

# GC–MS Profiling of the Volatile Oil Constituents of *Litsea udayanii* Bark

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**Abstract**—The present study investigates the phytochemical composition of volatile bark oil extracted from *Litsea udayanii*, an aromatic species belonging to the family Lauraceae, endemic to the Western Ghats of Kerala, India. Gas Chromatography–Mass Spectrometry (GC–MS) analysis was carried out to identify the volatile constituents present in the bark oil. The chromatogram revealed the presence of several hydrocarbons, cyclic compounds, aldehydes, and oxygenated volatile constituents. Major compounds identified included cyclohexane, methyl cyclopentane derivatives, pentane derivatives, tetradecanal, hexadecanal, and octadecanal. The abundance of hydrocarbon-based volatile compounds suggests potential industrial and pharmacological applications. The study provides preliminary phytochemical information on the bark essential oil of *Litsea udayanii* and establishes a foundation for future pharmacological and chemotaxonomic investigations.

**Index Terms**—*Litsea udayanii*, Lauraceae, GC–MS analysis, bark oil, volatile compounds, phytochemicals, essential oil

## I. INTRODUCTION

Medicinal and aromatic plants are important sources of bioactive secondary metabolites with applications in pharmaceuticals, cosmetics, food preservation, and traditional medicine<sup>1,2</sup>. Essential oils derived from aromatic plants possess significant antimicrobial, antioxidant, anti-inflammatory, and insecticidal properties owing to their chemically diverse volatile constituents<sup>3,4</sup>.

The genus *Litsea* Lam. belongs to the family Lauraceae and comprises numerous aromatic species distributed mainly in tropical and subtropical regions<sup>5</sup>. Several species of *Litsea* are traditionally used in folk medicine for treating fever, inflammation, microbial infections, and digestive disorders<sup>6</sup>. Essential oils obtained from different *Litsea* species are rich in monoterpenes, sesquiterpenes, aldehydes, and phenolic compounds that contribute to their biological activities<sup>6,7</sup>.

Recent investigations on *Litsea* species demonstrated remarkable biological activities including antibacterial, antioxidant, anti-inflammatory, and enzyme inhibitory effects. Essential oils from *Litsea cubeba*, *Litsea balansae*, and *Litsea tomentosa* have been reported to exhibit significant antimicrobial and anti-inflammatory activities attributed mainly to volatile terpenoids and oxygenated compounds<sup>5,7</sup>.

*Litsea udayanii* is a recently described species from the southern Western Ghats of Kerala, India<sup>8</sup>. However, scientific information regarding its phytochemical composition remains scarce. Therefore, the present investigation aimed to characterize the volatile phytochemical constituents of the bark oil of *Litsea udayanii* using Gas Chromatography–Mass Spectrometry (GC–MS) analysis.

## II. MATERIALS AND METHODS

### 2.1 Plant Material

Bark samples of *Litsea udayanii* were collected from the Western Ghats region of Kerala, India. The

collected bark samples were thoroughly cleaned to remove extraneous materials, shade-dried under ambient conditions to minimize the loss of volatile constituents, and subsequently pulverized prior to essential oil extraction. Proper collection and drying procedures are essential for preserving the integrity of volatile phytochemicals and ensuring reproducibility of essential oil analyses<sup>9,10</sup>.

Bark samples of *Litsea udayanii* were collected from the Western Ghats region of Kerala, India. The collected material was cleaned, shade dried, and processed for essential oil extraction.

### 2.2 Extraction of Bark Oil

The volatile oil was extracted from the dried bark material by hydrodistillation using a Clevenger-type apparatus following standard protocols recommended for aromatic plant materials<sup>11</sup>. The powdered bark was subjected to hydrodistillation for 3 hours until complete recovery of the volatile fraction was achieved. The obtained essential oil was separated from the aqueous phase, dried over anhydrous sodium sulfate to remove residual moisture, and stored in airtight amber glass vials at 4°C until further analysis. Hydrodistillation remains one of the most widely employed techniques for the isolation of essential oils because of its efficiency and suitability for volatile phytoconstituents<sup>1,2</sup>.

