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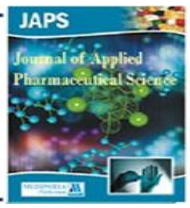


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# GC-MS Analysis of Bioactive Components of *Feronia elephantum* Correa (Rutaceae)

**Muthulakshmi A, Jothibai Margret R and Mohan V.R.**

**Muthulakshmi A**
*Department of Chemistry, V.O Chidambaram College, Tuticorin -628002, Tamil Nadu. India,*

**Jothibai Margret R**
*Department of Chemistry, Pope's college, Sawyerpuram-628251, Tamil Nadu, India.*

**Mohan V.R.**
*Ethnopharmacology Unit, Research Department of Botany, V.O.Chidambaram College. Tuticorin-628008, Tamil Nadu, India*

***For Correspondence***
**Mohan V.R.**
*Email: vrmohan_2005@yahoo.com*

**ABSTRACT**

*Feronia elephantum* belongs to the family Rutaceae is well known in Indian traditional system for its traditional uses. The present investigation was carried out to determine the possible bioactive components of leaves and bark of *F. elephantum* using GC-MS analysis. 18 components from leaves and 14 components from bark of the above said plant were identified. The prevailing compounds in the ethanol extract of leaves of *F. elephantum* were 7–Norbornadienyl t-butyl ether (17.26%) , 2–isopropyl–5-methyl–1– heptanol (11.40%), 1–Octanol,2–butyl (8.47%), Phenol, 4–[2–(dimethylamino)–ethyl]– (4.56%), 2,3–Dimethylquinolin-4(1H)–one (3.58%), Ethyl iso–allocholate (1.63%). The ethanol extract of *F. elephantum* bark contained, 2–Propenenitrile, 3–(3.4-dimethoxyphenyl)–(60.72%) was found as major component followed by phenol, 4–(3-hydroxy-I-propenyl)-2-methoxy–(9.35%), 3-(2-N-Acetyl–N-methylaminoethyl)indol (1.15%), cholesta–8,24–dine–3–ol, 4–methyl–(3a'- 4a')–(0.86%) as the major components.

**Keywords:** *F. elephantum*, wood apple, GC-MS, bioactive components.

## INTRODUCTION

From ancient days to recent civilization, human beings depend on nature for running their life smoothly from day to day. Plants remain a vital source of drugs and now-a- days much emphasis has been given to nutraceuticals. *F. elephantum* is one of the medicinally important plants belonging to Rutaceae, commonly known as wood apple. Various parts of wood – apple have been used against various ailments in ethnomedicine. Juice of young leaves is mixed with milk and sugar candy given as remedy for biliousness and intensive troubles of children. A powdered gum mixed with honey, is given to overcome dysentery and diarrhea in children. The leaves are used traditionally in Ayurveda as antiemetic, aromatic, expectorant, purgative, useful in anorexia, bronchitis, calculus, cardiac debility, cough, gastropathy, hiccup and in vitiated conditions of vayu (Gill *et al*., 1998; Parajapat *et al*., 2003).

Fruit pulp is sour, sweet, edible stomachic. The pulp is applied externally as a remedy for the bites of venous insects. Fruit pulp is also used by tribal of Rewa District of Madhya Pradesh against boils and amoebiasis. The bark is also aromatic and cooling, and useful in vitiated conditions of pitta. The bark is occasionally prescribed for biliousness and useful in liver diseases (Priya, 2000; Mohammed and Anwar, 2003). Taking into consideration of the medicinal importance of this plant, the ethanol extract of leaves and bark of *F. elephantum* were analyzed for the first time using GC – MS. This work will help to identify the compounds of therapeutic value. GC – MS is the best technique to identify the bioactive constituents of long chain hydrocarbons, alcohols, acids, ester, alkaloids, steroids, amino and nitro compound etc.

## MATERIALS AND METHODS

### Collection of plant material

Leaves and bark of *Feronia elephantum* Correa were collected in the month of February and March 2011 from the Agasthiarmalai Biosphere Reserve, Western Ghats, Tamil Nadu. The plant were identified with help of local flora, Voucher specimen preserved in the Ethnopharmacology Unit, Research Department of Botany, V.O.Chidambaram College, Tuticorin – 628 008, Tamil Nadu, India.

