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LEUCAS ASPERA THE COMPARTIVE REVIEW ON ITS PHYTOCHEMICAL PROFILE AND ANTI MICROBIAL ACTIVITY AS AN HERBAL EAR DROPS

Abstract

Ear infections have become one of the most widespread health issues of both children and adults around the world. As the resistance to antimicrobial agents is growing, conventional antibiotic usage is becoming less effective and alternative treatment must be sought. *Leucas aspera* (Willd.) The medicinal herb, Link has been used for the treatment of earache, ear discharge and other infectious diseases in traditional Indian medicine. This review is a summary of the botanical description, ethnomedicinal uses, phytochemical composition and antimicrobial activity of *Leucas aspera* with particular reference to its use as a herbal ear drop. It has antimicrobial and anti-inflammatory properties, with various bioactive components such as triterpenoids, flavonoids, phenolics, sterols, and essential oils. It has been shown to be effective against clinically significant pathogens like *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli* in several studies. Further studies are necessary for the standardization, safety evaluation, ototoxicity and clinical efficacy before commercialization of the product can be considered. Based on the available evidences, *Leucas aspera* could be used in the development of a safe and effective herbal ear drop formulation.

Keywords: *Leucas aspera*, *Herbal ear drops*, *Antimicrobial activity*, *Phytochemicals*, *Ear infections*, *Otopathogens*.

1. Introduction

Otitis media (external and chronic suppurative) is an important cause of morbidity in the world. Most of the infections are due to bacterial and fungal pathogens that can lead to pain, inflammation, hearing loss and recurrent infection. The development of resistance of infective organisms to anti-microbial drugs is a serious problem in the treatment of ear disorders.

The popularity of herbal medicines as therapeutic agents is increasing because of their low cost, availability and relative absence of side effects. Use of herbal ear drops with plant-based bioactive compounds may offer antimicrobial and anti-inflammatory properties, and reduce the risk of resistance.

Leucas aspera, popularly known as “Thumbai” or “Dronapushpi”, is a medicinal plant which is employed in various indigenous systems of medicine. Squeeze the juice out of the fresh leaf and instill it in the ear to treat earache and ear discharge. The phytochemical profile and the antimicrobial activity reported for it indicate that it is a good candidate to develop herbal ear drops.

2. Botanical profile and ethnomedicinal uses

Leucas aspera (Willd.) The family of Link's is Lamiaceae. Erect annual herb found in India, Sri Lanka, Bangladesh and other tropical countries throughout. It is abundant in wastelands, roadsides and cultivated fields.

Most parts of the plant are traditionally used for treating fever, cough, skin infections, wounds, insect bites, inflammation and ear disorders. Frequently the juice of fresh leaves is used as a folk medicine in the treatment of earache and otorrhoea, which indicates its use in ear infections.¹

Table 1. Botanical Profile of *Leucas aspera*

Parameter	Description
Family	Lamiaceae
Scientific Name	<i>Leucas aspera</i> (Willd.) Link
Common Names	Thumbai, Dronapushpi
Habit	Annual herb
Distribution	India, Sri Lanka, Bangladesh

¹ Prajapati MS, Patel JB, Modi K, Shah MB. Pharmacognostic and phytochemical studies on *Leucas aspera*.

