

GC-MS aspect of moss *Funaria hygrometrica* Hedw.

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Abstract

The moss *Funaria hygrometrica* Hedw. occurs cosmopolitan occurring worldwide in distribution. Plants grown on moist rocks, cemented old walls, bridges, and bricks and even on soil surface. Plants found in loose to compact tufts, in large patches and green to yellowish green in colour. Thallus is simple and branched having slender stem which is erect and 5 to 10 mm high. Lower leaves found small, costa poorly developed and upper leaves large crowded at apex and upper cells sub-hexagonal, elongated, long and wide. Seta found erect two to three cm long, terminal and reddish on maturity. Capsule horizontal to pendulous, curved, pyriform, oblique, and globose at back. Operculum large convex, mouth wide and bear two rows of teeth. The plant *Funaria* itself have ecological significance especially nutrient recycling and its role in establishment of community in ecosystem. It possesses characteristic smell and habitat of micro flora due to unique phytochemicals present in it. Hence preliminary phytochemical analysis confirms the presence of alkaloids, flavonoids, glycosides and terpenoids as an important phyto constituent. Using sophisticated techniques, the methanol extract was subjected for GC-MS analysis and probable chemical correlation was tried to explore. Future advanced chemical analysis may lead to new platform for novel drugs.

Keywords: Moss, Phytochemicals, GC-MS analysis, Potency, drug design

1. Introduction

Mosses like *Funaria hygrometrica*, *Atriam* sp., *Pogonatum* sp. known for enveloping over the forest with moisture, temperature, prevents soil erosion and provides seed beds.

Mosses species are indicator of metal rich soil and good indicators of air pollution [1]. Moss like *Sphagnum* used in therapeutic due to its potent medicinal properties and used in agriculture practises due to high water retention capacity. Medicinally, mosses known and used extensively in Chinese, Native Americans and Indian sub continents. *Physcomitrella*, *Philontis*, *Bryum*, *Sphagnum* used on burns and wounds, boils, burns and abscess with certain antibiotic properties. Antimicrobial activity of ethanolic extracts of 15 Indian mosses like *Sphagnum* sp., *Barbula* sp., *Brachythecium* sp., *Mnium* sp., *Entodon* sp. and found active against 12 micro-organisms [2].

2. METHODOLOGY

The mosses plant *Funaria hygrometrica* get collected from the Melghat forest during rainy and winter season in sealed bags to avoid interaction with air nitrogen. The material brought in laboratory to get cleaned, washed under tap water and placed for air dry and powdered done by the mechanical blender avoiding excessive heating. Preliminary phytochemical analysis like test for alkaloids, flavonoids, tannins, phenolics, steroids, saponins and terpenoids done to trace the presence of chemical potential [3]. Plant sample extract in volatile

methanol solvent were send to common facility centre, Shivaji University, Kolhapur for Gas Chromatography-Mass Spectroscopy (GC-MS) analysis. Technically, GC-MS analysis of the sample was carried out using Shimadzu Make QP-2010 with non-polar 60 M RTX 5MS Column. Helium was used as the carrier gas and the temperature programming was set with initial oven temperature at 400C and held for 3 min and the final temperature of the oven was 4800C with rate at 100C [min.sup.1]. A 2-µL sample was injected with split less mode. Mass spectra was recorded over 35 - 650 amu range with electron impact ionization energy 70 eV. The chemical components from the methanolic extract of plant was identified by comparing the retention times of chromatographic peaks using Quadra pole detector with NIST Library to relative retention indices. Quantitative determinations were made by relating respective peak areas to TIC areas from the GC-MS.

3. RESULTS AND DISCUSSION

The moss *Funaria hygrometrica* showed effective composition, mostly due to presence of alkaloids, flavonoids, sterols, glycosides and less reactive to test for tannins and saponins under phytochemical analysis.

