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GC-MS Analysis For Determination of Bioactive Compounds of Phellinus Pectinatus: A Species of Wild Mushroom from Uttarakhand Himalaya, India

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KEYWORDS
Antimicrobials, Antioxidants, bioactive compounds, GC-MS, Phellinus pectinatus, Wild mushrooms

ABSTRACT:

Introduction: Nature has been the main storehouse of medicinal treasures for thousands of years. Based on their use in traditional medicine, important compounds are being isolated from these natural sources to make modern medicines. Wild mushrooms (macrofungi) may be an important source of drugs for modern medicine. Since mushrooms possess medicinal properties like antimicrobials, antifungals, antivirals, antioxidants, anti-HIV, antitumors, and anticancer, there has been an increasing demand for the isolation of their bioactive compounds. The present study is intended to identify bioactive compounds in the wild mushrooms *Phellinus pectinatus*. *Phellinus pectinatus* was collected from the Garhwal Himalayan region of Uttarakhand state. After collection, the sample was dried, ground to a fine powder, and then subjected to methanol extraction. The GC-MS method was used to identify the significant volatile components. Identification is based on the peak area%, molecular weight, and, retention time. In the present study, a total of thirty-nine components were identified from methanolic extract of *Phellinus pectinatus* by GC-MS analysis. From all the identified components, 19 components are already having biological activity while 20 components were firstly reported in the present study, and their biological activities are not previously reported in scientific literature. n-Hexadecanoic acid (11.19%), Dibutyl phthalate(10.57%), hexadecanoic acid, methyl ester (9.31%) and Benzene, 1,3,5-tris(3-methyl-3-butenyl)- (8.01%) are the main components present in methanolic extract of *Phellinus pectinatus* at, while some other useful components also present at moderate level i.e Methyl 10-trans,12-cis-octadecadienoate (5.41%),9,12-Octadecadienoic acid (Z,Z)-(5.19%), and 4,5-Diphenylocta-1,7-diene (dl) (4.87%) .These findings suggested that the extract of *Phellinus pectinatus*, could be a good source of bioactive compounds for medicinal purposes, as well as agricultural importance.

Methods: The fruiting body of *Phellinus pectinatus* was collected from the Garhwal Himalayan region in Uttarakhand India. Identification and authentication were done at available field guide of macrofungi, monographs, review of relevant literature, and available web resources mycokey.com, www. Mushrooms (Kothiyal et al. 2022). The specimen was deposited in the Laboratory, Department of Microbiology, SGRRU Patel Nagar, Dehradun, Uttarakhand, India.

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Results: The use of GC-MS is one of the most efficient techniques available for identifying volatile matter, long-chain, branched-chain hydrocarbons, organic acids, alcohols, phenol, ketone, and esters, among others. Among the most active wild mushroom species, methanol extract of *Phellinus pectinatus* was selected for GC-MS analysis.

Conclusions: In the present study, GC-MS was employed to identify various compounds in *Phellinus pectinatus* methanol extract that exhibits antiviral, anticancer, antimicrobial, antioxidant, hypocholesterolemic, pesticidal, insecticidal, nematicide, antiandrogenic, anti-inflammatory, anti-hypertension, antihistaminics, anticoagulants, ophthalmic drug activity, and anti-fungal activities. The presence of medically important compounds justifies the medicinal properties of this wild mushroom. Moreover, by isolating and characterizing the bioactive components found in this mushroom in the future, these compounds may be utilized to develop effective drugs against harmful strains of bacteria. Also, it can be used as a potential source to improve agricultural production.

