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phytochemical investigation of essential oils from polyalthia longifolia ethanolic extract using gas chromatography-mass spectrometry

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Abstract

Background: *Polyalthia longifolia* (PL) holds local significance in India, celebrated for its rich heritage and medicinal properties. Its leaves and bark are used in essential oil production and in treating skin diseases, diabetes, hypertension, helminthiasis, and imbalances in *vata* and *pitta*. Phytochemical analysis of PL's ethanolic leaf extract has revealed the presence of alkaloids, glycosides, carbohydrates, steroids, flavonoids, saponins, and tannins.Objective: The purpose of this study was to identify phytoconstituents in PL leaves through Gas Chromatography-Mass Spectrometry (GC-MS), with potential applications in disease treatment.Materials and Methods: GC-MS techniques were employed to analyze phytoconstituents based on retention time and mass spectra, which were then verified against mass spectrometry libraries from PL leaf extracts. The analysis identified compounds such as caryophyllene, oxiranetetradecyl, 5-(7a-isoprenyl-4,5-dimethyl-octahydroinden-4-yl)-3-methyl-pent-2-en-1-ol, cedrandiol (8S,14), and gurjunenepoxide-(2).Conclusion: Further research on PL leaves could explore additional extraction and chromatographic techniques to isolate higher proportions of these and other phytoconstituents, with a focus on their ethnopharmacological activities. This would deepen the understanding of PL's potential in traditional and modern medicine.

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INTRODUCTION

Phytochemistry is a burgeoning field that not only focuses on the identification of chemical structures, biosynthesis, and metabolism but also on the applications of various biological activities [1]. In recent years, researchers have made significant progress by employing hyphenated techniques to elucidate, isolate, identify, and characterize a wide range of phytoconstituents found in plants. Gas Liquid Chromatography (GLC) is particularly noted for its sensitivity and capability to provide both quantitative and qualitative results in a single operation, making it comparable to High-Pressure Liquid

Chromatography (HPLC) [2]. The difference in operating temperatures between GLC and HPLC arises from GLC's capacity to undergo thermal rearrangement during separation.

Mass spectrometry has revolutionized the study of natural products and advanced phytochemistry research by identifying specific components based on molecular weight and fragmentation patterns. Coupling mass spectrometry with other chromatographic techniques, such as Gas Chromatography-Mass Spectrometry (GC-MS), offers a sophisticated method for elucidating structures [3]. Essential oils from terpenoids are crucial in commercial perfumes and the food industry as flavoring agents and spices. Terpenes, including monoterpenes and sesquiterpenes, are primarily separated using GLC due to their volatility [[1].

Polyalthia longifolia is a large shrub with about 120 species, found in 14 different regions across India. This species comes in two varieties: one with spreading perpendicular branches and another with drooping pendulous branches, used as an avenue tree. The leaves are alternate, stipulate, aromatic, and lanceolate with a fine acuminate apex. The leaf oil contains various sesquiterpene constituents such as alloaromadendrene, β-selinene, β-humulene, and ar-curcumene [5]. GC-MS, in conjunction with other chromatographic techniques, is essential for separating and identifying volatile phytoconstituents.

AIMS AND OBJECTIVES:

The study aimed to identify and confirm the structures of the constituents in the ethanolic extract of PL leaves using GC-MS.

MATERIALS AND METHODS:

- **Part A: Collection, Authentication, Extraction, and Preliminary Phytochemical Screening**: PL leaves were collected, authenticated, extracted, and subjected to preliminary phytochemical screening as described in previous studies.
- **Part B: GC-MS Studies on PL Leaves**: The ethanolic extract was analyzed using GC-MS. The mobile phase involved an ethanol EI-MS spectrum scanned at 70 eV with the following instrument details:
    - **MS Model**: Joel Accu Time of Flight Analyzer (TOF) GCV, mass range 10-2000 amu, resolution 6000.
    - **GC Manufacturer**:Agilent 7890, with a Flame Ionization Detector (FID).

Table 1 Various compounds and their fragments in EPL Leaves Extract

Sr.No	Retention time	Identity	Molecular Formula	m/z	Synonyms
1	9.53	(1)	$C_{15}H_{24}$	205	Bicyclol [7.2.0] undec-4-ene, 4,11,11-trimethyl-8-methylene-, [1R-(1R,4E,9S)]; Bicyclol [7.2.0] undec-4-ene, 4,11,11-trimethyl-8- methylene-, (E)-(1R,9S)-(-)-; β-Caryophyllen; β-Caryophyllene; trans-Caryophyllene; L-Caryophyllene; Caryophyllene α + β mixture; Bicyclol [7.2.0] undec-4-ene, 8-methylene4,11,11-trimethyl-, (E)-(1R,9S)- (-)-; 8-methylene-4,11,11-(trimethyl) bicyclol [7.2.0] undec-4-ene; 4,11,11-Trimethyl-8- methylene bicyclol[7.2.0]undec-4-ene
2	27.80	(2)	$C_{16}H_{32}O$	241	Hexadecane,1,2, epoxy-; Hexadecylene oxide; 1,2-Epoxyhexadecane; 1,2-Hexadecane oxide; 1,2-Hexadecane epoxide; 2-Tetradecyloxirane
3	27.98	(3)	$C_{20}H_{34}O$	289	No synonyms
4	29.44	(4)	$C_{15}H_{26}O_2$	236	Cedrane-8,13-diol
5	29.70	(5)	$C_{15}H_{24}O$	221	1,2-(3,8-Dimethyl-1,2,3,5,6,7,8,8a-octahydro-5-azulenyl-)-2-methyloxirane

- **Run Time**:30 minutes, using a splitless injection of 1.0 µL sample in ethanol on a Hewlett Packard 6890 gas chromatograph fitted with a 5% phenyl methyl siloxane HP-5 MS capillary column (30 m x 0.25 mm x 0.26 mm coating thickness).
- **Operating Conditions**: Injector temperature 200°C, transfer line temperature 260°C, oven temperature program 60–280°C with a ramp of 5°C/min, carrier gas: helium at 1.5 mL/min.

RESULTS AND DISCUSSION:

Essential oils, being volatile, are analyzed using GC-MS based on their m/z charges. The study identified caryophyllene, a bicyclic sesquiterpene, among other components in the GC-MS analysis of the PL extract. Essential oils have various applications from major to minor ailments [1,8]. The GC-MS technique revealed five components in the mass spectrum of the PL extract.

Error! Reference source not found. depicts the c omponents found in the ethanolic Polyalthia longifolia (EPL) leaf extract, including their retention time, m/z, formula, and synonyms.

The identified components are:Caryophyllene (1) with m/z 204, and fragment ions at 41, 55, 69, 79, 93, 107, 120, 133, 147, 161, 175, 189, 204.Oxiranetetradecyl (2) with m/z 241, and fragment ions at 41, 55, 71, 82, 96, 109, 123, 138, 222 and 5-(7a- .

CONCLUSION:

The study of EPL extract is expected to advance the field of phytochemistry by enhancing the identification, isolation, and characterization of essential oils with ethnopharmacological potential

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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