Available online on 15.08.2024 at <http://jddtonline.info>

# Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Copyright © 2024 The Author(s): This is an open-access article distributed under the terms of the CC BY-NC 4.0 which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited



Open Access Full Text Article



Research Article

## Qualitative Analysis of Bioactive Compounds from different Polypores from Kolhapur District

Dr. Anjali Rajendra Patil , Ms. Mrunalini Ajitkumar Vedpathak \*, Mr. Yogesh Sadashiv Patil

Department of Botany, Rajaram College, Kolhapur, Maharashtra, India, 416004

### Article Info:



#### Article History:

Received 20 May 2024

Reviewed 04 July 2024

Accepted 27 July 2024

Published 15 August 2024

### Cite this article as:

Patil AR, Vedpathak MA, Patil Ys, Qualitative Analysis of Bioactive Compounds from different Polypores from Kolhapur District, Journal of Drug Delivery and Therapeutics. 2024; 14(8):54-63

DOI: <http://dx.doi.org/10.22270/jddt.v14i8.6749>

### \*Address for Correspondence:

Ms. Mrunalini Ajitkumar Vedpathak, Department of Botany, Rajaram College, Kolhapur, Maharashtra, India, 416004

### Abstract

It is now widely recognized that biological activity occurs throughout the fungal kingdom. Since ancient times so called mushrooms belonging to Basidiomycota have been used for medicinal purpose. Various bioactive compounds show important biological activities such as antioxidative, free radical scavenging, anticarcinogenic, immunomodulatory, antiviral, and antibacterial etc. In earlier times, mushrooms were originally regarded as a significant source of medicinal in oriental regions. Discovering new major medicines is becoming a great challenge for scientific community. The present study deals with qualitative analysis and identifies the different classes of bioactive compounds as well as their potential therapeutic properties in three different polypores viz. *Earliella scabrosa*, *Podocypha petalodes* and *Polyporus gramocephalous*. This information can provide insight about the bioactivity and metabolite production from these Polypore fungi, which can potentially lead to the development of new drugs.

**Keywords:** Bioactive compounds, Polypores fungi, Therapeutic properties

## INTRODUCTION

The phylum Basidiomycota, or basidiomycetes, has a wide variety of terrestrial fungi known as polypores. These fungi, along with other Ascomycota, are important sources of compounds that have medicinal activity. Of the approximately 25,000 species of basidiomycetes, 5000 belong to the Aphyllophorales group, a polyphyletic group that includes the polypores. While many of these fungi are widely distributed around all inhabited continents, including Africa, many have circumboreal distributions in North America, Europe, and Asia; only a small number of the most common species, known for their distinctive fruiting bodies (basidiocarps), have been assessed for biological activity. These biologically active compounds have attracted a lot of interest lately due to their immunomodulatory properties, which have anticancer effects. These high molecular weight compounds, also known as immunopotentiators or biological response modifiers (BRM), inhibit the development of cancer, have direct anticancer effects, and prevent tumor proliferation. Certain protein-bound polysaccharides derived from polypores and other basidiomycetes have been commercialized in Japan as anticancer medications<sup>1</sup>. Investigation of secondary metabolites from basidiomycetous fungus, with great commercial potential. The health of humans is either directly or indirectly enhanced through a number of industrial products made of fungal metabolites derived from basidiomycete sources. These fungi play a crucial role in the degradation of lignin, cellulose, and hemicellulose and are therefore important in the carbon cycle. Fungi are known to be

a significant source of various biological and chemical entities that can have either beneficial or harmful effects. In addition, most filamentous fungi produce secondary metabolites that are valuable sources of compounds for various biotechnological and pharmaceutical industries. These metabolites include antibiotics, medicinal products, organic acids, food processing enzymes, and many others that are used in the feed and food industry. Moreover, white and brown-rot fungi that degrade lignocellulose and secrete polysaccharides exhibit a greater diversity of lignin degrading peroxidases, multicopper oxidases and glycoside hydrolases. These enzymes play a role in the slow breakdown of substrates high in lignin by acting in a sequential manner. For thousands of years, polypores has been utilized in traditional Chinese medicine and its use is growing in popularity globally. Their bioactivities are diverse, encompassing antiviral, anti-inflammatory, anti-cancer and immunostimulant qualities. The relevance of Basidiomycetes fungus for bioactivity and metabolite formation has not been explored, despite the fact that numerous research has concentrated on their secondary metabolites. Bioactive proteins are another essential category of functional components found in mushrooms, which have significant potential for pharmaceutical application. An estimated 75% of polypore fungi tested have strong antimicrobial activity, suggesting that they could be a good source for developing new antibiotics<sup>1</sup>. These fungi synthesize a variety of compounds with cytotoxic, antineoplastic, and antiviral properties<sup>2</sup>. It has been reported that *Microporus xanthopus* possesses anthelmintic, antimicrobial, anticancer, and antiangiogenic properties. The habitat and substrate in

which the polypore mushroom grows are thought to be responsible for the increased quantities of these therapeutic qualities<sup>3</sup>. Several antioxidant substances, such as phenolic compounds,  $\beta$ -glucans, ergosterol, ergothioneine, vitamin C, and tocopherols, have been found in Polyporales fungi. Fungi are consumed by rural people for their health advantages, but their antioxidant composition also draws interest from the culinary, cosmetic, and pharmaceutical industries. Two phenolic compounds- tyrosol and p-hydroxyphenyl acetamide, novel natural products were extracted from *Coriolopsis rigida*, which was discovered as an endophytic fungus. Medicinal mushroom has several essential biological active compounds that are beneficial for human health. The two primary bioactive constituents of *Ganoderma lucidum*, polysaccharides and triterpenoids, are primarily responsible for its anticancer and immunomodulatory properties, which are among its most appealing pharmacological features. Bioactive molecules derived from fungi can be categorized into two types: high molecular weight compounds, which include polysaccharides and proteins, and low molecular weight compounds, which include sterols, terpenoids, and phenols

Finding the biologically active compounds included in various polypores is the current scientific issue that this work seeks to resolve viz. *Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous* using GC-MS analysis and FTIR. Specifically, the study aims to identify the different bioactive secondary metabolites, as well as their potential therapeutic properties. This information can provide insight into the bioactivity and metabolite production of these Polypore fungi, which can potentially lead to the development of new drugs.

## MATERIAL AND METHODS

### Study Area: Kolhapur district:

The district lies in the Krishna-Panchaganga basin and lies between 15° 43' and 17° 10' N. latitude, and 73° 40' and 74° 42' E. longitude. It is bounded on the north by Sangli district, on the west by Ratnagiri district. The area of the district is 3;188'4 sq. miles. and it is an irregular belt of Deccan plateau lying along east of Sahyadri crest. The district is blessed with hilly terrain which is the main natural feature that includes the main range of Sahyadri running north and south and large spurs stretch north-east and east from Sahyadri and valleys. The wet rugged hilly terrains provide luxuriant suitable forest. The climate of the district is tropical and receive south-west and north-east monsoon. June to September shows average temperatures between 21°C and 30°C and relative humidity levels between 57% and 70%. These kinds of circumstances offer ideal growing conditions to the macrofungi<sup>4</sup>

### Collection of Specimen:

*Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous* were selected for this study and collected from the natural habitats of Kolhapur District, Maharashtra, India, during the months of July- August 2023. Morphological and ecological characters were noted in the field. Microscopic observations of the fresh fruiting body were done with the help of cotton blue staining under Lawrence and Mayo N-300M research microscope. Fresh fruiting bodies were labelled properly and were allowed to dry. These were later used to determine the bioactive contents.