1. Introduction

Natural products have played an important role in the treatment and prevention of human diseases for thousands of years all over the world. Medicines have been developed from a variety of natural sources including fungi, plants, microorganisms, and animals. mushrooms (macrofungi) have a large fruit-bearing body that is unlike any other fungus and is clearly visible to the naked eye (Kothiyal and Singh 2022). Since prehistoric times, mushrooms have been utilized as both food and medicinal (O'Neil et al. 2013). Mushrooms have been the center of attraction since time immemorial because of their unusual features such as clusters, rings, various shapes, and sudden appearances in different places. Mushrooms constitute the most diverse group of organisms in this biosphere after insects (Pala et al. 2012). Mushrooms have been in existence since the lower cretaceous period (130 million years ago), long before the evolution of humans, which is known from the fossil record. About 140,000 species of macrofungi are found on earth, of which only 10% of species are known (Parmar and Kumar 2015). Assuming only 5% of the undiscovered and unexamined mushrooms will be useful, this implies 7000 yet unknown species might offer benefits to mankind. A wide range of medicinal properties is existent in wild macrofungi. These include antimicrobial, antifungals, antivirals, antiparasitic, antioxidant, anti-HIV, antitumor, anticancer, anti-inflammatory,antidiabetic, hepatoprotective, hypocholesterolemic, cytotoxic, anti-coagulant, and antiproliferative (Kothiyal et al. 2022). The presence of different types of compounds is found in them like terpenoids, polyketides, steroids, flavonoids polysaccharides (especially β-glucans). alkaloids, dietary fibers, and polyphenol. The nutritional value of mushrooms is almost the same as that of meat, egg, and milk foods. The nutritional value of mushrooms is immense owing to their high protein, vitamin, mineral, fiber, and trace element content, as well as their low calorie and cholesterol content. They are also helpful in the accumulation of heavy metals from the environment as well as in the bioremediation of industrial waste (Kalac et al. 2004). GC-MS is a method that is widely used to identify a variety of substances present in a sample. GCMS techniques have been used to look for new medications in mushrooms, and polysaccharides such as xylomannans and -glucans have been reported from the edible fungus *Flammulina velutipes* (Smiderle et al. 2006). The presence of fatty acid, their esters, and antimicrobial activity in *Pleurotus ostreatus* was detected by the GC-MS technique. GC–MS (gas chromatography-mass spectrometry) is a powerful tool for separating and detecting volatile organic compounds. It is therefore possible to interpret the volatile compositional properties of mushrooms using GC-MS. With the emergence of gas chromatography-mass spectrometry (GC-MS) in the last few years, it has become a prominent platform for analyzing secondary metabolites in both plant and non-plant species (Oni et al. 2020). The main objective of the present study is to detect the presence of bioactive volatile compounds in the methanolic extract of *Phellinus pectinatus* by GC-MS analysis. The results obtained from the study can be used in the future for pharmaceutical, nutraceutical, therapeutic uses, and agricultural applications.

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Material and methods

Sample collection: The fruiting body of *Phellinus pectinatus* (**Figure.1)** was collected from the Garhwal Himalayan region in Uttarakhand India. Identification and authentication were done at available field guide of macrofungi, monographs, review of relevant literature, and available web resources mycokey.com, www. Mushrooms (Kothiyal et al. 2022). The specimen was deposited in the Laboratory, Department of Microbiology, SGRRU Patel Nagar, Dehradun, Uttarakhand, India.

Figure 1: A pictrorial view of *Phellinus pectinatus* captured in natural habitat

Wild mushroom material preparation

Mushrooms were cut into small pieces. These were then dried with the help of sunlight and a commercial dryer (NOVA, NV-617B). with the help of an electronic blender, the small pieces of macrofungi were finely ground. The powdered powder was stored in a plastic box at normal room temperature for further analysis.

Extraction of mushroom

Extraction was carried out in the microbiology laboratory, SGRR School of Basic & Applied Sciences, SGRR University Dehradun. The powder of 40g *Phellinus pectinatus* was extracted with 250ml methanol by cold maceration method for 72h. After extraction, it was filtered through Whatman Number 1 filter paper to remove solid particles and evaporated to dryness under vacuum with a rotary evaporator to remove the solvent. For further use, the crude extract obtained was stored at 4 °C (Kothiyal and Singh 2022) .

