion technique and documented maximum inhibition zone for *Penicillium* sp. (10 mm) and minimum inhibition zone for *Candida tropicalis* (3 mm).

### F. Antidiabetic Activity

Gupta *et al.* [25] reported significant anti-hyperglycemic activities of ethanol and petroleum ether extracts of *L. aspera* in alloxan and streptazotocin induced hyperglycemic rats. Mannan *et al.* [26] documented 34.01% and 28.39% reduction in serum glucose level in mice due to methanol extract of *L. aspera* leaves and stem at 400 mg extract/kg body weight maximum dosage.

### G. Antinociceptive

Methanolic extract of whole plants of *L. aspera* demonstrated better antinociceptive activity in the acetic acid-induced gastric pain test. Even at the lowest dose of 50 mg extract per kg body weight, the extract reduced the number of writhing by 50.1%, which was more or less comparable to that of aspirin [27].

### H. Mosquitocidal Activities

*L. aspera* is used for mosquito repellent and as an insecticide [28]. Larvicidal effect on I, II, III and IV instar larvae of mosquito species *Culex quinquefasciatus* have been investigated in a dose dependant manner for 48 hours with 1.0%, 3.0% and 5.0% concentration. The results indicated that 100% mortality of I, II, III instar larvae of *C. quinquefasciatus* was observed at 5% concentration of *L. aspera* aqueous extract. Whereas, 1.0% concentration of chloroform extract exhibited 100% mortality rate against all the four instar larvae of *C. quinquefasciatus* [29]. The efficacy of whole plant extracts of *L. aspera* has been proven against larvicidal and pupicidal activities of the malarial vector, *Anopheles stephensi*.

### I. Central Nervous System Activity

The root ethanolic extract of *L. aspera* was assessed employing pentobarbitone induced sleeping time test, the hole cross test and the open field test on Swiss albino mice for its impact on central nervous system (CNS). The results supported that *L. aspera* root may possess biologically active constituent (s) having CNS activity [30]. Furthermore, ethanolic extract of roots exhibited noteworthy peripheral antinociceptive activity at the concentration of 400 mg/kg [6].

### J. Cytotoxicity

Brine shrimp lethality assay is a rapid and inexpensive method used to correlate the cytotoxic and anti-tumor properties of natural and synthetic compounds. Various studies of *L. aspera* using this model exhibited cytotoxicity (LC<sub>50</sub> = 1, 900 µg/ml) from the hydro-alcoholic extract of whole plant, especially in root extract at LC<sub>50</sub> = 52.8µg/ml cytotoxicity [6]. Morshed *et al.* [31] found lethality level LC<sub>50</sub> of ethanol, ethyl acetate and n-hexane extract of *L. aspera* respectively 114.70 µg/ml, 43.97 µg/ml and 30.32 µg/ml in brine shrimp assay. Alam *et al.* [32] also examined *in vivo* cytotoxicity against *Artemiasalina* (brine shrimp nauplii). They reported active constituents as  $\alpha$  amyryn and  $\alpha$  tocopherol isolated from the dichloromethane fraction and their cytotoxic effects against *A. salina* with 241 and 195 ppm LC value, respect-

-ively.

#### K. Anti-ulcer Activity

Reddy *et al.* [33] investigated the antiulcer activity of *L. aspera* alcoholic extract by the following experimental models: aspirin induced ulcer and shay rat ulcer. They observed a significant decline in acid secretion along with reduced ulcer score in rats and concluded as a result of anti-secretory and protective action on gastric mucosa.

#### L. Antiparkinson's Effect

Parkinson's disorder is the progressive neurodegenerative disorder caused as a consequence of degeneration of dopaminergic neurons in substantia nigra pars compacta (SNpc) in the mid brain [34]. Rotenone is the alkaloidal pesticide and used to induce Parkinson's disorder in animals. Ethanolic extract of *L. aspera* was found to protect the animals from rotenone induced Parkinson's disorder by increased motor coordination, protective changes in oxidative marker levels and also with no depletion of dopamine content [35].

### VII. FUTURE DIRECTIONS

*L. aspera* has been traditionally utilized for plenty of pharmacological as well as ayurvedic medicinal uses. Unsystematic and careless exploitation of natural resources is responsible for the current threatened status of this species. Hence large scale propagation through tissue culture is the future requirement for conservation of the species. Importance should be paid to boost productivity and enhance secondary metabolites to meet the industrial demand. Development of transgenic plants should be encouraged that may result in ameliorated production of secondary metabolites. Methods can be optimized for somatic embryogenesis, which may aid in the development of synthetic seeds, thus non viability of seeds or low seed set issue can be solved. The phyto-constituents and its biological activities reviewed in this study can help researchers to investigate this plant to further extent. Its utilization in different other diseases as well as its toxicity can be tested. Consequently, clinical trials should form a standard for safe therapeutic applications of this species.