### Preparation of Extract:

1gm of fresh fruiting bodies were crushed using 10ml of 70% Methanol. The extract was sonicated at 20°C for 30 min. and centrifuged at 10,000 rpm for 10 min. Supernatant was subjected to GC-MS/MS and FTIR analysis.

### Sample analysis:

#### a. GC-MS/MS analysis:

GC-MS/MS analysis was performed on Shimadzu, Japan TQ 8050 plus HS 20. Helium was used as the carrier gas. For analysis following conditions were maintained; Column oven temperature: 50.0 °C, Injection temperature: 250.00 °C, Injection mode: Split, Flow control mode with linear velocity, Pressure: 54.4 kPa, Total flow: 54.6 ml/min, Column flow: 1.01 mL/min, Linear velocity : 36.5 cm/sec, Purge flow : 3.0 mL/min, Split Ratio: 50.0. Initially, the oven temperature was set to 50°C and held for 2 minutes, followed by rate 5 for 180 °C held for 2 minutes, followed by rate 5 for 250°C held for 2 minutes and then rate 5 at 260 °C held for 2 minutes. For GC ion temperature was maintained at 200 °C, interference temperature at 270 °C with a solvent cut time of 3.00 min and detector gain mode is relative to tuning. The result detector gain is about 1.17 kV and a threshold was 0. For MS, the start time was 3.00 min and the end time was 50 min. The acq. mode on Q3 Scan and Event Time was about 0.3 sec with scan speed 1666. The Start m/z 45.00 and end m/z 500.

#### b. Fourier Transformed Infrared Spectroscopy

FTIR, or Fourier Transform Infrared Spectrophotometer, is the most efficient tool for determining the various kinds of functional groups and chemical bonds found in phytochemicals. A prominent characteristic of the chemical bond is the wave length of the light absorbed. A compound's chemical bonds can be ascertained by analyzing its infrared absorption spectra. Comparative analysis of spectra was conducted by using the Essential FTIR software, which provides a clear understanding of similarities in the spectra, as shown in Fig 1, 2 and 3 indicate the spectra which were analyzed by the Alpha Bruker instrument. British Wiley library was used for FTIR data analysis. A 0.1gm/ml methanolic extract of dried natural fruiting bodies was sonicated at 20°C for 45 minutes and centrifuged at 10,000 rpm for 5 minutes. The supernatant was subjected to FTIR analysis using ALPHA Bruker, Germany. FTIR analysis was performed on the extract of freshly collected fungus material sample in methanol. The Spectra were taken in the region 4000-400 cm<sup>-1</sup> for analysis of functional groups.

The FTIR spectroscopic analysis of methanolic extracts of polypore fungi viz. *Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous*. Figures 4,5 and 6 shows graphical FTIR spectra of methanolic extracts of polypore fungi respectively. The FTIR spectroscopic analysis of methanolic extracts of polypore fungi showed different form of peaks revealed the presence of different functional groups of the bioactive compounds. (Table: 4,5 and 6).

## RESULT AND DISCUSSION

The sample was analyzed and the peaks were compared to those of reference chemicals analyzed under the same circumstances. Compounds shows some bioactive and pharmacological properties. Secondary metabolite study from basidiomycetous fungi which has tremendous commercial potential.<sup>2</sup> This study discovered that compounds from *Earliella scabrosa*, *Podoscypha petalodes*, and *Polyporus gramocephalous* contains medicinally and nutritionally significant substances. These Polypores can be used in effluent treatment, the pulp and paper industry, synthetic chemistry, bio-fuels, cosmetics, agro industry and textile industry producing essential products. Table 1, 2 & 3 provides a summary of the bioactive compounds found in *Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous*.

*Earliella scabrosa*, *Podoscyphapetalodes* and *Polyporus gramocephalous* has been reported to exhibit antibacterial, anticancer, antiangiogenic and anthelmintic activities. The higher concentrations of these medicinal properties are believed to be a result of the environment and substrate in which the polypore mushroom grows<sup>5</sup>. The proposed compounds of *Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous* detected in negative mode and positive mode, along with their molecular masses, scores, chemical natures, formulas, and properties. These compounds were identified through Gas chromatography and mass spectrometry, which is a powerful analytical technique used to identify the chemical structure of a compound. The identified compounds have diverse chemical natures and functionalities, ranging from alkaloids, esters, phenols, and steroids to bile acids, macrolides, and sesquiterpenoids and shows diverse pharmacological activities, including antimalarial, antibacterial, antifungal, antiviral, anticancer, anti-inflammatory etc. (Table 1,2 & 3)

FTIR is an important method to identify the functional groups of chemical constituents and elucidate the compounds<sup>32</sup>. FTIR allows infrared spectrum simultaneously providing speed and accuracy in measurements of whole range of biological specimens<sup>33</sup>, and has been used as a requisite method to identify medicines in pharmaceuticals companies of many countries<sup>33</sup>. The methanolic extract of polypore fungi *Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous* were subjected to FTIR spectroscopic analysis under IR region in the range of 400-4000  $\text{cm}^{-1}$ .

FTIR analysis of the extracts of polypore fungi *Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous* revealed that the presence of various chemical constituents. The Infra-Red of extracts of polypores showed absorption bands with the wave number ( $\text{cm}^{-1}$ ) of prominent peaks. Several bands are pertained to functional groups represent chemical components or metabolic products in the polypore fungi.

The spectra wavelength observed in the methanolic extracts of polypore fungi *Earliella scabrosa*, *Podoscypha petalodes* and *Polyporus gramocephalous* served as a characteristic medium to elucidate the inherent functional group and organic compounds. The FTIR spectral analysis conducted in this study revealed significant absorption bands at different wave numbers ( $\text{cm}^{-1}$ ), which suggests the presence of chemical structures. Thus, the various functional groups of the chemical compounds found in the polypore fungus were identified by the absorption peaks obtained by FTIR spectroscopy. Biologically active chemicals can be extracted and filtered out of the extracts using the FTIR analysis, which revealed the presence of aromatics, alkyl halides, carboxylic acids, amines, amides, aliphatic amines, primary amines or amides, alkanes, and phenol compounds. With their high efficacy and demand for the treatment of a wide range of ailments, fungi have always been a reliable source of medicinal agents.