GC-MS Methodology

The methanolic extract of the mushroom was analyzed to detect the presence of various volatile compounds by the Gas Chromatography-Mass Spectrometry (GC-MS) technique. The analysis was done at the *CytoGene*® Research & Development, Lucknow, India. Autonomous Registered organization by Ministry of corporate affairs, Government of India under Companies Act 2018. Certified by ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

AOC 20i auto-injector and GCMS-TQ8040 NX was used for the detection of sample analysis. The following parameters were used: plunger speed (suction), high; visocosity comp. temperature, 0.4sec; plunger speed (injection), high; syringe insertion speed, high; injection mode, normal; pumping time,5; injection port dwell time, 0.3 sec; plunger washing speed, high; washing volume, 8 µL; column oven temperature, 60.0 °C; injection temperature,240.00 °C; flow control mode, linear velocity; pressure, 58.4 KPa; total flow,14.2ml/min; column flow,1.01ml/min; linear velocity, 36.7cm/sec; purge flow, 3.0 ml/min; split ratio, 10.1; ion source temperature, 240.00 °C; interface temperature, 250.00 °C; solvent cut time, 2.00 min; detector gain mode, relative to the tuning result; detector gain, +0.00 kV; threshold, 0; acquire data without using CID gas (Q3scan), ON.

Interpretation of mass spectra of GC-MS was carried out using the national institute of standards and technology (NIST) database. The unknown component's spectra were compared to the known component's spectrum contained in the NIST 17 collection. The components of the test materials were identified by their name, molecular weight, and structure.

Results

The use of GC-MS is one of the most efficient techniques available for identifying volatile matter, long-chain, branched-chain hydrocarbons, organic acids, alcohols, phenol, ketone, and esters, among others.

Among the most active wild mushroom species, methanol extract of *Phellinus pectinatus* was selected for GC-MS analysis.

In the current study, the Methanolic extract of *Phellinus pectinatus* displayed 39 peaks in the GC-MS

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chromatogram analysis. Using the database stored in the NIST 17 library, the peaks in the chromatogram were integrated and compared with the spectrum of known components. **Table.1** shows identified compounds and their peak area percentage, and retention time (RT) as well as their molecular formula (MF), and molecular weight (MW). **Figure.2** shows the mass spectra of all the compounds identified in the ethanolic extract of *Phellinus pectinatus*.

n-Hexadecanoic acid (11.19%), Dibutyl phthalate (10.57%), hexadecanoic acid, methyl ester (9.31%), and Benzene, 1,3,5-tris(3-methyl-3-butenyl)- (8.01%) are among the most abundant compounds found in the peak zone. Moderately abundant compounds included Methyl 10-trans,12-cis-octadecadienoate (5.41%),9,12-Octadecadienoic acid (Z,Z)- (5.19%),4,5-Diphenylocta-1,7-diene(dl) (4.87%), 6-Octadecenoic acid, Methyl stearate (3.61%), methyl ester, (Z)- (2.51%), 4,5-Diphenylocta-1,7-diene(dl) (2.71%), 2(1H)-Naphthalenone, octahydro-4a-phenyl-, cis- (2.83%), 9-Octadecenoic acid, (E)- (2.93%). Apart from this other compounds were found in small amounts which are shown in **Table.1, Figure. 2 .**