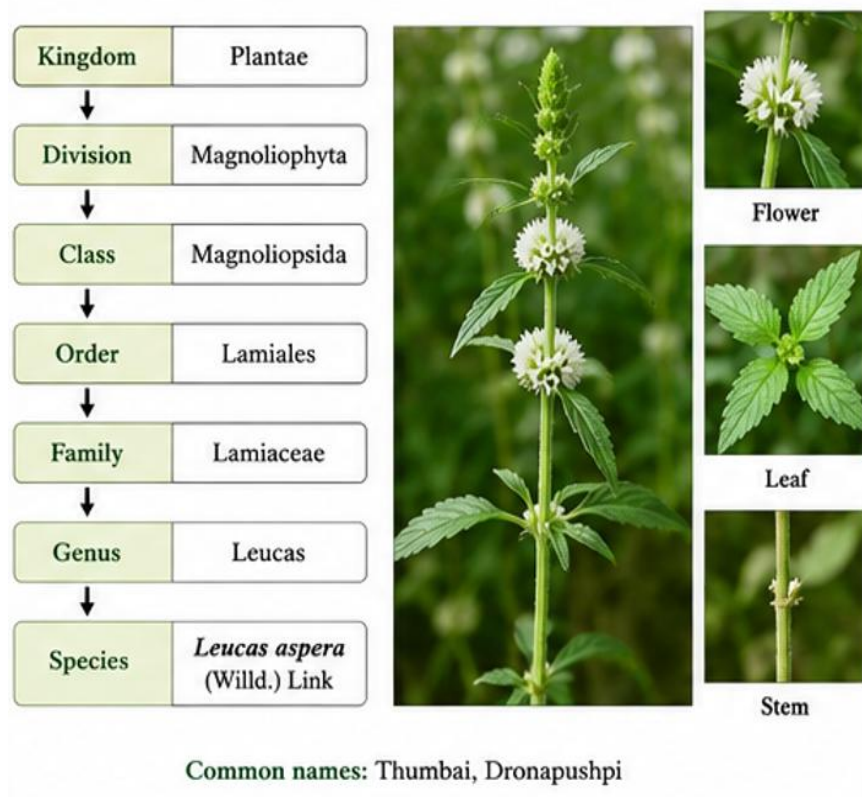


Figure 1 Botanical Profile / Taxonomical Classification of *Leucas aspera*

3. Phytochemical Profile

3.1 Triterpenoids

The triterpenoids are one of the most significant groups of compounds found in *Leucas aspera*. The leaves and aerial parts contain a large amount of triterpenoids, in particular ursolic acid, oleanolic acid and maslinic acid. These compounds have anti-inflammatory, anti-microbial, anti-oxidant and wound healing properties.²

² Chew YL et al. Antioxidant and antimicrobial properties of *Leucas aspera* extracts.

3.2 Flavonoids

In the plant, flavonoids like apigenin, chrysoeriol and glycosides have been detected. These compounds have antioxidant properties and play major roles in antimicrobial and anti-inflammatory properties.³

Table 2. Major Phytoconstituents Reported from *Leucas aspera*

Phytochemical Class	Major Compounds	Reported Activity
Triterpenoids	Ursolic acid, Oleanolic acid	Antimicrobial, Anti-inflammatory
Flavonoids	Apigenin, Chrysoeriol	Antioxidant, Antimicrobial
Phenolics	Phenolic acids	Antioxidant
Sterols	β -Sitosterol	Anti-inflammatory
Essential Oils	β -Caryophyllene	Antimicrobial

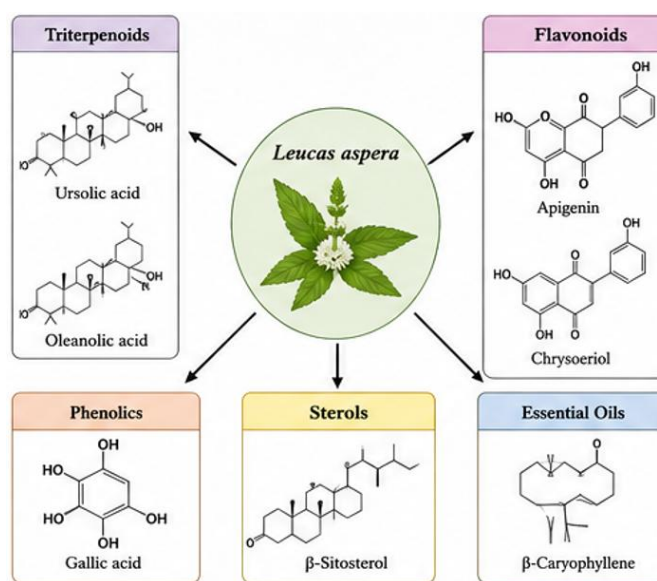


Figure 2. Major Phytochemical Classes Present in *Leucas aspera*

³ Alam MK et al. Antimicrobial activity of *Leucas aspera* against pathogenic microorganisms.