***Earliella scabrosa*:** The functional groups were separated based on its peak ratio. The bands between 650-1000  $\text{cm}^{-1}$  assigned to =C-H bend represent the presence of aromatics, alkyl halides, carboxylic acids, amines and amides in the sample. In this study, the bands at 670.01  $\text{cm}^{-1}$  and 891.51  $\text{cm}^{-1}$  assigned to =C-H bend which means aromatics, alkyl halides, carboxylic acids, amines and amides are present in methanolic

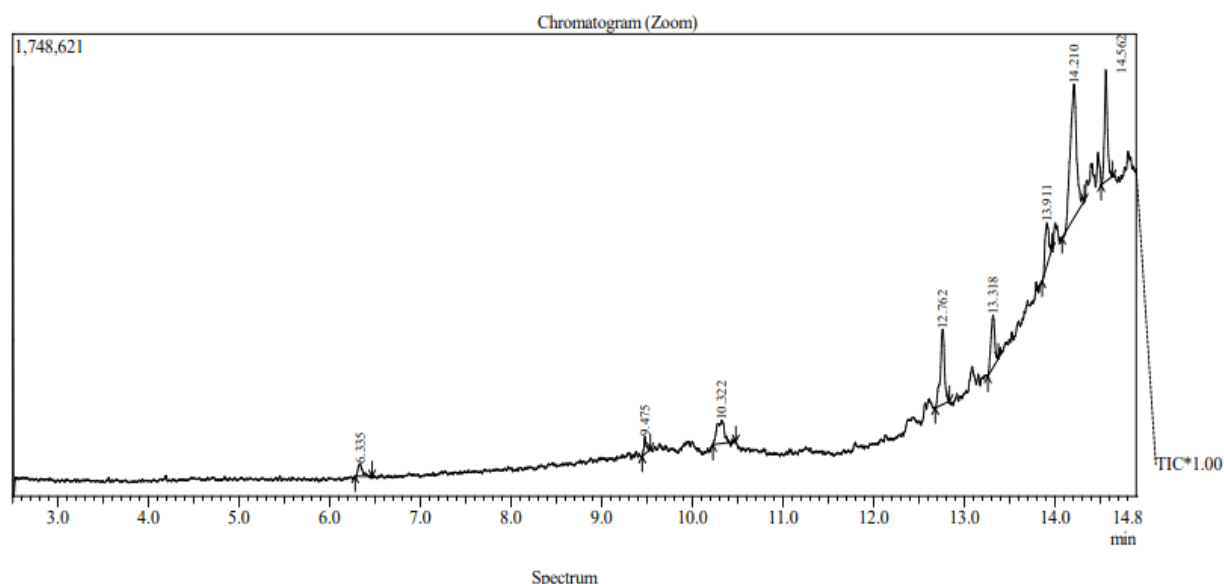
extracts of *E. scabrosa*. The aliphatic amines are indicated by the C-N stretches between 1020 and 1250  $\text{cm}^{-1}$ . So, the bands at 1045.11 1155.65, 1201.54, 1249.30  $\text{cm}^{-1}$  assigned to the C-N stretch which means aliphatic amines are present in *E. scabrosa*. The peak value at 1314.01 and 1372.28  $\text{cm}^{-1}$  assigned to the O-H bending confirms Alcohol and hydroxy compounds. The peak at 1643.10  $\text{cm}^{-1}$  assigned to the N-H bend confirms Amine and amino groups. The results of FTIR spectra analyses showed the presence of peak at wave number The peak at 2923.87  $\text{cm}^{-1}$  assigned to Methylene C-H asym./sym stretch confirms Saturated aliphatic (alkane/alkyl). The results of FTIR spectra analyses showed the presence of peak at wave number of 3382.54  $\text{cm}^{-1}$  assigned to the O-H stretch indicates the Alcohol and hydroxy. (Graph 4 and Table 4).

***Podoscypha petalodes*:** The functional groups were separated based on its peak ratio. The bands between 650-1000  $\text{cm}^{-1}$  assigned to =C-H bend represent the presence of aromatics, alkyl halides, carboxylic acids, amines and amides. In present investigation, methanolic extracts of *Podoscypha petalodes* shows bands at 670.01  $\text{cm}^{-1}$  assigned to =C-H bend which means aromatics, alkyl halides, carboxylic acids, amines and amides are present. The aliphatic amines are indicated by the C-N stretches between 1020 and 1250  $\text{cm}^{-1}$ . So, the bands at 1020.25, 1113.75  $\text{cm}^{-1}$  assigned to the C- N stretch which means aliphatic amines are present in *P. petalodes*. The peak value at 1413.52  $\text{cm}^{-1}$  assigned to the O-H bending vibration confirms carboxylic acid. The peak at 1448.36  $\text{cm}^{-1}$  assigned to the Methyl C-H asym./sym. bend confirms Saturated aliphatic (alkane/alkyl) group. The peak at 2830.99  $\text{cm}^{-1}$  and 2942.63  $\text{cm}^{-1}$  assigned to C-H stretch confirms Alkanes. The results of FTIR spectra analyses showed the presence of peak at wave number of 3301.88 and 3341.54  $\text{cm}^{-1}$  assigned to the O-H stretch indicates the Alcohol or Phenol. (Graph 5 and Table 5).

***Polyporus gramocephalous*:** The functional groups were separated based on its peak ratio. The bands between 650-1000  $\text{cm}^{-1}$  assigned to =C-H bend represent the presence of aromatics, alkyl halides, carboxylic acids, amines and amides. In present study, the bands at 691.08  $\text{cm}^{-1}$  assigned to =C-H bend which means aromatics, alkyl halides, carboxylic acids, amines and amides are present in methanolic extracts of *P. gramocephalous*. The aliphatic amines are indicated by the C-N stretches between 1020 and 1250  $\text{cm}^{-1}$ . So, the bands at 1019.04 and 1112.67  $\text{cm}^{-1}$  assigned to the C- N stretch which means aliphatic amines are present in *P. gramocephalous*. The peak value at 1410.56  $\text{cm}^{-1}$  assigned to the O-H bending vibration confirms carboxylic acid. The peak at 1654.67  $\text{cm}^{-1}$  assigned to the N-H bend confirms primary amines or amides. The peak at 2832.08  $\text{cm}^{-1}$  and 2942.87  $\text{cm}^{-1}$  assigned to C-H stretch confirms Alkanes. The results of FTIR spectra analyses showed the presence of peak at wave number of 3351.12  $\text{cm}^{-1}$  assigned to the O-H stretch indicates the Alcohol or Phenol. (Graph 6 and Table 6).