S.No.	Name of Compound	R.Time	Area %	MF	MW
1	6-Desoxy-l-gulitol	2.559	2.90	$C_6H_{14}O_5$	166
2	Pyridine	2.642	0.98	C_5H_5N	79
3	L-(-)- Fucose, tetrakis (trifluoroacetate), benzyloxime (isomer 1)	12.046	0.36	$C_{21}H_{15}F_{12}NO_9$	653
4	Dodecanal	18.142	0.23	$C_{12}H_{24}O$	184
5	2,4Di-tert- butylphenol	20.580	0.35	$C_{14}H_{22}O$	206
6	Phenol,3,5-dichloro-2-methoxy-	22.018	0.21	$C_7H_6Cl_2O_2$	193
7	Phthalic acid, ethyl pentadecyl ester	22.506	0.31	$C_{25}H_{40}O_4$	404
8	Cyclooctasiloxane, hexadecamethyl-	23.437	1.96	$C_{16}H_{48}O_8Si_8$	593
9	8-Pentadecanone	24.476	0.96	$C_{15}H_{30}O$	226
10	Methyl 3-[2,4-dichlorophenyl]-3methoxy-2-[6-methyl-2-pyridyl] propionate	25.079	0.66	$C_{17}H_{17}Cl_2NO_3$	353
11	2-Pentanone, 4-cyclohexylidene-3,3-diethyl-	26.765	0.33	$C_{15}H_{26}O$	222
12	Cyclononasiloxane, octadecamethyl-	26.924	2.31	$C_{18}H_{54}O_9Si_9$	666
13	Pentadecanoic acid	28.495	0.82	$C_{15}H_{30}O_2$	242
14	9-Octadecanone	28.820	1.57	$C_{18}H_{36}O$	268
15	4-Bromobutanoic acid, heptadecyl ester	28.982	0.42	$C_{21}H_{41}BrO_2$	405
16	7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione	29.428	0.65	$C_{17}H_{24}O_3$	276
17	Hexadecanoic acid, methyl ester	29.868	9.31	$C_{17}H_{34}O_2$	270
18	Cyclodecasiloxane, eicosamethyl-	29.958	1.61	$C_{20}H_{60}O_{10}Si_{10}$	741
19	2-t-Butyl-6-methyl-5-(1-phenylbut-3-anyl) [1,3]dioxan-4-one	30.049	1.24	$C_{19}H_{26}O_3$	302
20	Benzene, 1,3,5-tris(3-methyl-3-butenyl)-	30.294	1.95	$C_{21}H_{30}$	282
21	Dibutyl phthalate	30.422	10.57	$C_{16}H_{22}O_4$	278
22	n-Hexadecanoic acid	30.549	11.19	$C_{16}H_{32}O_2$	256
23	Benzene, 1,3,5-tris(3-methyl-3-butenyl)-	30.960	8.01	$C_{21}H_{30}$	282
24	2(1H)-Naphthalenone, octahydro-4a-phenyl-, cis-	32.255	2.83	$C_{16}H_{20}O$	228
25	Cyclooctasiloxane, hexadecamethyl-	32.723	1.26	$C_{16}H_{48}O_8Si_8$	593
26	Methyl 10-trans,12-cis-octadecadienoate	33.083	5.41	$C_{19}H_{34}O_2$	294
27	6-Octadecenoic acid, methyl ester, (Z)-	33.218	2.51	$C_{19}H_{36}O_2$	296
28	Methyl stearate	33.719	3.61	$C_{19}H_{38}O_2$	298
29	9,12-Octadecadienoic acid (Z,Z)-	33.771	5.19	$C_{18}H_{32}O_2$	280
30	4,5-Diphenylocta-1,7-diene(dl)	33.818	4.87	$C_{20}H_{22}$	262
31	9-Octadecenoic acid, (E)-	33.881	2.93	$C_{18}H_{34}O_2$	282
32	Octadecanoic acid	34.323	1.34	$C_{18}H_{36}O_2$	284
33	4,5-Diphenylocta-1,7-diene(dl)	34.419	2.71	$C_{20}H_{22}$	262
34	Cyclononasiloxane, octadecamethyl-	35.224	1.16	$C_{18}H_{54}O_9Si_9$	666
35	5-Hydroxy-4-methoxy-6-phenethyl-5,6-dihydro-2H-pyran-2-one	35.373	0.70	$C_{14}H_{16}O_4$	248
36	1-Cyclohexyldimethylsilyloxy-3,5-dimethylbenzene	35.996	0.30	$C_{16}H_{26}OSi$	262
37	1-Phenylcyclopentanecarboxylic acid	36.159	4.39	$C_{12}H_{14}O_2$	190
38	1-Cyclohexyldimethylsilyloxy-3,5-dimethylbenzene	37.236	0.85	$C_{16}H_{26}OSi$	262
39	Cyclononasiloxane, octadecamethyl-	37.558	1.06	$C_{18}H_{54}O_9Si_9$	666

