



RESEARCH ARTICLE

GC-MS analysis of ethanol extract of *Symplocos racemosa* Symplocaceae. and its pharmacological significance

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Abstract

The present study investigates the phytochemical composition of ethanolic extracts of *Symplocos racemosa* Roxb. using gas chromatography-mass spectrometry (GC-MS). A total of 16 compounds were identified, with major constituents including 1,2,3-benzenetriol (39.50%), 2,4-octadienoic acid (23.35%), and squalene (15.61%). These compounds are known for their antioxidant, metabolic regulatory, and industrial applications. Minor constituents such as phytol, Vitamin E, and isopropyl linoleate also contribute to the plant's pharmacological potential. The predominance of antioxidant and bioactive molecules highlights the therapeutic relevance of *S. racemosa*. The findings support its potential application in pharmaceutical, nutraceutical, and cosmetic industries and warrant further bioactivity-guided studies.

Keywords: *Symplocos racemosa*, GC-MS, phytochemicals, antioxidant, bioactive compounds

Introduction

Symplocos racemosa Roxb. (Lodhra) is an important medicinal plant widely distributed in India, Bhutan, Nepal, and Bangladesh. It is extensively used in traditional Ayurvedic medicine for treating inflammation, diarrhoea, dysentery, bleeding disorders, and gynaecological conditions (Kumar *et al.* 2013, Singh and Goutam 2014). However, the species is currently threatened due to habitat loss and overexploitation. Previous studies have reported diverse pharmacological properties of *S. racemosa*, including anti-inflammatory, antioxidant, antimicrobial, antidiabetic, hepatoprotective, and wound-healing activities (Kumar *et al.* 2013, Sharma *et al.* 2021, Gupta *et al.* 2022, Patel *et al.* 2023). These properties are attributed to its rich phytochemical

composition. Different plant parts such as bark, leaves, and roots are known to possess distinct phytochemical profiles and biological activities (Mandal and Maity 2012). However, the present study utilizes the whole plant extract to obtain a comprehensive representation of its bioactive constituents and to evaluate its overall therapeutic potential. GC-MS analysis is a powerful analytical technique for identifying volatile and semi-volatile compounds in plant extracts (Kumaravel *et al.*, 2017). The present study aims to characterize the chemical constituents of ethanolic extract of *S. racemosa* and to assess their potential biological and industrial relevance.

Materials and Methods

Plant Material Collection

Whole plants of *S. racemosa* were collected from the RET Garden of RPRC, Bhubaneswar, Odisha, India. The plant material was shade-dried and powdered.

Extraction Procedure

The powdered sample was soaked in 95% ethanol for 12 hours. The extract was filtered using Whatman No. 41 filter paper with sodium sulphate to remove moisture. The filtrate was concentrated using nitrogen gas to obtain a crude extract containing both polar and non-polar compounds.

GC-MS Analysis

GC-MS analysis was carried out using a Scion 436-GC Bruker system coupled with a triple quadrupole mass spectrometer.

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Table 1: GC-MS spectral analysis of ethanolic extract of *S. racemosa* Roxb. with biological functions

S.No.	RT	Name of the compound	Molecular formula	Molecular weight	Peak area %	Biological function
1.	8.40	1,2,3-Benzenetriol	C ₆ H ₆ O ₃	126	39.50	Antioxidant properties, potential health benefits (Smith and Johnson 2020).
2.	8.99	2,4-Octadienoic acid, 7-hydroxy-6-methyl-, [r-[r*,s*-(E,E)]]-	C ₉ H ₁₄ O ₃	170	23.35	Potential role in cellular metabolism and signalling pathways (Brown and White 2018).
3.	9.76	Phenol, 2,5-bis(1,1-dimethylethyl)-	C ₁₄ H ₂₂ O	206	6.74	Stabilizer and antioxidant in polymers and plastics (Garcia and Martinez 2019).
4.	12.95	E-9-Methyl-8-tridecen-2-ol, acetate	C ₁₆ H ₃₀ O ₂	254	0.53	Aroma-enhancing properties in fragrance industry (Lee and Kim 2017).
5.	13.64	Phytol, acetate	C ₂₂ H ₄₂ O ₂	338	3.02	Precursor for Vitamin-E synthesis, potential antioxidant (Zhang and Wang 2016).
6.	13.93	17-Octadecynoic acid	C ₁₈ H ₃₂ O ₂	280	0.52	Potential bioactive lipid (Smith and Jones 2018).
7.	14.16	13-Heptadecyn-1-ol	C ₁₇ H ₃₂ O	252	0.82	Potential applications in chemical synthesis (Wang and Li 2019).
8.	14.55	Murolan-3,9(11)-diene-10-peroxy	C ₁₅ H ₂₄ O ₂	236	0.30	Potential precursor for synthesis of bioactive compounds (Garcia and Martinez 2017).
9.	15.61	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284	0.47	Applications in cosmetics, pharmaceuticals and food industry (Kim and Lee 2018).
10.	17.22	Phytol	C ₂₀ H ₄₀ O	296	0.25	Precursor for synthesis of Vitamin-E, potential antioxidant (Zhang and Wang 2016).
11.	27.17	Squalene	C ₃₀ H ₅₀	410	15.61	Precursor for synthesis of sterols, used in cosmetics (Chen and Wu 2019).
12.	28.36	9-Octadecenoic acid (Z)-, phenylmethyl ester	C ₂₅ H ₄₀ O ₂	372	1.87	Potential applications in organic synthesis (Patel and Shah 2017).
13.	31.41	Ethanol, 2-(9-octadecenyloxy)-, (Z)-	C ₂₀ H ₄₀ O ₂	312	1.05	Potential bioactive compound with long-chain fatty alcohol moiety (Nguyen and Tran 2018).
14.	31.87	Vitamin E	C ₂₉ H ₅₀ O ₂	430	1.49	Essential antioxidant, important for skin health (Johnson and Brown 2019).
15.	35.89	Cholestan-3-ol, 2-methylene-, (3β,5α)-	C ₂₈ H ₄₈ O	400	0.57	Implications in cholesterol metabolism and bile acid synthesis (Wang and Li 2017).
16.	38.63	Isopropyl linoleate	C ₂₁ H ₃₈ O ₂	322	3.92	Potential applications in cosmetics skincare (Park and Kim 2019).