### 2.3 GC–MS Analysis

Gas Chromatography–Mass Spectrometry (GC–MS) analysis of the bark essential oil was carried out at the School of Biosciences, Mahatma Gandhi University, Kerala, India. Chromatographic separation was performed using a TG-5MS capillary column (5% phenyl methyl polysiloxane stationary phase) with helium employed as the carrier gas at a constant flow rate. The instrument was operated using the method designated as “Essential oil\_TG5MS-1ul-50split-first10mintemp-elongated. meth”. Mass spectral acquisition was conducted over a scan range of 35–500 m/z, and the total chromatographic run time was 46.03 min.

Identification of the volatile constituents was achieved by comparing the obtained mass spectra with those available in the National Institute of Standards and Technology (NIST) Mass Spectral Library. Tentative identification was based on spectral matching quality, retention characteristics, and comparison with

published literature data where available. GC–MS is widely recognized as a reliable analytical technique for qualitative characterization of volatile and semi-volatile phytochemicals present in essential oils and aromatic plant extracts<sup>12,13</sup>.

## III. RESULTS

### 3.1 GC–MS Profile of Bark Oil

The GC–MS analysis of the bark essential oil of *Litsea udayanii* revealed a complex mixture of volatile constituents distributed over a retention time range of 3.77–39.57 min. Compound identification was accomplished by comparing the obtained mass spectra with those available in the NIST Mass Spectral Library and published spectral databases<sup>12</sup>.

The total ion chromatogram (TIC) showed several prominent peaks, with major chromatographic signals observed at retention times (RT) 3.99, 4.01, 4.07, 4.15, 4.36, 4.39, and 4.66 min. The volatile profile was characterized predominantly by low-molecular-weight aliphatic and cyclic hydrocarbons, accompanied by minor oxygenated compounds, aromatic derivatives, and long-chain aldehydes.

A total of sixteen major compounds were tentatively identified. The hydrocarbon fraction comprised pentane, 2,2-dimethylbutane, 2-methylpentane, 3-methylpentane, n-hexane, 2,4-dimethylpentane, methylcyclopentane, 2-methylhexane, cyclohexane, cis-1,3-dimethylcyclopentane, and cis-1,2-dimethylcyclopentane. Among these, cyclohexane (RT 4.66 min; probability 68.07%), n-hexane (RT 4.13 min; probability 69.33%), and 2-methylhexane (RT 4.61 min; probability 65.42%) represented some of the major identified hydrocarbon constituents.

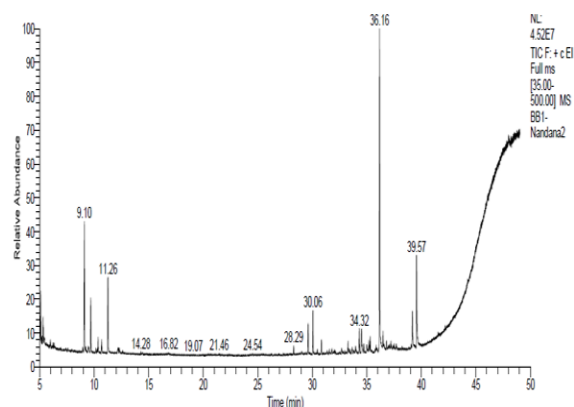
An oxygenated compound, identified as 4-allyloxy-2-methyl-pentan-2-ol, was detected at RT 9.10 min with a matching probability of 16.84%. In addition, an aromatic constituent identified as naphthalene, 1,2,3,4,4a,5,6,8a-octahydro-4a,8-dimethyl- was observed at RT 36.16 min.

At higher retention times, the chromatogram revealed the presence of biologically important long-chain aldehydes, including tetradecanal, hexadecanal, and octadecanal, detected at RT 39.57 min with matching probabilities of 14.19%, 10.87%, and 10.02%, respectively. These aldehydes constituted the principal oxygenated constituents identified in the bark oil.

