The use of mushrooms for the treatment of diseases can be traced to Paleolithic era. One mushroom that has shown potent medicinal properties both by oral consumption and topical application is the Tremella fuciformis. GC/MS analyses of T. fuciformis oil obtained by hydro-distillation showed four predominant compounds. 9,19-Cyclolanost-24-en-3-ol, (3.beta.)- was the most predominant with R_T of 20.766 and 24.672 min and a percentage total of 32.681 followed by 7-Isopropenyl-1,4a-dimethyl-4,4a,5,6,7,8-hexahydro-3H-naphthalen-2-one with R_T of 22.425 min and a percentage total of 21.334, lupeol had R_T of 22.825 and 23.230 min and a percentage total of 18.531, while lanosterol had R_T of 21.079 and 23.034 min and a percentage total of 17.845. These four compounds represent 90.391% of the total constituent compounds in T. fuciformis oil. The therapeutic properties of two predominant compounds (lanosterol and lupeol) of this mushroom confirm its use for the treatment of both dermatological and ophthalmological related diseases by traditional medical practitioners.

**Key words:** mushrooms Tremella fuciformis, GC/MS analysis, volatile components, lipids, triterpenoid.
(dead mango tree stump) in Ikeduru Local Government Area of Imo State, South-East Nigeria. A quantity of the mushroom (2.5 kg) was thoroughly washed with distilled water and air dried for a period of 2 weeks in a clean dust free environment. The dried samples were ground using a Thomas Scientific, (Model 4) Wiley’s mill until a fine smooth powder was obtained.

**GC/MS analysis of mushroom oil.** The ground mushroom powder (100 g) was added to 3.0 dm$^3$ of distilled water and the oil obtained by hydro-distillation was collected into hexane. The solution was concentrated by evaporation at room temperature. The oil was analysed using a combined gas chromatograph model HP 6890 and mass spectrometer model 5973 (AgilentTech.) fitted with a capillary column HP-5 MS (5% phenylmethylsiloxane) 30.0 m×250 μm×0.25 μm, using helium as a carrier gas at initial column temperature 120 °C for 5 min. Thereafter, the column temperature was increased at 5 °C per minutes to 320 °C and held for 5 min. Electron impact ionization for mass spectroscopy was done at ionization energy of 70 eV. The essential oil was diluted with 98% hexane and 2 μl of the diluted sample was automatically injected into AgilentTech model 5973 mass spectrometer. The constituent compounds were identified using the Chem-Office software attached to the MS library. The names, molecular formulas, molecular weights and structures of the component oils were ascertained using the database of National Institute Standard and Technology (NIST).

**Results and Discussion**

The five constituent oils from *T. fuciformis*, their gas chromatogram, spectra and structures are shown in Table and Fig. 1-6 respectively. The four predominant oils identified are 9,19-Cyclolanost-24-en-3-ol, (3.beta.)- with R$_t$ of 20.766 and 24.672 min and a percentage total of 32.681, 7-Isopropenyl-1,4a-dimethyl-4,4a,5,6,7,8-hexahydro-3H-naphthalen-2-one with R$_t$ of 22.425 min and a percentage total of 21.334, Lupeol with R$_t$ of 22.825 and 23.230 min and a percentage total of 18.531 and Lanosterol with R$_t$ of 21.079 and 23.034 min and a percentage total of 17.845. These four oils represent 90.391% of the total constituent oil in *T. fuciformis*. 2(1H)Naphthalenone, 3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)- was the least compound identified in this mushroom with R$_t$ of 22.560 min and a percentage total of 9.609.

In this present study, the GC/MS analysis of the oil from *T. fuciformis* showed the presence of five compounds. In terms of percentage concentration, 9,19-cyclolanost-24-en-3-ol, (3.beta.)-, acetic acid,7-Isopropenyl-1,4a-dimethyl-3-oxo-2,3,4,4a,5,6,7,8-octahydronaphthalen-2-yl ester, lupeol and lanosterol were predominant in this mushroom. Although two (9,19-cyclolanost-24-en-3-ol, (3.beta.)- and acetic acid,7-Isopropenyl-1,4a-dimethyl-3-oxo-2,3,4,4a,5,6,7,8-octahydropyrophthalen-2-yl ester) of the four major compounds in this mushroom may have served as aromatic and protective compounds, lanosterol and lupeol have shown different therapeutic properties. The double retention time observed

