REVIEW ARTICLE

Morphological Features, Phytochemical, and Pharmacological Study of *Leucas aspera* (Lamiaceae): A Brief Review

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ABSTRACT

Medicinal plants are the only source for the treatment of physiological disorders in ancient days. In India, herbs are always acted as the primary source of traditional medicine. *Leucas aspera* (Willd.) Link (family-Lamiaceae), an annual herbaceous medicinal weed, and it is locally known as "*Shwetdron*." The plant is distributed throughout India from the Himalayas down to Ceylon. This present review deals with the phytochemical, botanical, ethnomedicinal, and other important pharmacological features of *L. aspera*. The major secondary metabolites of these plants are phenolics, alkaloids, glycosides, steroids, lignins, flavonoids, terpenoids, and galactose. Extensive studies of the different parts of this plant are reported to have various medicinal properties, such as, antimicrobial, anti-inflammatory, antioxidant, anti-cancer, anti-diabetic, hepatoprotective, and larvicidal properties. The plant parts are used against many diseases for a long time in the world. The plant is also applied in various industries, like food, cosmetics, nutraceuticals, and pharmaceuticals. It is also used as an anti-pyretic and insecticidal agent from ancient times. The present review can be helpful for the identification and preparation of a clear profile of *L. aspera*.

Keywords: Ethnomedicine, *Leucas aspera*, Pharmacology, Phytochemicals, Toxicity.

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INTRODUCTION

Plants are the mainstay of the treatment of human diseases from ancient days. Since then, numerous herbs have been identified as medicinal plants because of their potency to heal various ailments.[1] *L. aspera* (Willd.) Link (family: Lamiaceae) is commonly known as "*Thumbai*" and in West Bengal, it is known as *Shwetdron* (Figure 1).[2] The plant is highly distributed throughout India from the Himalayas down to Ceylon.[3] In India, herbs are always acted as the major source of medicine in *Siddha*, *Ayurveda*, *Unani*, *Kabiraji*, and Homeopathy treatment system. The plant parts are used traditionally as an anti-pyretic and insecticidal agent, and the flowers are valued as a stimulant, expectorant, and diaphoretic. The leaves of the plants are also useful in chronic rheumatism, psoriasis, and other chronic skin eruptions. It is an aromatic, erect herb widely distributed in tropical Asia, Africa, and grows as a weed in highland crop fields, human settled areas, grasslands, and roadsides.[4] Many phytochemicals that are present in the plant parts belong to the classes of terpenoids, steroids, glycosides, long-chain compounds, flavonoids, lignins, and alkaloids. These varieties of phytochemicals were identified and isolated by different extraction methods. These varieties of chemical substances are mainly responsible for different biological activities, including antimicrobial, hepato-protective, insecticidal, and herbicidal properties. It showed stimulant, emmenagogue, aperients, and expectorant properties as well. *L. aspera* leaves are also used against psoriasis and skin eruptions diseases.[5,6]

Figure 1: Natural habitat of *L. aspera*

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TAXONOMICAL POSITION

Kingdom: Plantae
Sub-kingdom: Tracheobionta
Super-division: Spermatophyta
Division: Angiospermae
Class: Dicotyledonae
Sub-class: Gamopetalae
Order: Lamiales
Family: Lamiaceae
Genus*: Leucas*
Species*: aspera*
Botanical name*: L. aspera* (Willd.) Link[7]

OTHER NAMES

Sanskrit: *Dronapushpi*, *Chitrapathrika*, *Chitrak-shupa*; Bengali: *Shwetdron*, *Darunaphula*, *Hulkasha*; Punjabi: *Guldora*; Gujarati: *Kulnnphul*; Hindi: *Goma Madhupati*; Sindhi: *Kubo*; Maharashtra: *Bahuphul*; Mumbai: *Tumbai*; Telugu: *Tunni*.[2]