Overall, the GC–MS profile demonstrated that the bark essential oil of *Litsea udayanii* is dominated by hydrocarbons and cyclic hydrocarbons, together with minor oxygenated compounds, aromatic constituents, and long-chain aldehydes. The results provide the first report on the volatile phytochemical composition of the bark oil of this recently described species from the Western Ghats of India.

Table 1. Major compounds identified in the bark oil of *Litsea udayanii*

RT (min)	Compound Identified	Chemical Class
3.77	Pentane	Aliphatic hydrocarbon
3.87	2,2-dimethyl-Butane	Branched alkane
3.99	2-methyl- Pentane	Branched hydrocarbon
4.05	3-methyl- Pentane	Branched hydrocarbon
4.33	2,4-dimethyl- Pentane	Branched hydrocarbon
4.37	Methyl- Cyclopentane	Cyclic hydrocarbon
4.61	2-methyl- Hexane	Branched hydrocarbon
4.66	Cyclohexane	Cyclic hydrocarbon
4.83	cis- 1,3-dimethyl- Cyclopentane	Cyclic hydrocarbon
4.89	cis- 1,2-dimethyl- Cyclopentane,	Cyclic hydrocarbon
9.10	4-allyloxy-2-methyl- Pentan-2-ol	Oxygenated alcohol
36.16	Octahydrodimethyl Naphthalene derivative	Aromatic sesquiterpenoid-like compound
39.57	Tetradecanal	Long-chain aldehyde
39.57	Hexadecanal	Long-chain aldehyde
39.57	Octadecanal	Long-chain aldehyde



GC-MS of the volatile oil of *Litsea udayanii* bark

#### IV. DISCUSSION

The GC–MS analysis of the bark volatile oil of *Litsea udayanii* revealed the presence of diverse volatile constituents comprising mainly aliphatic hydrocarbons, cyclic hydrocarbons, oxygenated compounds, and long-chain aldehydes. The identified compounds included pentane derivatives, methyl-substituted pentanes, cyclohexane, methyl cyclopentane derivatives, tetradecanal, hexadecanal, octadecanal, and oxygenated alcohol derivatives. The occurrence of such chemically diverse volatile constituents indicates the complex phytochemical nature of the bark oil and suggests possible ecological and pharmacological functions.

Species belonging to the genus *Litsea* are widely recognized for producing essential oils rich in biologically active volatile compounds. Essential oils from several *Litsea* species have been reported to possess antimicrobial, antioxidant, anti-inflammatory, insecticidal, and preservative properties owing to the presence of terpenoids, aldehydes, and oxygenated constituents<sup>14,15</sup>. Recent studies on *Litsea cubeba* demonstrated significant antibacterial and antifungal activities associated with its volatile constituents, highlighting the pharmaceutical potential of the genus<sup>16</sup>.

The predominance of low-molecular-weight hydrocarbons observed in the present study reflects the highly volatile nature of the bark oil. Hydrocarbon compounds such as cyclohexane, methyl cyclopentane derivatives, and branched pentane derivatives contribute significantly to aroma characteristics and may participate in ecological interactions including plant defense and chemical signalling<sup>7</sup>. Hydrocarbon-

rich volatile fractions have been reported in various aromatic members of Lauraceae and are considered important contributors to fragrance profiles and environmental adaptability<sup>17</sup>. The presence of these compounds in *L. udayanii* suggests chemotaxonomic similarities with other Lauraceous plants while also indicating species-specific variations in secondary metabolism.

Cyclic hydrocarbons identified in the bark oil, particularly cyclohexane and cyclopentane derivatives, may influence the physicochemical properties of the oil. These lipophilic compounds facilitate interactions with biological membranes and have been associated with enhanced permeability effects in microbial cell walls. Essential oils containing cyclic hydrocarbons frequently exhibit antibacterial activity through disruption of membrane integrity and interference with cellular metabolic processes<sup>18</sup>. Similar mechanisms have been proposed for hydrocarbon-rich essential oils of Lauraceae species exhibiting broad-spectrum antimicrobial activity.