3.3 Phenolics

The extracts of *Leucas aspera* contain phenolic compounds such as gallic acid derivatives. These compounds are known to have free radical scavenging and antimicrobial properties, which can aid in tissue repair and infection management.⁴

3.4 Sterols

The major sterol in the plant is considered to be β -Sitosterol. The anti-inflammatory and immunomodulatory activities of plant sterols can also be beneficial in the therapeutic effect of *Leucas aspera*.

3.5 Essential Oils

The compounds found in essential oils extracted from the flowers and leaves include β -caryophyllene, menthol-like compounds and different terpenes. Such volatile compounds have antimicrobial and anti-inflammatory properties.

4. Comparative Analysis of Phytochemicals

Leucas aspera shows variation in their phytochemical content depending on various factors such as: plant part, extraction solvent, geographical location and the time of collection. Leaves generally have more of the triterpenoids, flavonoids, and phenolics than stems or roots. Methanolic and ethanolic extracts contain higher amount of bioactive compounds than aqueous extracts. Plants harvested in the flowering stage may have a higher phytochemical content. These differences emphasize the need for standardisation in the process of production of herbal products.⁵

Table 3. Comparative Phytochemical Distribution in Different Plant Parts

Plant Part	Major Constituents	Relative Abundance
Leaves	Flavonoids, Triterpenoids	High

⁴ World Health Organization. Antimicrobial Resistance Report.

⁵ Sharma A, Singh R. Medicinal plants used in ear infections: A review.

Flowers	Essential Oils	High
Stems	Sterols	Moderate
Roots	Fatty acids	Low–Moderate

5. Antimicrobial Activity

5.1 Activity Against *Staphylococcus aureus*

The extracts of *Leucas aspera* have been shown to have significant antibacterial activity against *Staphylococcus aureus* in several studies. In general, larger inhibition zones are observed with methanolic leaf extracts than aqueous extracts, suggesting that the methanolic extracts contain potent antimicrobial constituents.⁶

5.2 Activity Against *Pseudomonas aeruginosa*

Pseudomonas aeruginosa is one of the major pathogens that causes ear infections. Experimental studies have been reported of moderate to strong inhibitory activity of *Leucas aspera* extracts against this organism and thus could be useful in topical preparations for ears.

5.3 Activity against *Escherichia coli*

Leucas aspera extracts were found to be inhibitory towards *Escherichia coli*. Flavonoids, triterpenoids and phenolics are commonly thought to work in synergy to exert the antimicrobial effect.⁷

5.4 Activity Against Fungal Pathogens

Less studies have been conducted on antifungal activity, but those that exist indicate that they are inhibitory to *Candida* species and *Aspergillus* species. Because fungal pathogens often play a role in otomycosis, additional research should be conducted.⁸

⁶ Gupta D, Kumar M. Herbal formulations for otic infections: Current developments.

⁷ Indian Pharmacopoeia Commission. Quality standards for herbal medicines.

⁸ Kirtikar KR, Basu BD. Indian Medicinal Plants.

Table 3. Antimicrobial Activity Against Major Pathogens

Pathogen	Extract	Activity
Staphylococcus aureus	Methanol	Strong
Pseudomonas aeruginosa	Methanol/Ethanol	Moderate–Strong
Escherichia coli	Methanol	Moderate
Proteus spp.	Methanol	Moderate