Figure 2: Complete plant of *L. aspera*

BOTANICAL DESCRIPTION

L. aspera (Figure 2) is an annual, branched, and herbaceous weed that erects to a height of 15 to 65 cm with the stout, hispid, and acutely quadrangular stem (Figure 3). The stems are light green in color and the exterior area is hairy and rough. The leaves (Figure 4) of the plants are sub-sessile and yellowish-green in color. It is linear or directly lanceolate, sub-acute, and pubescent. It is more or less 3 to 8 cm long and 1 to 3 cm wide. Corolla is approximately 1-cm long and the tube is 5 mm long. It is pubescent above, annulated in the central part, and intensely white woolly; the middle lobe is large and rounded in shape, the lateral lobe comparatively small and sub-acute. Calyx variable, vasiform, 5–15 mm long and tube curved; the lower half portion is membranous, and the upper half portion is covered with stiff bristles. It is basically composed of 5 connate sepals and 5–20 secondary lobes. Flowers (Figure 5) are white in color and sessile; bracts are 6.5 mm long. The nutlets are 2.5 to 3 mm long, dark brownish with schizocarp fruit. Seeds are 0.5 cm long, smooth, and brownish, and it is 0.15 cm wide and ovoid. The plant roots (Figure 3) are variable in size and tubular in shape. In this plant species, fine rootlets can be found.[2,6,8,9]

PHYTOCHEMISTRY

In *L. aspera*, different types of phytoconstituents are present. Among them, polyphenols, flavonoids, alkaloids, and terpenoids are the major ones. In a previous research study, it was observed that triterpenes are present in the whole plant parts. Terpenoids are the largest secondary metabolic groups that are responsible for the flavors, fragrance, and bioactivities of the herbs. A variety of essential phytochemicals was revealed through the previous research investigations of *L. aspera*, such as, alkaloids, reducing sugars, phenolics, nicotine, steroids, alkaloids (α-sitosterol and β-sitosterol), flavonoids, lignins, glycosides, etc. These bioactive compounds are mainly found in the aerial parts of the plants. Some important flavonoids are found in the plant, like acacetin, apigenin, and chrysoeriol. Lignin class of compounds, such as, nectandrin, mesodihydroguaiaretic acid, macelignan, chicanine, licarin A, myristargenol B, and machilin C were reported from the previous study of *L. aspera*.[9-12]

Figure 3: Stem and root

Figure 4: Leaves

Figure 5: Inflorescences and flowers

From the previous study of methanol extracts of the leaves of the plants, 24 major phytochemicals were reported by using gas chromatography coupled with mass spectrometry (GC-MS) analysis method. The hydro-distillation method of aerial parts showed important essential oil, among them 43 compounds represent 98.09% of the total essential oil. In the same method, other compounds, like β-caryophyllene, 1-octen-3-ol, α-humulene, α-pinene, epi-α-bisabolol, and limonene were considered as main phytoconstituents of the plant. The type of essential oils was observed to be rich in sesquiterpene class of hydrocarbons.[13] The seed was reported to contain palmitic acid, stearic acid, oleic acid, linoleic acid, and linolenic acid.[14]

Phytochemical compounds and secondary metabolites of *L. aspera* which were identified in the previous studies can be classified in the following manner, such as:

Terpenoids

Oleanolic acid, ursolic acid, squalene, β-caryophyllene, α-humulene, α-pinene, epi-α-bisabolol, limonene, x-thujene, menthol, leucasperone A, leucasperone B, and leucasperone C

Flavonoids

Catechin, acacetin, apigenin, and chrysoeriol

Steroids and Fatty Acids

3-sitosterol; 9, 12, 15-Octadecatrienoic acid methyl ester, n-hexadecanoic acid, linoleic acid, oleic acid, stearic acid, ceryl alcohol, and dotriacontanol

Glycosides

Glucoside, linifolioside, leucasperosides-A, leucasperosides-B, and leucasperosides-C

Lignans

Nectandrin B, meso-dihydroguaiaretic acid, (-) chicanine, and erythro-2-(4-allyl-2, 6-dihydroguaiaretic1-(4-hydroxy-3-methoxyphenyl)-propan-1-ol

Long Chain Phytocompounds

4-(24-hydroxyl-1-oxo-5-n-propyltetracosanyl)-phenol, 28 hydroxypentatriacontan-7-one, 7-hydroxydotriacontan-2one, 1-hydroxytetratriacontan-4-one, 32-methyltetratriacontan-8-ol, and 5-acetoxytriacontane

Other Compounds

Nicotine alkaloids, 1, 2-benzene dicarboxylic acid bis-(2-methyl propyl) ester, 1-octen-3-ol, amyl propionate, isoamyl propionate, and asperphenamate[9-14]