Among the compounds detected, long-chain aldehydes such as tetradecanal, hexadecanal, and octadecanal are of particular biological significance. Aldehydes are highly reactive compounds capable of interacting with proteins, enzymes, and membrane lipids. Several studies have demonstrated that aldehyde-containing essential oils possess notable antimicrobial and antioxidant activities. Their antimicrobial effects are attributed to membrane disruption, leakage of intracellular constituents, and inhibition of essential enzymatic pathways<sup>19,20</sup>. The occurrence of these aldehydes therefore suggests that the bark oil of *L. udayanii* may possess preservative and antimicrobial potential.

The identification of oxygenated constituents, including 4-allyloxy-2-methyl-pentan-2-ol, further enhances the potential biological value of the oil. Oxygenated volatile compounds are generally considered more bioactive than simple hydrocarbons because of their increased polarity and improved interaction with biological targets. Previous investigations on *Litsea* essential oils have shown that oxygenated compounds contribute substantially to antioxidant, anti-inflammatory, and antimicrobial activities<sup>16, 21</sup>. Such compounds are also important determinants of aroma quality and commercial value in aromatic plant oils.

Aromatic compounds related to naphthalene derivatives were detected at higher retention times. Aromatic hydrocarbons may contribute to fragrance stability and biological activity in essential oils. Although present in relatively low abundance, these constituents can influence the overall organoleptic properties of the oil and may act synergistically with other volatile components<sup>22</sup>.

Interestingly, the chemical profile observed in the present study differs from many previously reported *Litsea* essential oils, which are commonly dominated by monoterpenes such as citral, limonene, linalool, geraniol, and citronellal<sup>14,15</sup>. The predominance of hydrocarbons and long-chain aldehydes in *L. udayanii* bark oil may indicate species-specific biosynthetic pathways, environmental influences, plant-part specificity, or geographical variation associated with the Western Ghats ecosystem. Such chemotypic variation is well documented among members of the genus *Litsea* and is considered important for understanding their chemotaxonomy and biological properties.

Overall, the GC–MS analysis demonstrated that the bark oil of *Litsea udayanii* possesses a distinctive volatile phytochemical profile characterized by hydrocarbons, cyclic compounds, aldehydes, and oxygenated constituents. The occurrence of biologically important aldehydes and oxygenated molecules suggests potential applications in pharmaceutical, cosmetic, and food-preservation industries. Further investigations involving quantitative analysis, isolation of major constituents, and evaluation of antimicrobial, antioxidant, and anti-inflammatory activities are required to validate the therapeutic potential of this newly described species.

## V. CONCLUSION

The present investigation represents a preliminary GC–MS characterization of the bark volatile oil of *Litsea udayanii*. The study revealed the presence of diverse volatile constituents dominated by hydrocarbons, cyclic compounds, aldehydes, and oxygenated molecules. Major compounds identified included cyclohexane, methyl cyclopentane derivatives, n-hexane, tetradecanal, hexadecanal, and octadecanal. The phytochemical diversity observed in the bark oil suggests potential medicinal and industrial applications. The findings provide baseline

phytochemical data for future pharmacological and chemotaxonomic studies on this recently described species.