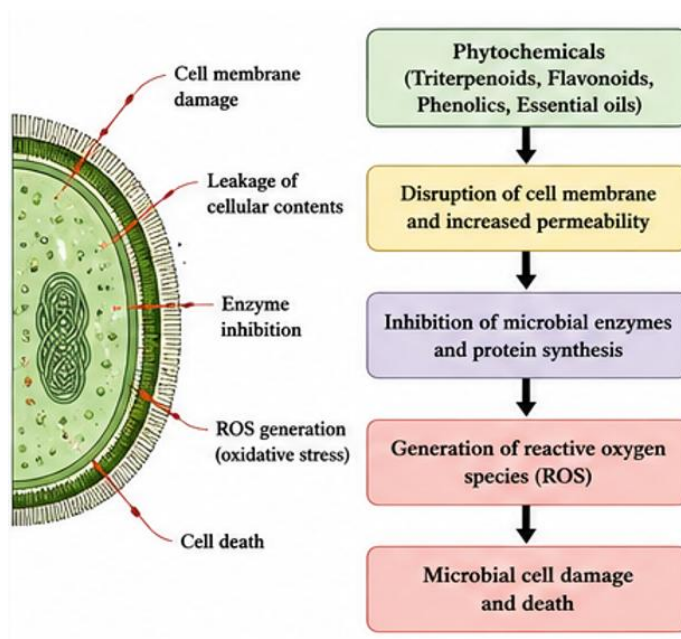


Figure 3 Mechanism of Antimicrobial Action

6. Potential as Herbal Ear Drops

Leaves of *Leucas aspera* have been traditionally used for treating ear ailments, thereby supporting the development and formulation of *Leucas aspera* herbal ear drop. The overall antimicrobial, anti-inflammatory, antioxidant and wound-healing properties indicate therapeutic

potential. Local application via ear drops can ensure local action in the infected area, with lower systemic side effects.⁹

Table 4. Advantages and Limitations of *Leucas aspera* Herbal Ear Drops

Advantages	Limitations
Natural source	Lack of clinical trials
Broad antimicrobial activity	Standardization issues
Traditional use evidence	Ototoxicity studies lacking
Cost-effective	Stability concerns

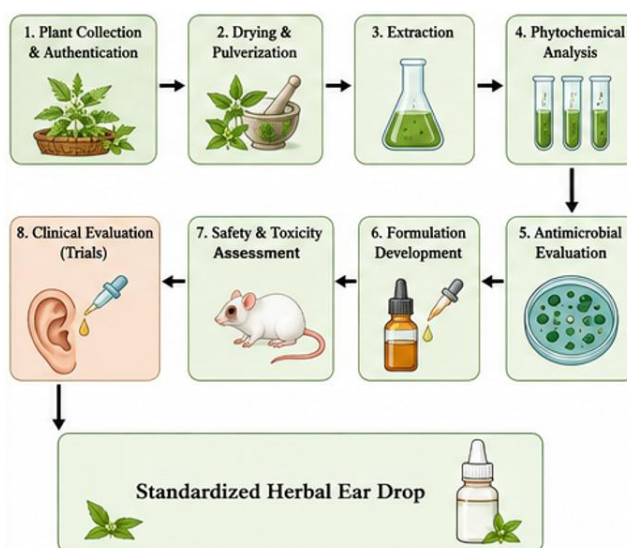


Figure 4. Development Pathway of *Leucas aspera* Herbal Ear Drop

7. Safety and Toxicity considerations

Although there is wide-spread traditional use, there is limited scientific information on ototoxicity and long-term safety. Standardized extracts must be tested for local irritation, sensitization, microbial contamination, heavy metals, pesticide residues, and potentially on

⁹ Ghosh PK, Gaba A. Phyto-extracts in wound healing and antimicrobial applications: A review. *Pharmacognosy Reviews*. 2013;7(14):118–125.

auditory structures prior to clinical application. To ensure safety, thorough toxicological evaluations are crucial.¹⁰

8. Research Gaps and Future Perspectives

Existing studies consist mostly of in vitro studies and crude extracts. Future studies should be conducted on:

- Standardization of extracts.
- Identification of active marker compounds.
- Evaluation for clinically isolated otopathogens.
- Detailed antifungal studies.
- Ototoxicity assessment.
- Formulation & stability studies.
- Animal and clinical trials.

These investigations will help in developing scientifically validated ear drop formulation of *Leucas aspera*.

9. Conclusion

Leucas aspera is an ethnomedicinal important medicinal plant with wide variety of phytochemical composition. Its wide antimicrobial activity is attributed to the presence of triterpenoids, flavonoids, phenolics, sterols, and essential oils. There is some existing evidence that supports its traditional application in ear disorders, as well as for its potential as a herbal ear drop. Further research on standardization, safety, formulation and therapeutic efficacy is, however, necessary to fully define therapeutic application.

¹⁰ Cowan MM. Plant products as antimicrobial agents. *Clinical Microbiology Reviews*. 1999;12(4):564–582.

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