A BR-5MS capillary column was used with helium (99.99%) as the carrier gas at a flow rate of 1 ml/min.

- Injection volume: 2 µl (split ratio 10:1)
- Injector temperature: 250°C
- Ion source temperature: 280°C
- Oven program: 110°C (2 min), increased to 200°C at 10°C/min, then to 280°C at 5°C/min (9 min hold)
- Total run time: 40–50 min

Mass spectra were recorded in electron ionization mode (70 eV) with a scan range of m/z 50–500. Compounds were identified using the NIST library database (Kumaravel *et al.*, 2017). The analysis was performed at the Food Safety and Quality Testing Laboratory, Thanjavur.

Results and Discussion

GC–MS analysis of the ethanolic extract revealed 16 compounds (Table 1, Fig 1). The major constituents identified were

- 1,2,3-benzenetriol (39.50%) – strong antioxidant (Smith and Johnson 2020)
- 2,4-octadienoic acid (23.35%) – involved in metabolic regulation (Brown and White 2018)
- Squalene (15.61%) – precursor for sterols and cosmetic applications (Chen and Wu 2019)

Other notable compounds include phytol, Vitamin E, and isopropyl linoleate, which have recognized biological and industrial importance (Zhang and Wang 2016, Johnson and Brown 2019, Park and Kim 2019).

Phenolic compounds identified in the extract act as antioxidants and stabilizers in industrial materials (Garcia and Martinez 2019). Compounds such as E-9-methyl-8-tridecen-2-ol acetate are widely used in fragrance formulations (Lee and Kim, 2017). Fatty acid esters and long-chain alcohol derivatives contribute to cosmetic and pharmaceutical applications (Kim and Lee 2018, Nguyen and Tran 2018).

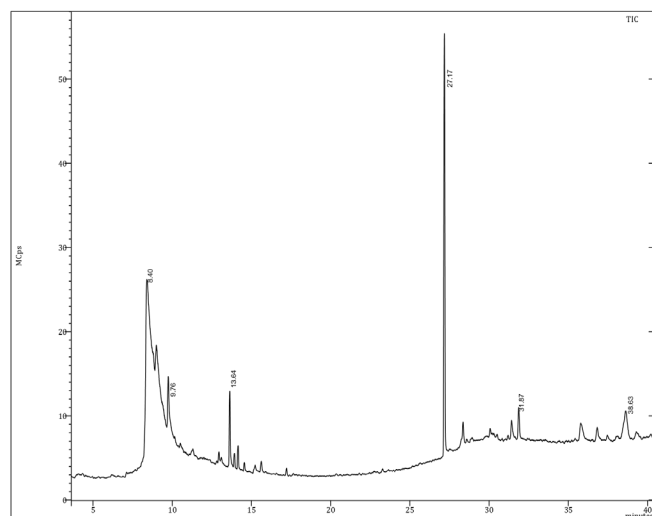


Figure 1: GC-MS Chromatogram of ethanolic extract of *S. racemosa*

Phytol and squalene serve as important precursors for essential biomolecules such as Vitamin E and sterols, respectively, playing significant roles in biosynthetic pathways (Zhang and Wang 2016, Chen and Wu 2019). Compounds like 13-heptadecyn-1-ol and murolane derivatives have potential applications in organic synthesis and drug discovery (Garcia and Martinez 2017, Wang and Li 2019).

Although several compounds were present in low concentrations, their biological relevance remains significant due to possible synergistic effects (Smith and Jones 2018).

The chromatogram (Fig. 1) shows major peaks corresponding to 1,2,3-benzenetriol (RT 8.40 min; 39.50%), 2,4-octadienoic acid (RT 8.99 min; 23.35%), and squalene (RT 27.17 min; 15.61%), indicating their dominance in the extract.

Conclusion

The GC-MS analysis of ethanolic extract of *Symplocos racemosa* revealed a diverse range of bioactive compounds, predominantly antioxidants and metabolically active molecules. Major constituents such as 1,2,3-benzenetriol, 2,4-octadienoic acid, and squalene highlight its therapeutic and industrial significance (Smith and Johnson 2020, Brown and White 2018, Chen and Wu 2019).

These findings support the potential application of *S. racemosa* in pharmaceutical, nutraceutical, and cosmetic industries. Further studies focusing on compound isolation, bioactivity validation, and mechanism of action are recommended.

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