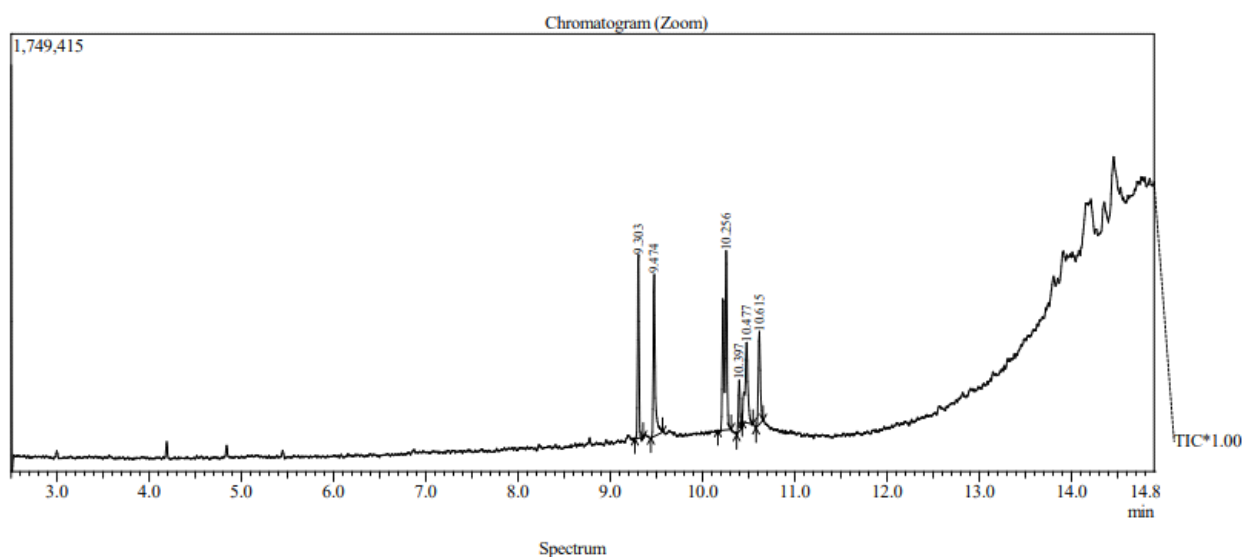
## CONCLUSION:

This study has identified a range of compounds present in various polypores using Gas Chromatography - mass spectrometry and FT-IR. These compounds have diverse chemical natures and functionalities, and compounds have promising pharmacological activities with potential uses in medicine, agriculture, and other industries. These bioactive compounds highlight the potential for natural products to be developed into effective drugs for a range of conditions.

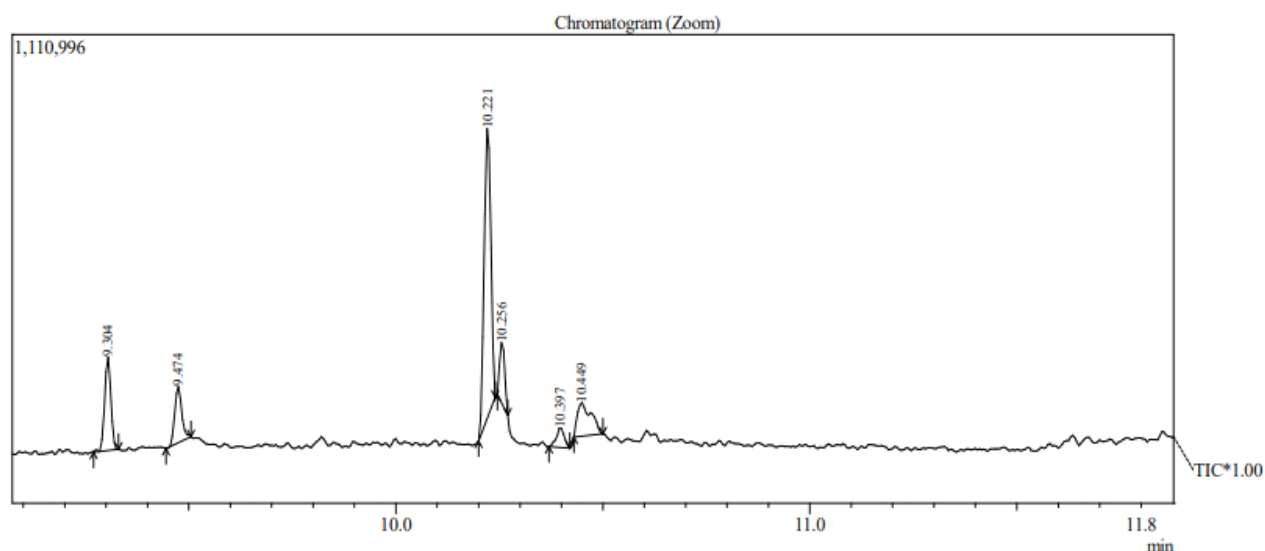
Graph 1: GC-MS/MS Chromatogram of *Earliella scabrosa*.Table 1: Bioactive compounds of *Earliella scabrosa*.

| Sr. No. | Name                                                                                                    | Formula                                                         | Mol.wt. | Properties                                                                                        |
|---------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------|---------------------------------------------------------------------------------------------------|
| 1       | tert-Butyl S-(4,6-dimethylpyrimidin-2-yl)thiolcarbonate                                                 | C <sub>11</sub> H <sub>16</sub> N <sub>2</sub> O <sub>2</sub> S | 240     | -                                                                                                 |
| 2       | Pyrazine, 2-methyl-3-(methylthio)-                                                                      | C <sub>6</sub> H <sub>8</sub> N <sub>2</sub> S                  | 140     | Antibacterial and Anti-cancerous activity. <sup>6</sup>                                           |
| 3       | n-Hexadecanoic acid                                                                                     | C <sub>16</sub> H <sub>32</sub> O <sub>2</sub>                  | 256     | Pesticide and nematocide. <sup>7</sup>                                                            |
| 4       | Pentadecanoic acid                                                                                      | C <sub>15</sub> H <sub>30</sub> O <sub>2</sub>                  | 242     | Antifungal and antibacterial. <sup>8</sup>                                                        |
| 5       | Octadecanoic acid                                                                                       | C <sub>18</sub> H <sub>36</sub> O <sub>2</sub>                  | 284     | Antitumor, Antifungal and Antibacterial. <sup>9</sup>                                             |
| 6       | hexadecanoic acid, oxydi-2,1-ethanediyl ester                                                           | C <sub>36</sub> H <sub>70</sub> O <sub>5</sub>                  | 582     | Antioxidant activity. <sup>10</sup>                                                               |
| 7       | Heptaethylene glycol, TBDMS derivative                                                                  | C <sub>20</sub> H <sub>44</sub> O <sub>8</sub> Si               | 440     | Antibacterial and Antifungal activity. <sup>11</sup>                                              |
| 8       | Octaethylene glycol, TBDMS derivative                                                                   | C <sub>22</sub> H <sub>48</sub> O <sub>9</sub> Si               | 484     | No activity reported                                                                              |
| 9       | Hexaethylene glycol, TBDMS derivative                                                                   | C <sub>18</sub> H <sub>40</sub> O <sub>7</sub> Si               | 396     | Antimicrobial activity. <sup>12</sup>                                                             |
| 10      | Nonaethylene glycol, TBDMS derivative                                                                   | C <sub>24</sub> H <sub>52</sub> O <sub>10</sub> Si              | 528     | No activity reported                                                                              |
| 11      | Undecaethylene glycol, TMS derivative                                                                   | C <sub>25</sub> H <sub>54</sub> O <sub>12</sub> Si              | 574     | Antimicrobial activity. <sup>13</sup>                                                             |
| 12      | 2-[2-[2-[2-[2-[2-[2-[2-(2-Hydroxyethoxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethanol | C <sub>22</sub> H <sub>46</sub> O <sub>12</sub>                 | 502     | No activity reported                                                                              |
| 13      | 2-[2-[2-[2-[2-[2-[2-(2-Methoxyethoxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethanol           | C <sub>19</sub> H <sub>40</sub> O <sub>10</sub>                 | 428     | No activity reported                                                                              |
| 14      | Ergosterol                                                                                              | C <sub>28</sub> H <sub>44</sub> O                               | 396     | Fluidity and integrity of the membrane and the proper function of membrane enzymes. <sup>14</sup> |
| 15      | Ergosta-5,8,22-trien-3-ol, (3.β.,22E)-                                                                  | C <sub>28</sub> H <sub>44</sub> O                               | 396     | Anti-tumor and anti-angiogenesis activity. <sup>15</sup>                                          |
| 16      | Ergosta-4,7,22-trien-3.β.-ol                                                                            | C <sub>28</sub> H <sub>44</sub> O                               | 396     | Antioxidant and antiinflammatory activity. <sup>16</sup>                                          |