### ACKNOWLEDGMENT

Authors acknowledge the library assistance from the Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India. We further are thankful to the anonymous reviewers and the editor of this article for their critical comments and suggestions on the manuscript.

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(OSBECK) MERRILL FOR ENHANCING ITS PHARMACEUTICAL METABOLITES" in Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia.

#### Publication

##### Book chapter:

Gantait S, **Kundu S**, Salma U (2017) *Pavonia odorata*: Botany, Conventional Applications, Phytochemistry and Pharmacology. In: A.A. Mahdi, Y.K. Sharma, M. Abid, M.M. Abid Ali Khan (eds.) Biochemistry and Therapeutic Uses of Medicinal Plants. Discovery Publishing House Pvt. Ltd., New Delhi (India), pp. 220-231.

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Gantait S, **Kundu S**, Yeasmin L, Ali MN (2017) Impact of differential levels of sodium alginate, calcium chloride and basal media on germination frequency of genetically true artificial seeds of *Rauwolfia serpentina* (L.) Benth. ex Kurz. Journal of Applied Research on Medicinal and Aromatic Plants, 4: 75–81 (<http://dx.doi.org/10.1016/j.jarmap.2017.01.005>) (Elsevier).

**Kundu S**, Salma U, Ali MN, Mandal N (2017) Factors influencing large-scale micropropagation of *Sphagneticola calendulacea* (L.) Pruski and clonality assessment using RAPD and ISSR markers. In Vitro Cellular and Developmental Biology – Plant (In Press) (doi: 10.1007/s11627-017-9824-7) (Springer) (SCI IF 1.15; NAAS 7.12).



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Vivekananda Institute of Biotechnology, Nimpith, Dist. South 24 Parganas, West Bengal	Evaluation of growth performance of <i>Trichoderma viride</i> on different culture media and its population count from carrier based culture and subsequently its packaging for distribution.
Ramakrishna Mission Vivekananda University (RKMVU)	Dissertation Work on "Mites and insects on medicinal plants, assessment of biopesticides and effect of mite feeding on active ingredients."

Now she is working on "ACCELERATED MICROCLONING AND IN VITRO ELICITATION OF PHARMACOLOGICAL ACTIVE INGREDIENTS IN *ECLIPTA ALBA* (L.) HASSK." in Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia.

#### Publication

##### Book chapter:

Salma U, Kundu S, Gantait S (2017) Phytochemistry and Pharmaceutical Significance of *Picrorhiza kurroa* Royle ex Benth. In: A.A. Mahdi, M. Abid, M.M. Abid Ali Khan (eds.) Phytochemistry and Pharmacology of Medicinal Herbs. Lenin Media Pvt. Ltd., New Delhi (India), pp. 26-37.

##### Articles:

Salma U, Kundu S, Gupta SK (2017) New records of mites occurring on medicinal plants and bio-efficacy of green pesticides for management of *Tetranychus ludeni* Zacher on *Rauwolfia serpentina* (L.) Benth. ex Kurz. Pesticide Research Journal Vol. 29(1): 60-67.

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**EDUCATIONAL PROFILE**

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Qualification	Board/University	Year of Passing
B.Sc (Agriculture)	College of Agriculture, Central Agricultural University, Imphal	2013
M. Sc. (Agriculture, Plant Biotechnology)	University of Agricultural Science, Bangalore	2015
Ph.D (Agricultural Biotechnology)	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia	2019

He has qualified National Eligibility Test (NET) conducted by ASRB, 2015 in Agricultural Biotechnology. He has been awarded a fellowship from Department of Biotechnology, India.

Now he is working on “Genetic transformation on Indica rice” in Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia.



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Qualification	Board/University	Year of Passing
B.Sc (Agriculture)	Bidhan Chandra Krishi Viswavidyalaya	1989
M. Sc. (Agriculture, Genetics and plant breeding)	Bidhan Chandra Krishi Viswavidyalaya	1992
Ph.D (Agricultural Biotechnology)	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia	1996

**Publication**

**Book chapter:**

Sustainable management of rice blast [*Magnaporthe grisea* (Hebert) Barr]: 50 years of research progress in molecular biology. In: Arya A and Perello AE (eds.) Mmanagement of fungal plant pathogens: Current trends and progress. CAB International, Nosworthy Way, Wallingford, Oxford, Oxford shire, UK, Chapter 8, pp 92-106.

**Articles:**

Mandal N and Gupta S (1997) Anther culture of an interspecific rice hybrid and selection of fine grain type with submergence tolerance. *Plant Cell Tissue and Organ Culture* 51: 79-82.

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