*MF- molecular formula, MW- molecular weight

Table: 1 . GC-MS profiling of methanolic extract of Phellinus pectinatus

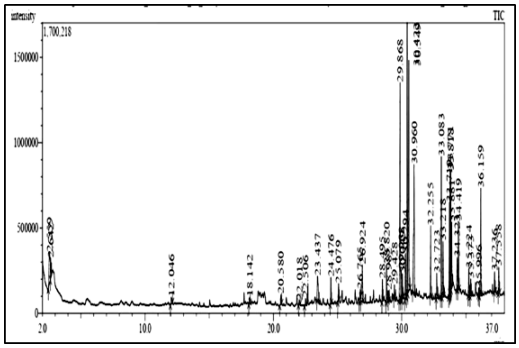

Figure 2: GC-MS Chromatogram of methanol extract of Phellinus pectinatus

Various compounds found, such as 1-Deoxy-d-mannitol; Pyridine; 2,4Di-tert- butylphenol; 8-Pentadecanone; Cyclononasiloxane, octadecamethyl-; Pentadecanoic acid; 9-Octadecanone; 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione; Hexadecanoic acid, methyl ester; Cyclodecasiloxane, eicosamethyl-; Dibutyl phthalate; n-Hexadecanoic acid; 6-Octadecenoic acid, methyl ester, (Z)-; Methyl stearate; 9,12-Octadecadienoic acid (Z,Z)-; 9-Octadecenoic acid, (E)-; and Octadecanoic acid, have been shown to have biological activity shown in **Table. 2** and that has been also reported in previous studies. The mushroom's sporocarp (fruit body) contains a variety of bioactive substances, which is important from the point of view of health-related and industrial benefits. Several studies have shown that the mushroom is also responsible for important biological activities such as antibacterial,

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anti-inflammatory, anti-fungal, anti-Diabetic, Cytotoxic, anticoagulant, anti-HIV, antitumor, antimalarial, antioxidant, etc. (Gebreyohannes *et al.*, 2019; Elkhateeb *et al.*, 2020). Apart from this, Dodecanal; L-(-)-Fucose, tetrakis (trifluoroacetate), benzyloxime (isomer 1); Phenol,3,5-dichloro-2-methoxy-; Phthalic acid, ethyl pentadecyl ester; Cyclooctasiloxane, hexadecamethyl-; Methyl 3-[2,4-dichlorophenyl]-3methoxy-2-[6-methyl-2-pyridyl] propionate; 2-Pentanone, 4-cyclohexylidene-3,3-diethyl-; 4-Bromobutanoic acid, heptadecyl ester; 2-t-Butyl-6-methyl-5-(1-phenylbut-3-enyl) [1,3]dioxan-4-one; Benzene, 1,3,5-tris(3-methyl-3-butenyl)-; 2(1H)-Naphthalenone, octahydro-4a-phenyl-, cis-; Methyl 10-trans,12-cis-octadecadienoate; 5-Hydroxy-4-methoxy-6-phenethyl-5,6-dihydro-2H-pyran-2-one; 1-Cyclohexyldimethylsilyloxy-3,5-dimethylbenzene; 1-Phenylcyclopentanecarboxylic acid have been found to be unique, whose biological activity has not been reported in the previous studies **(Table.2)**. To the best of our knowledge, there is no literature available about *Phellinus pectinatus* so far. Therefore, the useful bioactive components present in this mushroom can be isolated and used to develop new medicines in the coming time.