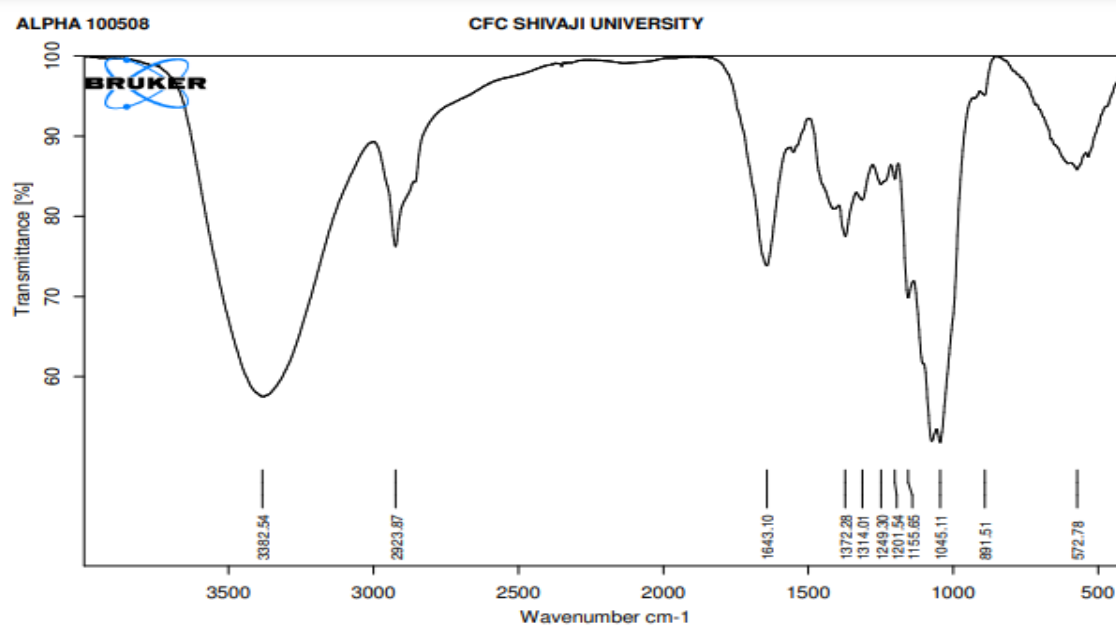


Graph 2: GC-MS/MS Chromatogram of *Podoscypha petalodes*.Table 2: Bioactive compounds of *Podoscypha petalodes*.

| Sr No | Name                                                | Formula                                         | Mol.wt | Properties                                                                                                                                     |
|-------|-----------------------------------------------------|-------------------------------------------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Hexadecanoic acid, methyl ester                     | C <sub>17</sub> H <sub>34</sub> O <sub>2</sub>  | 270    | Larvicidal, pesticide <sup>7</sup> antifungal, <sup>8,17</sup> Anticancer, <sup>9</sup> Antioxidant and Antibacterial activity. <sup>8,9</sup> |
| 2     | n-Hexadecanoic acid                                 | C <sub>16</sub> H <sub>32</sub> O <sub>2</sub>  | 256    | Pesticide and nematicidal activity. <sup>7</sup>                                                                                               |
| 3     | l-(+)-Ascorbic acid 2,6-dihexadecanoate             | C <sub>38</sub> H <sub>68</sub> O <sub>8</sub>  | 652    | antioxidant, anti-inflammatory and anticancer activity. <sup>18</sup>                                                                          |
| 4     | Pentadecanoic acid                                  | C <sub>15</sub> H <sub>30</sub> O <sub>2</sub>  | 242    | Antifungal, antibacterial <sup>8</sup> and Antioxidant activity. <sup>9</sup>                                                                  |
| 5     | 9-Octadecenoic acid, methyl ester, (E)-             | C <sub>19</sub> H <sub>36</sub> O <sub>2</sub>  | 296    | Antifungal activity. <sup>19</sup>                                                                                                             |
| 6     | 11-Octadecenoic acid, methyl ester                  | C <sub>19</sub> H <sub>36</sub> O <sub>2</sub>  | 296    | No activity reported                                                                                                                           |
| 7     | trans-13-Octadecenoic acid, methyl ester            | C <sub>19</sub> H <sub>36</sub> O <sub>2</sub>  | 296    | Acidifier, acidulant, arachidonic acid-inhibitor and inhibit production of uric acid. <sup>20</sup>                                            |
| 8     | 9-Octadecenoic acid (Z)-, methyl ester              | C <sub>19</sub> H <sub>36</sub> O <sub>2</sub>  | 296    | Antimicrobial and Nematicidal activity. <sup>17</sup>                                                                                          |
| 9     | Methyl stearate                                     | C <sub>19</sub> H <sub>38</sub> O <sub>2</sub>  | 298    | Antioxidant and antifungal activity. <sup>21</sup>                                                                                             |
| 10    | 1-Hexadecanaminium, N,N,N-trimethyl-, octadecanoate | C <sub>37</sub> H <sub>77</sub> NO <sub>2</sub> | 567    | No activity reported                                                                                                                           |
| 11    | 9-Octadecenoic acid, (E)-                           | C <sub>18</sub> H <sub>34</sub> O <sub>2</sub>  | 282    | No activity reported                                                                                                                           |
| 12    | Oleic Acid                                          | C <sub>18</sub> H <sub>34</sub> O <sub>2</sub>  | 282    | Anticancer, Anemiagenic, Insectifuge, Antiandrogenic and Dermatitigenic activity. <sup>20</sup>                                                |
| 13    | cis-Vaccenic acid                                   | C <sub>18</sub> H <sub>34</sub> O <sub>2</sub>  | 282    | antibacterial and hypolipidemic effects in rats. <sup>22</sup>                                                                                 |
| 14    | cis-13-Octadecenoic acid                            | C <sub>18</sub> H <sub>34</sub> O <sub>2</sub>  |        | Anti-inflammatory, cancer preventive and hepatoprotective properties. <sup>23</sup>                                                            |
| 15    | Octadecanoic acid                                   | C <sub>18</sub> H <sub>34</sub> O <sub>2</sub>  | 284    | antitumor, Antifungal and Antibacterial activity. <sup>9</sup>                                                                                 |
| 16    | Octadecanoic acid, 2-(2-hydroxyethoxy)ethyl ester   | C <sub>22</sub> H <sub>44</sub> O <sub>4</sub>  | 372    | -                                                                                                                                              |
| 17    | Docosanoic acid                                     | C <sub>22</sub> H <sub>44</sub> O               | 340    | anti-inflammatory activity. <sup>24</sup>                                                                                                      |