ETHNOMEDICINAL USES

L. aspera is used to cure various physiological disorders from ancient times. Many studies showed that the plant extract has no side effects on the treated patient. One of the crucial ethnomedicinal properties of the plant parts was observed against the snake venom and scorpion bites. The leaves smoke of this plant showed a significant protective role against the filarial vector mosquitoes as well. A vast range of rural and urban population uses *L. aspera* in their regular needs in the different parts of the world. The plant extracts help to reduce fever, cough, and cold. It is also used to give fragrance to food. The juice of the flowers was used in folklore medicine for intestine worm infections of the children. The leaves sups frequently used to heal psoriasis, skin disorder, headaches, and to relieve painful inflammations. Traditionally young vegetative shoots and flowers of *L. aspera* and in combination with an equal amount of fruits of some medicinal plants are taken orally for curing the dysmenorrheal.[5]

PHARMACOLOGICAL PROPERTIES

All the parts of *L. aspera* showed various pharmacological properties. The present review article is dealing with the pharmacological activities of this plant in different solvents.[13,15]

Antimicrobial Property

From the previous study, it was observed that the chloroform and petroleum ether extracts of *L. aspera* had good antifungal activity against the *Trichophyton* and *Microsporum gypseum.* Its root, flower, leaf, and stem exhibits good antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhimurium*, *Salmonella choleraesuis*, and *Shigella flexneri.*[16] The earlier study reported that the ethanolic and methanolic decoctions contain more active principles than the water and these organic solvents showed better antimicrobial properties against various bacterial strains.[17] The ethanolic extract of the whole plant parts showed potent bactericidal activity. Gram-positive bacterial strains, such as, *Bacillus cereus*, *Bacillus subtilis*, *Bacillus megaterium*, and *S. aureus* are found to be more sensitive than gram-negative bacterial strains, like *Salmonella typhi*, *Salmonella paratyphi*, *Salmonella dysenteriae*, *E. coli*, *Vibrio cholera*, and *Pseudomonas aeroginosa* in the ethanolic extract.[18] 80% ethanolic extract of this plant showed good antibacterial property against *S. aureus* and *B. subtilis*.[19,20] The dichloromethane fraction of the methanolic extract of *L. aspera* leaves was observed with profound antibacterial activity and in the case of ethyl acetate extract, it was active against *Plasmodium falciparum*, as well as, against the gram-positive bacterial strains in the disc diffusion method.[21,22] Volatile oil from *L. aspera* showed significant antibacterial activity against *P. aeruginosa*, *Haemophilus influenza*, *S. aureus*, and *Candida albicans*. However, it did not show any activity against *B. subtilis*, *Proteus vulgaris*, *Neisseria gonorrhea*, and *Trichoderma vibriae*.[23,24]

Anti-Inflammatory Property

In an earlier study, the ethanolic and aqueous decoctions of *L. aspera* reported having a significant anti-inflammatory effect. The petroleum ether and ethanolic decoction showed anti-inflammatory properties with respect to the standard diclofenac sodium and analgin.[25] The extracts are highly effective against acute and chronic inflammations. *L. aspera* showed activity against mast cell degranulation persuaded by proprancolol and carbachol.[26] Petroleum ether, chloroform, ethanol, and aqueous raw extracts were previously investigated for the anti-inflammatory property.[25]

Antioxidant Property

From a previous study, it was observed that the ethanolic decoctions of *L. aspera* root showed significant antioxidant property.[27] The root extract of this plant exhibited a high free radical scavenging effect. The plant extracts also significantly increased the antioxidant enzymes, such as, superoxide dismutase, catalase, and glutathione peroxides, whereas the lipid peroxides levels in the liver become decreased.[13,28] The crude methanolic decoctions of the plant leaves were observed with strong 1, 1-diphenyl-2-picrylhydrazyl (DPPH) and superoxide radical scavenging properties compared to other polarity based extracted fractions.[6,29]