S.No.	**Name of compound**	**Biological activity**
1	1-Deoxy-d-mannitol	Antibacterial, Antipyretic
2	Pyridine	Anti-hypertenion , Anti Histaminics, Anti-coagulants, Anti-inflammatory, Anti-bacterial, Anti-fungal, Anti-tubercular, Anti-Diabetic, Anti-malarial
3	L-(-)- Fucose, tetrakis (trifluoroacetate), benzyloxime (isomer 1)	Not reported
4	Dodecanal	Not reported
5	2,4Di-tert-butylphenol	Antioxidant, Antifungal, Antimicrobial , Anticancer, Antiinflamatory
6	Phenol,3,5-dichloro-2-methoxy-	Not reported
7	Phthalic acid, ethyl pentadecyl ester	Not reported
8	Cyclooctasiloxane, hexadecamethyl-	Not reported
9	8-Pentadecanone	Strong stimulants to the feeding of aphids, Hepatotoxic, Demyelination, Conjunctivites
10	Methyl 3-[2,4-dichlorophenyl]-3methoxy-2-[6-methyl-2-pyridyl] propionate	Not reported
11	2-Pentanone, 4-cyclohexylidene-3,3-diethyl-	Not reported
12	Cyclononasiloxane, octadecamethyl-	Antimicrobial, Antifungal, Antioxidant
13	Pentadecanoic acid	Lubricants, Adhesive agents, Human breast cancer treatment, Anti-inflamation, anti- fibrotic activities, reduce risks of cardiometabolic disease, reduce type 2 diabetes, reliable biomarker of dairy fat intake, red cell stabilizing
14	9-Octadecanone	Acidifer, Acidulant, Arachidonic acid inhibitor, Inhibit production of uric acid
15	4-Bromobutanoic acid, heptadecyl ester	Not reported
16	7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione	Quorum quenching / Quorm sensing inhibition activity, Anti-inflammatory, ophthalmic drug activity, Antioxidant, Antimicrobial, Pesticide
17	Hexadecanoic acid, methyl ester	Antioxidant, Hemolytic, Insecticide,

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		Hypocholesterolemic, Pesticide, Nematicide
18	Cyclodecasiloxane, eicosamethyl-	Antimicrobial, Antifungal, Antioxidant
19	2-t-Butyl-6-methyl-5-(1-phenylbut-3-enyl) [1,3]dioxan-4-one	Not reported
20	Benzene, 1,3,5-tris(3-methyl-3-butenyl)-	Not reported
21	Dibutyl phthalate	Antibacterial, Antiproliferative
22	n-Hexadecanoic acid	Antioxidant, Nematicide, Pesticide, Lubricant, Antiandrogenic, Antinflammatory, cytotoxic activity, Antimicrobial, Hypercholesterolemic
23	Benzene, 1,3,5-tris(3-methyl-3-butenyl)-	Not reported
24	2(1H)-Naphthalenone, octahydro-4a-phenyl-, cis-	Not reported
25	Cyclooctasiloxane, hexadecamethyl-	Not reported
26	Methyl 10-trans,12-cis-octadecadienoate	Not reported
27	6-Octadecenoic acid, methyl ester, (Z)-	Antioxidant, Antimicrobial
28	Methyl stearate	Antiinflammatory, Intestinal calcium(voltage-sensitive) activator, Antihelmintic(Nematodes) reductant, Antimutagenic, Antiprotozoal (Leishmania), Antivral, Antioxidant, Anticancer
29	9,12-Octadecadienoic acid (Z,Z)-	Anti-inflammatory, Hypocholesterolemic, cancer preventive, Anti histaminic, Anticoronary, Antimicrobial,
		Nematicide insectifuge, Antieczemic,5-Alphareductase inhibitor antiandrogenic, Insectifuge, Antiacne
30	4,5-Diphenylocta-1,7-diene(dl)	Not reported
31	9-Octadecenoic acid, (E)-	Acidifier, Acidulant, Arachidonic acid inhibitor, inhibit production uric acid
32	Octadecanoic acid	Antifungle, Antitumor, Antibacterial
33	4,5-Diphenylocta-1,7-diene(dl)	Not reported
34	Cyclononasiloxane, octadecamethyl-	Antimicrobial, Antifungal, Antioxidant
35	5-Hydroxy-4-methoxy-6-phenethyl-5,6-dihydro-2H-pyran-2-one	Not reported
36	1-Cyclohexyldimethylsilyloxy-3,5-dimethylbenzene	Not reported
37	1-Phenylcyclopentanecarboxylic acid	Not reported
38	1-Cyclohexyldimethylsilyloxy-3,5-dimethylbenzene	Not reported
39	Cyclononasiloxane, octadecamethyl-	Antimicrobial, Antifungal, Antioxidant

Table 2: Bioactive compounds identified in the methanolic extract of *Phellinus pectinatus*

Discussion

Phellinus pectinatus is selected for GC-MS analysis as the most active mushrooms. In the present study, 39 peaks are identified in the methanol extract of *Phellinus pectinatus* by GC-MS chromatogram analysis. Based on the NIST 17 library database, the chromatogram's peaks are integrated and compared with the spectrum of known components.