Graph 3:GC-MS/MS Chromatogram of *Polyporus grammacephalous*.Table 3: Bioactive compounds of *Polyporus grammacephalous*.

| Sr No | Name                                    | Formula    | Mol.wt | Properties                                                                                                                                                                                                                                       |
|-------|-----------------------------------------|------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Hexadecanoic acid, methyl ester         | C17H34O2   | 270    | Larvicidal, pesticide <sup>7</sup> antifungal, <sup>8,17</sup> Anticancer, <sup>9</sup> Antioxidant and Antibacterial activity. <sup>8,9</sup>                                                                                                   |
| 2     | n-Hexadecanoic acid                     | C16H32O2   | 256    | Pesticide and nematocidal activity. <sup>7</sup>                                                                                                                                                                                                 |
| 3     | l-(+)-Ascorbic acid 2,6-dihexadecanoate | C38H68O8   | 652    | Antioxidant, anti-inflammatory and anticancer activity. <sup>18</sup>                                                                                                                                                                            |
| 4     | Pentadecanoic acid                      | C15H30O2   | 242    | Antifungal and antibacterial activity. <sup>8</sup>                                                                                                                                                                                              |
| 5     | Eicosanoic acid                         | C20H40O2   | 312    | Antifungal activity. <sup>25</sup>                                                                                                                                                                                                               |
| 6     | Methyl 10-trans,12-cis-octadecadienoate | C19H34O2   | 294    | Antimicrobial activity. <sup>26</sup>                                                                                                                                                                                                            |
| 7     | 9,12-Octadecadienoic acid, methyl ester | C19H34O2   | 294    | Antiinflammatory, Nematicide, Insectifuge, Antiacne, Hypocholesterolemic, Cancer preventive, Hepatoprotective, Antihistaminic, Antiarthritic and Anti-eczemic activity. <sup>27</sup>                                                            |
| 8     | Methyl 9-cis,11-trans-octadecadienoate  | C19H34O2   | 294    | Antibacterial and antifungal activity. <sup>28</sup>                                                                                                                                                                                             |
| 9     | 2-Chloroethyl linoleate                 | C20H35ClO2 | 342    | Antibacterial activity. <sup>29</sup>                                                                                                                                                                                                            |
| 10    | Methyl stearate                         | C19H38O2   | 298    | Antioxidant and antifungal activity. <sup>21</sup>                                                                                                                                                                                               |
| 11    | Linoelaidic acid                        | C18H32O2   | 280    | Antibacterial activity. <sup>30</sup>                                                                                                                                                                                                            |
| 12    | 9,12-Octadecadienoic acid (Z,Z)-        | C18H32O2   | 280    | Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective, Nematicide, Insectifuge, Antihistaminic, Antieczemic, Antiacne, 5-Alpha reductase inhibitor, Antiandrogenic, Antiarthritic and Anticoronary activity. <sup>27</sup> |
| 13    | 2-Chloroethyl linoleate                 | C20H35ClO2 | 342    | No activity reported                                                                                                                                                                                                                             |
| 14    | 9,12-Octadecadien-1-ol, (Z,Z)-          | C18H34O    | 266    | Antifungal activity. <sup>31</sup>                                                                                                                                                                                                               |

Graph. 4: FTIR Spectra of *Earliella scabrosa*Table 4: FTIR spectral peak values and corresponding functional groups of the methanolic extract of polypore fungus *Earliella scabrosa*.

| S. N. | Wavenumber(cm-1) | Functional group                | Compounds                                                      |
|-------|------------------|---------------------------------|----------------------------------------------------------------|
| 1     | 572.78           | =C-H bend                       | Aromatics, Alkyl halides, Carboxylic acids, Amines and Amides. |
| 2     | 891.51           | =C-H bend                       | Aromatics, Alkyl halides, Carboxylic acids, Amines and Amides. |
| 3     | 1045.11          | C-N stretches                   | aliphatic amines                                               |
| 4     | 1155.65          | C-N stretches                   | aliphatic amines                                               |
| 5     | 1201.54          | C-N stretches                   | aliphatic amines                                               |
| 6     | 1249.30          | C-N stretches                   | aliphatic amines                                               |
| 7     | 1314.01          | O-H bend                        | Alcohol and hydroxy                                            |
| 8     | 1372.28          | O-H bend                        | Alcohol and hydroxy                                            |
| 9     | 1643.10          | N-H bend                        | Amine and amino                                                |
| 10    | 2923.87          | Methylene C-H asym./sym stretch | Saturated aliphatic (alkane/alkyl)                             |
| 11    | 3382.54          | O-H stretches                   | Alcohol and hydroxy                                            |

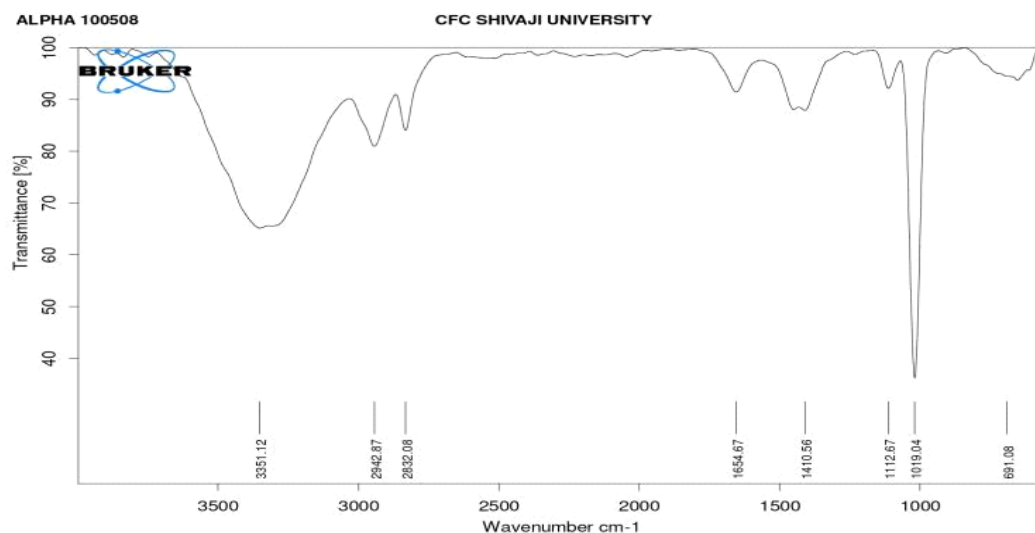
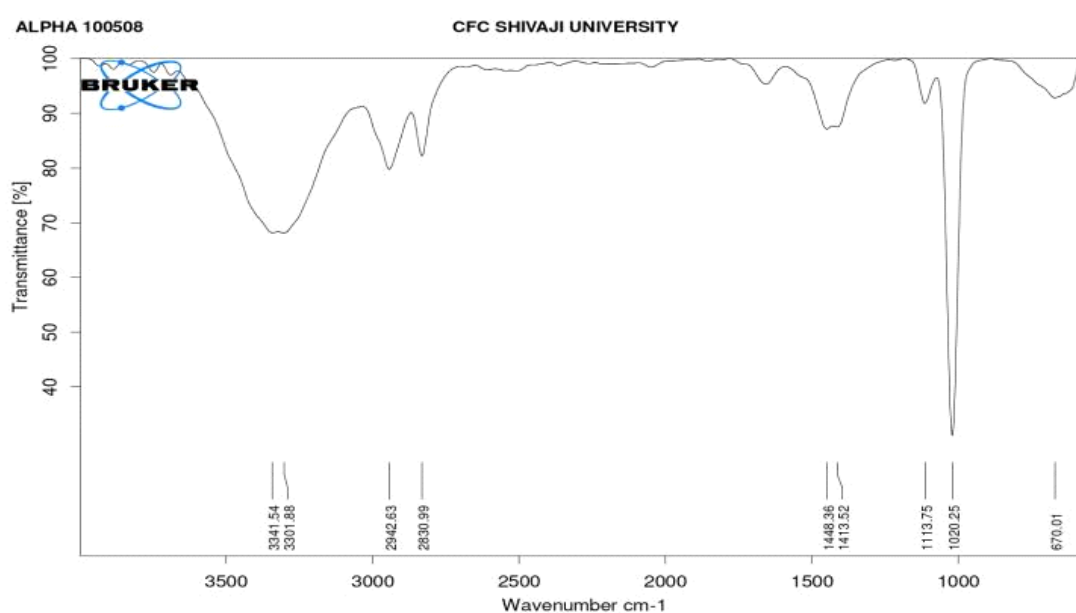
Graph. 5: FTIR Spectra of *Podoscypha petalodes*.