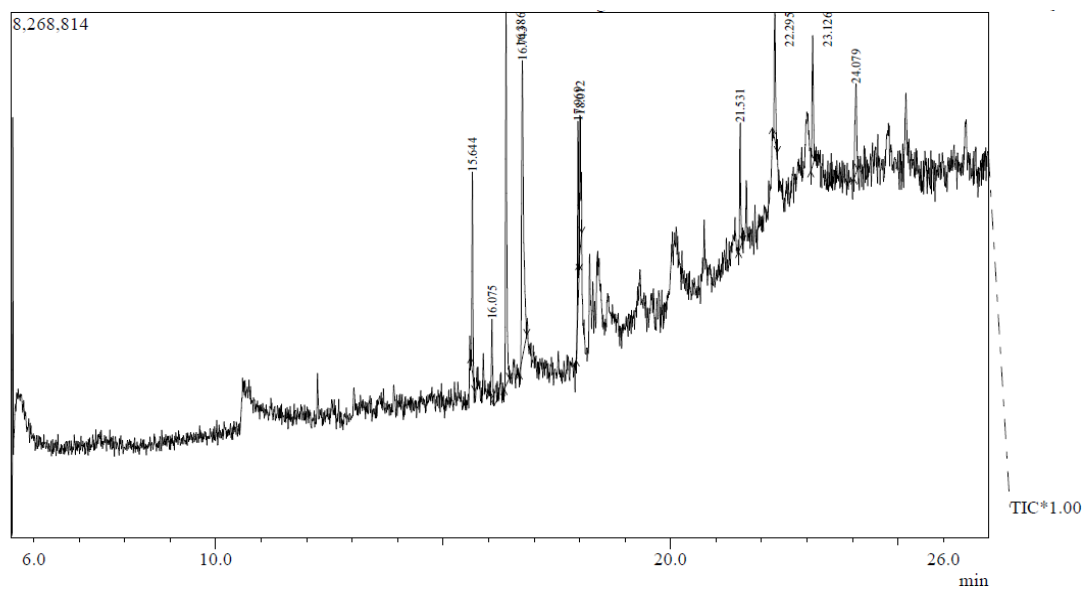


Fig: 1. GC-MS chromatogram of *Funaria hygrometrica*

Table 1 : Compounds analysed from mass spectrum

Sr. No.	Retention time	% area of the peak	Compound analyzed	Molecular formula	Molecular weight	Common Name	Activity reported As per Dr. Dukes Database [7]
1	15.64	8.18	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	C ₂₀ H ₄₀ O	296	Terpen alcohol	Anti-inflammatory Antibacterial, and Antifungal
2	16.07	3.59	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	C ₂₀ H ₄₀ O	296	Terpen alcohol	Anti-inflammatory Antibacterial, and Antifungal
3	16.38	20.49	Hexadecanoic acid, methyl ester	C ₁₇ H ₃₄ O ₂	270	Palmitic acid ester	Antioxidant, Hypocholesterolemic, Nematicide, Pesticide
4	16.74	26.23	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256	Palmitic acid	Antioxidant, Hypocholesterolemic, Nematicide, Pesticide
5	17.96	7.29	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	C ₁₉ H ₃₄ O ₂	294	Linoleic acid	Antioxidant Antibacterial, Anticancerous
6	18.01	7.01	7,10,13-Hexadecatrienoic acid, methyl ester	C ₁₇ H ₂₈ O ₂	264	Gamma-Linoleic acid	Antibacterial
7	21.53	5.49	Heptadecane, 2,6,10,15-tetramethyl	C ₂₁ H ₄₄	296	Alkane	Antibacterial Antifungal
8	22.29	6.90	Nonacosane	C ₂₉ H ₆₀	408	alkane	Antibacterial, waxy parafin Insect pheromonal
9	23.12	7.83	Hexacosane	C ₂₆ H ₅₄	366	alkane	Anti-inflammatory
10	24.79	6.98	Nonadecane	C ₁₉ H ₄₀	268	alkane	Antibacterial

Dr. Duke's phytochemical and ethnobotanical database (<https://phytochem.nal.usda.gov/phytochem>) [7]

Krishnan *et al.* [4] confirmed that, the bryophytes having alkaloids are pharmacologically active as they have physiological effects on human as well as other animals and serves as therapeutic and anti-malarial drugs. The presence of cardiac glycosides reported to be used in treating heart problems. Most of the bryophytes species have relevance in the production of drugs against heart problems and other ailments [5]. Hence, further research is needed to isolate these secondary metabolites and identify their specific types. Flavonoids are extremely common constituents of bryophytes and detected in Marchantiopsida, Anthocerotopsida and Bryopsida by Chopra and Kumar [6].

The moss *Funaria hygrometrica* (Table: 1) in GC-MS investigation showed wide range of phyto-constituents like 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, is a diterpene alcohol. It is by-product from the production of chlorophyll and essential material to produce vitamin K1 and vitamin E. The presence of chemical constituent like Heptadecane, 2, 6, 10, 15-tetramethyl. Heptadecane is an organic compound of alkane hydrocarbon. Interestingly, Ozdemir *et al.* [8] reported antimicrobial activity of heptadecane and tetradecane in methanol extract of *Spirulina platensis* against bacteria like *E. coli*, *S. aureus* and fungi *Candida albicans* with promising results. Nonadecane, compound also found effective

against bacteria like *S. aureus* and *E. coli* and found as therapeutic agent of pharmaceutical materials reported by Ibrahim *et al.* [9]. The compounds like Hexacosane is higher alkanes with higher number of carbon atoms. Agnihotri *et al.* [10] reported the anti-inflammatory properties of these compounds in traditional medicines. Nonacosane is a straight chain hydrocarbon, occurs naturally and present in several essential oils but can be synthesized artificially too. Naz *et al.* [11] tested Nonacosane from moss *Funaria parviflora* against bacteria like *S. aureus*, *E. coli*, *S. typhimurium*, *K. pneumoniae* and *S. epidermis* with positive results.

Bodade *et al.* [12] suggested that, the antimicrobial tendency of bryophytes can be attributed to active derivatives of terpenoids. Claude, [13] found that on insects attacks, these terpenoids will attract nematodes, that will destroy the larvae of these herbivorous insects. Its observed that plant species provides shelter to many earthworms, soil beetles, around the thalli and soil.

4. CONCLUSION

The GC-MS data obtained from the plant extract revealed the presence of chemical constituents like terpenes like phytol 3, 7, 11, 15-Tetramethyl-2-hexadecen-1-01, the hydrocarbons group of alkanes compounds like Nonacosane Hexacosane Nonadecane in the analysis. With the advancement of various techniques and modern instruments like (GC) gas chromatography and (MS) Mass spectrometry, NMR, HPTLC etc. for isolation as well as structure elucidation of novel compounds can be determined for the benefits and survival of human race.

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Conflict of interest

No conflict of interest influenced in this research.

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