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#### REFERENCES

- [1] Bakkali, F., Averbeck, S., Averbeck, D., & Idaomar, M. (2008). Biological effects of essential oils—A review. *Food and Chemical Toxicology*, 46(2), 446–475.
- [2] Dhifi, W., Bellili, S., Jazi, S., Bahloul, N., & Mnif, W. (2016). Essential oils' chemical characterization and investigation of some biological activities: A critical review. *Medicines*, 3(4), 25.
- [3] Burt, S. (2004). Essential oils: Their antibacterial properties and potential applications in foods—A review. *International Journal of Food Microbiology*, 94(3), 223–253.
- [4] Tongnuanchan, P., & Benjakul, S. (2014). Essential oils: Extraction, bioactivities, and their uses for food preservation. *Journal of Food Science*, 79(7), R1231–R1249.
- [5] Madusanka, D. M. D., Eeswara, J. P., & Hewage, C. M. (2021). A review on phytochemistry and pharmacological activities of the genus *Litsea* (Lauraceae). *Plants*, 10(10), 2038.
- [6] Wang, Y. S., Wen, Z. Q., Li, B. T., Zhang, H. B., & Yang, J. H. (2016). Ethnobotany, phytochemistry, and pharmacology of the genus *Litsea*: An update. *Journal of Ethnopharmacology*, 181, 66–107.
- [7] a) Liu, T. T., Yang, T. S., Wang, C. H., Chou, Y. C., & Chou, S. T. (2023). Recent advances in phytochemistry and biological activities of the genus *Litsea*. *Molecules*, 28(3), 1105. b) Liu, J., Wang, M., Zhao, Y. (2023). Chemical diversity and ecological functions of hydrocarbon-rich plant volatile oils. *Industrial Crops and Products*, 196, 116481.
- [8] Robi, A. J., & Satheesh George and Thushar K. V. (2015). *Litsea udayanii* (Lauraceae): A new species from the southern Western Ghats, India, *Phytotaxa* 222(1):044-050.
- [9] Azmir, J., Zaidul, I. S. M., Rahman, M. M., Sharif, K. M., Mohamed, A., Sahena, F., Jahurul, M. H. A., Ghafoor, K., Norulaini, N. A. N., & Omar, A. K. M. (2013). Techniques for extraction of bioactive compounds from plant materials: A review. *Journal of Food Engineering*, 117(4), 426–436.
- [10] Handa, S. S., Khanuja, S. P. S., Longo, G., & Rakesh, D. D. (2008). Extraction technologies for medicinal and aromatic plants. International Centre for Science and High Technology, United Nations Industrial Development Organization.
- [11] European Pharmacopoeia Commission. (2019). *European Pharmacopoeia* (10th ed.). Council of Europe.
- [12] Adams, R. P. (2017). Identification of essential oil components by gas chromatography/mass spectrometry (4th ed.). Allured Publishing Corporation.
- [13] Sparkman, O. D., Penton, Z., & Kitson, F. G. (2011). *Gas chromatography and mass spectrometry: A practical guide* (2nd ed.). Academic Press.
- [14] Wang, X., Li, Y., Zhang, W. (2023). Chemical composition and pharmacological properties of *Litsea* essential oils. *Plants*, 12(19), 3401.
- [15] Zhang, Y., Chen, Z., Xu, J. (2024). Recent advances in phytochemistry and biological activities of the genus *Litsea*. *Molecules*, 29(4), 821.
- [16] Ali, A., AlHussaini, K. I. (2024). Essential oil composition and biological activities of *Litsea cubeba*: A comprehensive review. *Microorganisms*, 12(1), 222–238.
- [17] Silva, M. A., Pereira, D. M., Costa, P. (2022). Volatile phytochemistry of Lauraceae species and their biological significance. *Biochemical Systematics and Ecology*, 101, 104398.
- [18] Nguyen, T. H., Tran, V. T., Le, P. H. (2023). Mechanisms of antimicrobial action of hydrocarbon-rich essential oils. *Molecules*, 28(15), 5892.
- [19] Borges, A., José, H., Homem, V., Simões, M. (2022). Antibacterial activity and mode of action

of aldehydes and aldehyde-rich essential oils. *Industrial Crops and Products*, 182, 114894.

- [20] Sharma, S., Patel, R., Gupta, P. (2024). Biological activities of long-chain aldehydes from medicinal plants: A review. *Journal of Essential Oil Research*, 36(2), 95–109.
- [21] Chen, Y., Zhang, H., Liu, X., Wang, Q. (2023). Oxygenated volatile compounds as key contributors to antioxidant and antimicrobial properties of plant essential oils. *Plants*, 12(8), 1589.
- [22] Kumar, P., Singh, R., Sharma, N. (2022). Aromatic hydrocarbons and their contribution to biological activity of medicinal plant essential oils. *Natural Product Communications*, 17(11), 1–10.