Table 5: FTIR spectral peak values and corresponding functional groups of the methanolic extract of polypore fungus *Podoscypha petalodes*.

| S.N. | Wave number (cm <sup>-1</sup> ) | Functional group           | Compounds                                                      |
|------|---------------------------------|----------------------------|----------------------------------------------------------------|
| 1    | 670.01                          | =C-H bend                  | Aromatics, Alkyl halides, Carboxylic acids, Amines and Amides. |
| 2    | 1020.25                         | C-N stretches              | aliphatic amines                                               |
| 3    | 1113.75                         | C-N stretches              | aliphatic amines                                               |
| 4    | 1413.52                         | O-H bend                   | Carboxylic acid                                                |
| 5    | 1448.36                         | Methyl C-H asym./sym. bend | Saturated aliphatic (alkane/alkyl) group                       |
| 6    | 2830.99                         | C-H stretch                | Alkanes                                                        |
| 7    | 2942.63                         | C-H stretch                | Alkanes                                                        |
| 8    | 3301.88                         | O-H stretch                | Alcohol or Phenol                                              |
| 9    | 3341.54                         | O-H stretch                | Alcohol or Phenol                                              |

Graph. 6: FTIR Spectra of *Polyporus gramocephalus*Table 6: FTIR spectral peak values and corresponding functional groups of the methanolic extract of polypore fungus *Polyporus gramocephalus*.

| S.N. | Wave number (cm <sup>-1</sup> ) | Functional group | Compounds                                                      |
|------|---------------------------------|------------------|----------------------------------------------------------------|
| 1    | 691.08                          | =C-H bend        | Aromatics, Alkyl halides, Carboxylic acids, Amines and Amides. |
| 2    | 1019.04                         | C-N stretches    | aliphatic amines                                               |
| 3    | 1112.67                         | C-N stretches    | aliphatic amines                                               |
| 4    | 1410.56                         | O-H bend         | Carboxylic acid                                                |
| 5    | 1654.67                         | N-H bend         | primary amines or amides                                       |
| 6    | 2832.08                         | C-H stretch      | Alkanes                                                        |
| 7    | 2942.87                         | C-H stretch      | Alkanes                                                        |
| 8    | 3351.12                         | O-H stretch      | Alcohol or Phenol                                              |



## Acknowledgments:

The authors are thankful to the Principal, Rajaram College, Kolhapur and Head of the Department of Botany for providing all facilities for research work.