Anti-Diabetic Property

In an earlier study, the ethanolic and petroleum ether extracts showed significant anti-hyperglycemic effects in alloxan-induced and streptozotocin-induced diabetic rats.[30] The study was done to evaluate the effect of leaves of the plant on experimental diabetic rats. Similarly, the methanolic extract of the plant was directed in streptozotocin-induced diabetic rats to reduce the blood glucose level.[31] Ethanolic extract of this plant leaves reduced the blood glucose levels in the dose-dependent study and restrained the biochemical parameters in the animal model.[32]

Anti-Cancer Property

The previous research investigation conducted the brine shrimp lethality assay and the study results observed that the hydroalcoholic decoctions of the whole plant showed cytotoxicity and this activity was more in 80% ethanolic root decoctions.[33] In a dose-dependent study, it was showed that the LC_{50} value is 52.8 µg/mL.[27] Brine shrimp lethality assay was also used to study the crude methanolic leaves extract of the plant. The study results showed the LC_{50} value of the sample and vincristine sulfate as 30 and 10.44 µg/mL, respectively.[34]

Hepato-Protective Property

Cold methanolic decoctions of the whole plant of *L. aspera* was evaluated for the hepato-protective property. The results showed that the plant part has a significant hepato-protective effect on liver damage. Fresh juice of the leaves was tested for carbon tetrachloride-induced liver damage as well.[35]

Larvicidal Property

Crude methanolic decoctions of plant leaf were examined for its larvicidal property against *Culex quinquefasciatus*, *Aedes aegypti*, and *Anopheles stephensi*. These activities tested against fourth-instar stages. Catechin, an isolated compound from the plant, showed noticeable larvicidal activity in a very low concentration. The LC_{50} and LC_{90} values for catechin were 3.05 and 8.25 ppm, respectively, against *A. aegypti* larvae. Similarly, the LC_{50} and LC_{90} values for catechin were 3.76 and 9.8 ppm, respectively, against *C. quinquefasciatus* larvae. The methanolic decoctions of the flower also have the larvicidal effect on *Anopheles subpictus* with LC_{50} and LC_{90} values of 53.16 ± 3.64 and 233.18 ± 25.68 ppm, respectively, and in the case of *Culex tritaeniorhynchus*, it is 81.24 ± 5.16 and 300.45 ± 31.6 in ppm, respectively.[36] Hexane decoctions were observed with effective larvicidal property against those vectors compared to ethanolic and chloroform decoctions.[37]

Central Nervous System Effect

In a previous study, the crude ethanolic extract of plant root was investigated for its effect on the central nervous system, using pentobarbitone-induced sleeping time test, the open field test, and the hole cross test in Swiss albino mice. The result of the study showed that these plant parts possess significant properties on the central nervous system.[38]

Antinociceptive Property

From a previous research investigation, it was observed that the ethanolic decoctions of these plant parts have significant peripheral antinociceptive effects at a particular dose (400 mg/kg).[27]

TOXICITY STUDY

In a research investigation in an animal model, the toxicity levels of *L. aspera* was evaluated by using Swiss albino mice. The female mice were used for the acute toxicity study. The female and male Wister rats were examined for sub-acute toxicity study. These experimental protocols were approved by the committee for the purpose of control and supervision of experiments on animal ethics. Animals were kept in cages. The animals were observed for any changes up to the first 4 hours and then for 24 hours for their mortality test. The results showed that no behavioral, as well as, no mortality changes happened during the study period. The administration of *L. aspera* extracts was safe up to 2,000 mg/kg body weight. So, this dose can be considered as the cut-off dose for the animals in that study.[35,39-41]

CONCLUSIONS

The present review highlighted that *L. aspera* (Willd.) Link has great potentiality on botanical, phytochemical, nutritional, and ethnobiological parameters, as well as, pharmacological properties. From the abovementioned explanations, it can be said that *L. aspera* has been used as an essential healing agent for several human physical disorders in different parts of the world which was briefly discussed in the review article. The researches on the pharmacological value of this plant prove that it has valuable compounds that can heal several diseases, and so it would a promising medicinal plant for future advanced phytomedicine. The review also showed the necessary biological or biochemical dimensions of *L. aspera*, as well as, cited the researchers who are actively working with this herbaceous weed to know the folkloric potentiality of the plant. This review also may be used for the identification and preparation of a clear monograph of the plant. The review found the loopholes or lacunae for future scientific studies to explore further significant and unknown benefits too.[42-46]

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