<table>
<thead>
<tr>
<th>S/N</th>
<th>Compound</th>
<th>Retention time (min)</th>
<th>Percentage of the total (%)</th>
<th>Molecular formula</th>
<th>Molecular weight (g/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9,19-Cyclolanost-24-en-3-ol, (3.beta.)-</td>
<td>20.766 24.672</td>
<td>32.681</td>
<td>C$<em>{32}$H$</em>{52}$O$_{2}$</td>
<td>468.754</td>
</tr>
<tr>
<td>2</td>
<td>Lanosterol</td>
<td>21.079 23.034</td>
<td>17.845</td>
<td>C$<em>{30}$H$</em>{50}$O</td>
<td>426.710</td>
</tr>
<tr>
<td>3</td>
<td>Acetic acid,7-Isopropenyl-1,4a-dimethyl-3-oxo-2,3,4,4a,5,6,7,8-octahydronaphthalen-2-yl ester</td>
<td>22.42</td>
<td>21.334</td>
<td>C$<em>{17}$H$</em>{26}$O$_{4}$</td>
<td>294.390</td>
</tr>
<tr>
<td>4</td>
<td>2(1H)Naphthalenone, 3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylene)</td>
<td>22.560</td>
<td>9.609</td>
<td>C$<em>{15}$H$</em>{22}$O</td>
<td>218.335</td>
</tr>
<tr>
<td>5</td>
<td>Lupeol</td>
<td>22.825 23.230</td>
<td>18.531</td>
<td>C$<em>{30}$H$</em>{50}$O</td>
<td>426.729</td>
</tr>
</tbody>
</table>
Fig. 1. Chromatogram of volatile components of *T. fuciformis*

Fig. 2. Mass spectrum of 9,19-cyclolanost-24-en-3-ol, (3.beta.)- (R<sub>t</sub>: 20.766 and 24.672 min)

Fig. 3. Mass spectrum of lanosterol (R<sub>t</sub>: 21.079 and 23.034 min)

Fig. 4. Mass spectrum of acetic acid. 7-Isopropenyl-1,4a-dimethyl-3-oxo-2,3,4,4a,5,6,7,8-octahydro-naphthalen-2-yl ester (R<sub>t</sub>: 22.425 min)
for 9,19-cyclolanost-24-en-3-ol, (3.beta.)- observed in this study shows the ability of this mushroom to absorb and accumulate lipid compound from their growth medium. 9,19-cyclolanost-24-en-3-ol, (3.beta.)- is a triterpenoid sterol that is domicile to plants, where it serves as the precursor for the synthesis of other plant steroids [5]. The fairly high concentration of lanosterol observed in this study not only confirms lanosterol as the precursor for the synthesis of steroids in this mushroom, but also shows the ability of this mushroom to synthesize lanosterol via a stepwise process initiated by the enzymatic conjugation of isopentenyl pyrophosphate and dimethylallyl pyrophosphate. Though lanosterol is a tetracyclic triterpenoid, its ability to prevent and reverse cataract formation in dogs and rabbits has being reported [6, 7]. However, a 6 day incubation of age-related cataractous human lens nuclei in lanosterol solution failed to reverse its nuclear opacity [8]. Zhao L. et al., [6] also reported the ability of lanosterol to reduce cataract severity and increase transparency in dissected rabbit cataractous lenses in vitro and cataract severity in vivo in dogs. Their identification of lanosterol as a key molecule in the prevention of lens protein aggregation points to a novel strategy for cataract prevention and treatment [6].

The traditional dermatological application of this mushroom may be as a result of its high lupeol content. As a pharmacologically active phytosterol and triterpene, lupeol has shown antimicrobial, antiprotozoal, antiinflammatory, antitumor and chemopreventive properties [9]. Geetha T., and Varalakshmi P., [10] reported that the use of lupeol causes a 39% decrease in paw swelling while indomethacin (a conventional anti-inflammatory agent) only reduces paw swelling in rats by 35%. As an anti-inflammatory agent, lupeol decreases IL-4 (interleukin 4) production by T-helper type 2 cells [9, 11]. Though [12,13] reported lupeol as effective inhibitor of both prostate and skin cancers, Marques et al., [14] showed that lupeol at its millimolar concentration can inhibit the activities dipeptidyl peptidase-4 and prolyl oligopeptidase enzymes.

The inhibition of dipeptidyl peptidase-4 by lupeol indicates that the consumption of this mushroom may induce an oral hypoglycemic effect via
prolonged incretin effect, which tantamount to a reduction on the incidence of type II diabetes mellitus. The consumption of this mushroom may also be relevant in the reduction of depressive symptoms via lupeol’s inhibitory effect on prolyl oligopeptidase enzyme. The presence and medicinal importance of these therapeutic triterpenoids observed in this mushroom confirms that the application of this mushroom in the treatment of both dermatological and ophthalmological related diseases by traditional medical practitioners is not limited to its glucuronoxylomannan and vitamin D content.

In conclusion, the two major therapeutic compounds (lanosterol and lupeol) observed in this pioneer GC/MS analysis of this mushroom may be responsible for both dermatological and nutraceutical potentials of this mushroom. This may be as a result of their individualistic effect or a synergetic effect of these triterpenoids and other therapeutic non-volatile compounds that may be present in this mushroom.

References


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