## Conflicts of Interest:

None

## REFERENCES

- Zjawiony JK. Biologically Active Compounds from Aphyllophorales (Polypore) Fungi. *J. Nat. Prod.* 2004; 67(2):300-310. <https://doi.org/10.1021/np030372w> PMID:14987072
- Shanka A, Sharma KK. Fungal secondary metabolites in food and pharmaceuticals in the era of multi omics. *Applied Microbiology and Biotechnology.* 2022; 106:3465-3488. <https://doi.org/10.1007/s00253-022-11945-8> PMID:35546367 PMID:PMC9095418
- Gurav KN, Patil VP. Qualitative Analysis of Bioactive Components in *Microporus xanthopus* (Fr.) Kuntze. *Biological Forum - An International Journal.* 2023;15(4):70-82.
- Census of India: District Census Handbook Kolhapur. The Maharashtra Census Office Bombay . 1961
- Sholola MT, Adongbede E M, Williams LL, Adekunle AA. Antioxidant and Antibacterial Activities of Secondary Metabolites from *Microporus xanthopus* (Fr.) Kuntze (Polypore) Collected from the Wild in Lagos, Nigeria. *J. Appl. Sci. Environ. Manage.* 2022 May;26(5)877-883. <https://doi.org/10.4314/jasem.v26i5.15>
- Naik C, Gadal SC, Rajeshwari T, Bhat AR, Band S, Chandini L. Isolation, identification and evaluation of antioxidant, anti-inflammatory and antimutagenic properties of bioactive pigment from *Rhodococcus corynebacterioides* SCG11. *International journal of applied microbiology and biotechnology research.* 2020;8:1-14.
- Abdullah R. Insecticidal Activity of Secondary Metabolites of Locally Isolated Fungal Strains against some Cotton Insect Pests. *Journal of Plant Protection and Pathology.* 2019;10(12):647-653. <https://doi.org/10.21608/jppp.2019.79456>
- Agoramoorthy G, Chandrasekaran M; Venkatesalu V, Hsu MJ. Antibacterial and antifungal activities of fatty acid methyl esters of the blind-your-eye mangrove from India. *Brazilian journal of Microbiology.* 2007;38:739-742. <https://doi.org/10.1590/S1517-83822007000400028>
- Reza ASM, Haque A, Sarker J, Nasrin S, Rahman M, Tareq AM, Khan Z, Rashid M, Sadik G, Tsukahara T, Alam AHMK. Antiproliferative and antioxidant potentials of bioactive edible vegetable fraction of *Achyranthes ferruginea* Roxb. in cancer cell line, *Food Sci. Nutr.* 2021;00:1-29. <https://doi.org/10.1002/fsn.3.2343> PMID:34262737 PMID:PMC8269638
- Arora S, Kumar G. Gas Chromatography-Mass Spectrometry (GC-MS) determination of bioactive constituents from the methanolic and ethyl acetate extract of *Cenchrus setigerus* Vahl (Poaceae). *The Pharma Innovation Journal,* 2017;6(11): 635-640.
- Chathuri GM. Disease biomarker discovery and fungal metabolites extraction protocol optimization using GCMS based metabolomics. [Thesis and Dissertations]. [Mississippi State, Mississippi]: Mississippi State University; 2021;174p.
- Balasubramaniam B, Prateek, Ranjan S, Saraf M, Kar P, Singh SP, Thakur VK, Singh A, Gupta RK. Antibacterial and Antiviral Functional Materials: Chemistry and Biological Activity toward Tackling COVID-19-like Pandemics, *ACS Pharmacology & Translational Science.* 2021;4(1):8-54. <https://doi.org/10.1021/acspstci.0c00174> PMID:33615160 PMID:PMC7784665
- Sebetsa, Mojabeng M. Chemical analysis and evaluation of a homemade pest control mixture used by a local farmer from Maloti-A-Phofung municipality of the Afromontane region in the Free State. *University of the Free State.* 2022;118
- Marek CL, Timmons SR. *Antimicrobials in Pediatric Dentistry* (Sixth Edition), Elsevier, 2019; 128-141. <https://doi.org/10.1016/B978-0-323-60826-8.00009-2>
- Chen S, Yong T, Zhang Y, Su J, Jiao C, Xie Y. Anti-tumor and Anti-angiogenic Ergosterols from *Ganoderma lucidum*. *Front. Chem.* 2017;5:85. <https://doi.org/10.3389/fchem.2017.00085> PMID:29164102 PMID:PMC5670154
- Khobjai W, Jarmkom K, Wisidsri N, Techaoei S. Gas Chromatography Mass Spectrometry Application to Investigate of Phytonutrient Different Parts of Lotus, *International Journal of Food Engineering.* 2021;7(2),35-40. <https://doi.org/10.18178/ijfe.7.2.35-40>
- Ali A, Javaid A, Shoaib A. GC-MS analysis and antifungal activity of methanolic root extract of *Chenopodium album* against *Sclerotium rolfsii*, *Planta Daninha.* 2017;v35:e017164713. <https://doi.org/10.1590/s0100-83582017350100046>
- Ihsan BRP, Delina AP, Shalas AF. Determination of Quercetin in Extracts and Herbal Products of *Phyllanthus niruri* by TLC Densitometry Method. *Proceedings of International Pharmacy Ulul Albab Conference and Seminar (PLANAR).* 2022;2: 31-37 <https://doi.org/10.18860/planar.v2i0.1855>
- Marimuthu K, Nagaraj N, Ravi D. GC-MS Analysis of phytochemicals, Fatty acids and Antimicrobial potency of Dry christmas Lima Beans. *International Journal of Pharmaceutical Sciences Review and Research.* 2014;27: 63-66.
- Adegoke AS, Jerry OV, Ademola OG. GC-MS Analysis of Phytochemical Constituents in Methanol Extract of Wood Bark from *Durio Zibethinus* Murr. *International Journal of Medicinal Plants and Natural Products (IJMPNP).* 2019;5(3):1-11. <https://doi.org/10.20431/2454-7999.0503001>
- Javaid A, Iqra Haider Khan IH, Malik FH. Bioactive Constituents of Wild Cannabis Sativa Roots from Pakistan. *Pakistan Journal of Weed Science Research.* 2021;27(3): 359. <https://doi.org/10.28941/pjwsr.v27i3.984>
- Qadir A, Aqil M, Ali A, Ahmad FJ, Ahmad S, Arif M, Khan N. GC-MS analysis of the methanolic extracts of *Smilax china* and *Salix alba* and their antioxidant activity. *Turkish Journal of Chemistry.* 2020;44: 352-363. <https://doi.org/10.3906/kim-1907-5> PMID:33488162 PMID:PMC7671229
- Mulatu A, Megersa N, Tolcha T, Alemu T, Vetukuri RR. Antifungal compounds, GC-MS analysis and toxicity assessment of methanolic extracts of *Trichoderma* species in an animal model. *PLoS ONE.* 2022;17(9):1-16. <https://doi.org/10.1371/journal.pone.0274062> PMID:36149851 PMID:PMC9506656
- Esmat AU, Mittapally S, Begum S. GC-MS Analysis of Bioactive Compounds and Phytochemical Evaluation of the Ethanolic Extract of *Gomphrena globosa* L. Flowers. *Journal of Drug Delivery and Therapeutics.* 2020;10: 53-58. <https://doi.org/10.22270/jddt.v10i2.3914>
- Kepel RC, Lumingas LJL, Tombokan JL, Mantiri DMH. Biomineral characterization and phytochemical profile of green algae *Halimeda macroloba* and *Halimeda opuntia* from coastal waters of Tanjung Merah, Bitung City, North Sulawesi, Indonesia. *AACL Bioflux.* 2021;14(6):3217-3230.
- Abdulaziz YAG. Phytochemical Screening, Chemical Composition, and Antimicrobial Activities of *Abutilon pannosum* (Forst.f.) Schlecht. Collected from Shada Mountain, Al- Baha Region, Saudi Arabia, Egypt. *J. Microbiol.* 2022;57:1-13 <https://doi.org/10.21608/ejm.2022.115399.1204>
- Ayoola AA, Ekunseitan DA, Muhammad SB, Oguntayo MA, Adejola YA. Phytochemicals Analysis and GC-MS Determination of Ethanolic Extracts of *Azadirachta indica* and *Mangifera indica* Stem Bark and their Biological Potentials. *Pacific Journal of Science and Technology.* 2020;21(1):219- 229.
- Adenike AA, Adegbola P, Fadahunsi OS. Antioxidant property and GCMS profile of oil extracted from *Cocos nucifera* using a fermentation method. *BioTechnologia,* 2019;100(4):349-358. <https://doi.org/10.5114/bta.2019.90236>

- 29 Aremu OS, Ogunleye TQ, Seru LK, Mkhize Z, Trant JF. Synergistic broad-spectrum antibacterial activity of Hypoxishemerocallidea-derived silver nanoparticles and streptomycin against respiratory pathobionts. *Scientific Reports*. 2021;11:15222 <https://doi.org/10.1038/s41598-021-93978-z> PMid:34315915 PMCid:PMC8316514
- 30 Firoozabad MSM, Nasr MM. Antimicrobial activities of microbial essential fatty acid against foodborne pathogenic bacteria. *Iran J Microbiol*. 2022;14(2):214-218.
- 31 Khan IH, Javaid A. Hexane soluble bioactive components of leaf extract of Quinoa, *Journal of Animal & Plant Sciences*, 2022;32(2):609-614.
32. Subrahmanian H, Suriyamoorthy P and Kanakasabapathi D. Fourier Transform Infra-Red Spectroscopy Analysis of *Erythrina variegata* L. *Journal of Pharmaceutical Science & Research*, 2017; 9(11):2062-2067.
33. Fadlemoula, A, Pinho D, Carvalho V.H, Catarino SO, Minas G. Fourier Transform Infrared (FTIR) Spectroscopy to Analyse Human Blood over the Last 20 Years: A Review towards Lab-on-a-Chip Devices. *Micromachines* 2022; 13:187. <https://doi.org/10.3390/mi13020187> PMid:35208311 PMCid:PMC8879834