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The identified compound 1-Deoxy-d-mannitol has been shown to have antibacterial and antipyretic properties (Devakumar et al. 2017). According to Patil et al. 2013; Altaf et al. 2015 Pyridine has been shown to have anti-hypertension, anti Histaminics, anti-coagulants, anti-inflammatory, anti-bacterial, anti-fungal, anti-tubercular, anti-Diabetic, and anti-malarial activities. 2,4Di-tert-butylphenol is known to have antioxidant, antifungal, antimicrobial, anticancer, and anti-inflammatory characteristic (Yoon et al. 2006; Varsha et al. 2015; Aissaoui et al. 2019; Nair et al. 2020). 8-Pentadecanone is used for hepatotoxic, demyelination, and conjunctivitis (Sunita et al. 2017). According to Jasim et al. 2015; Suriani, 2016; Kasim et al. 2022 Cyclononasiloxane, octadecamethyl- shown significant antimicrobial, antifungal, and antioxidant activities. Pentadecanoic acid is known for its various properties such as lubricants, adhesive agents, human breast cancer treatment, anti-inflammation, and antidiabetes (Sunita et al. 2017; Venn et al. 2020). Quorum quenching / Quorum sensing inhibition activity, anti-inflammatory, ophthalmic drug activity, antioxidant, antimicrobial, and pesticide it is all of the properties found in 7,9-Di-tert-butyl-1-oxaspiro (4,5) deca-6,9-diene-2,8-dione (Boopathi et al. 2017; Sriram et al. 2018; Abdullah, 2019). Sunita et al. 2017 have reported that Hexadecanoic acid, methyl ester has antioxidant, hemolytic, insecticide, hypocholesterolemic, and nematicide activities.

Jasim et al. 2015; Suriani, 2016; Kasim et al. 2022 reported that Cyclodecasiloxane, eicosamethyl- has medicinal properties such as antimicrobial, antifungal, and antioxidant. Antibacterial and antiproliferative activity is found in Dibutyl phthalate (Hsu et al. 2011; Shobi and Viswanathan, 2018). The following groups of authors Aparna et al. 2012; Awa et al. 2012; Ravi and Krishnan, 2017; Oni et al. 2020 reported that n-Hexadecanoic acid had antioxidant, nematicide, antiandrogenic, anti-inflammatory, cytotoxic, antibacterial, and hypercholesterolemic properties. 6-Octadecenoic acid, methyl ester, (Z)- are used as antioxidants and antimicrobials (Adegoke et al. 2019).

Previous researchers Smiderle et al. 2006; Petrova et al. 2007; Ribeiro et al. 2009; Dembitsky et al. 2010; Lacheva, 2014 have used GC-MS analysis to identify a number of compounds in various types of wild mushrooms, including fatty acids, amino acids, sugar alcohols, and polysaccharides. GC–MS (gas chromatography-mass spectrometry) is a powerful tool for separating and detecting volatile organic compounds. It is therefore possible to interpret the volatile compositional properties of mushrooms using GC-MS. With the emergence of gas chromatography-mass spectrometry (GC-MS) in the last few years, it has become a prominent platform for analyzing secondary metabolites in both plant and non-plant species (Oni et al. 2020).

Conclusion

In the present study, GC-MS was employed to identify various compounds in *Phellinus pectinatus* methanol extract that exhibits antiviral, anticancer, antimicrobial, antioxidant, hypocholesterolemic, pesticidal, insecticidal, nematicide, antiandrogenic, anti-inflammatory, anti-hypertension, antihistaminics, anticoagulants, ophthalmic drug activity, and anti-fungal activities. The presence of medically important compounds justifies the medicinal properties of this wild mushroom. Moreover, by isolating and characterizing the bioactive components found in this mushroom in the future, these compounds may be utilized to develop effective drugs against harmful strains of bacteria. Also, it can be used as a potential source to improve agricultural production.

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