### Preparation of powder and extract

Leaves and barks were cleaned, shade dried and pulverized to powder in a mechanical grinder. Required quantity of powder of leaves and bark were weighed respectively and transferred to Stoppard flask, and treated with ethanol until the powder is fully immersed. The flask was shaken every hour for the first 6 hrs and then it was kept aside and again shaken after 24 hrs. This process was repeated for 3 days and then the extract was filtered. The extract was collected and evaporated to dryness by using vacuum distillation unit. The final residue thus obtained was then subjected to GC – MS analysis.

### GC – MS analysis

GC –MS analysis were carried out on a GC Clarus 500 Perkin Elmer system and Gas Chromatograph interfaced to a Mass Spectrometer (GC – MS) instrument employing the following conditions: column Elite – 1 fused silica capillary column (30m x 0.25 mm 1D X 1 µ df, composed of 100% Dimethyl Poly Siloxane). For GC – MS detection, an electron ionization system with ionizing energy of 70 eV was used. Helium gas (99.999%) was used as the carrier gas at constant flow rate 1 ml / min. and an injection volume of 2 µl was employed (split ratio of 10 : 1) injector temperature-250° C; ion – source temperature 280°C. The oven temperature was programmed from 110°C ( isothermal for 2 min) with an increase of 10°C /min to 200°C/min, then 5°C/ min to 280°C /min, ending with a 9 min isothermal at 280°C. Mass spectra were taken at 70 eV; a scan interval of 0.5s and fragments from 40 to 550Da. Total GC running time was 36 minutes. The relative % amount of each component was calculated by comparing its average peak area to the total areas, software adopted to handle mass spectra and chromatogram was a Turbomass.

### Identification of Components

Interpretation on mass spectrum of GC – MS was done using the database of National Institute of standard and Technology (NIST) having more than 62,000 patterns. The mass spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight and structure of the components of the test materials were ascertained.

## RESULTS AND DISCUSSION

### GC – MS analysis

The components present in the ethanol extracts of leaves and bark of *F. elephantum* was identified by GC – MS (Figures 1 and 2).

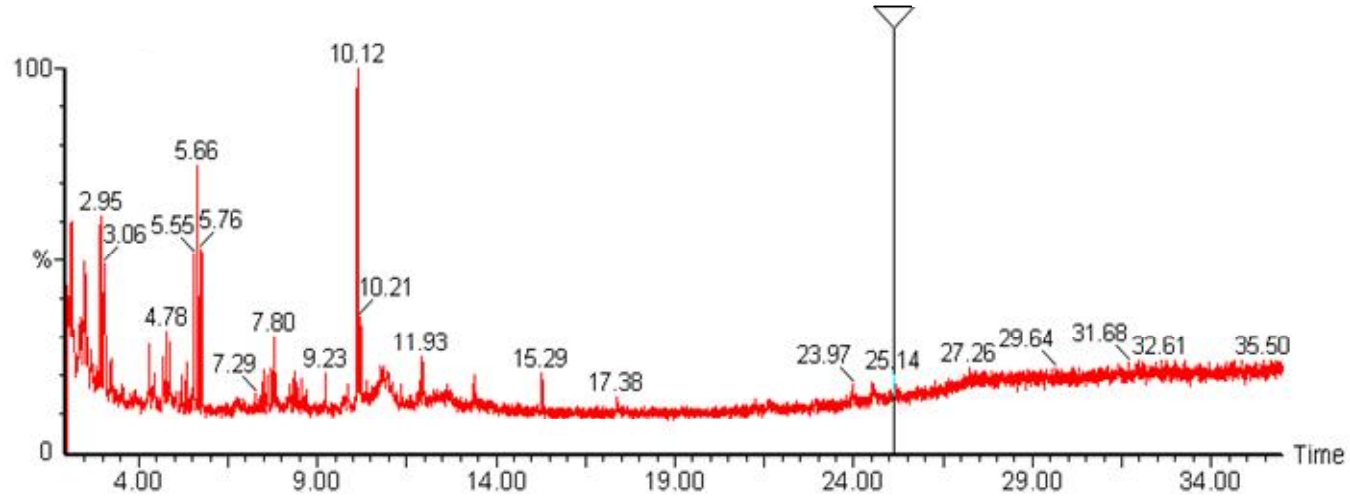



**Fig. 1:** GC-MS chromatogram of ethanol extract of leaves of *Feronia elephantum.*

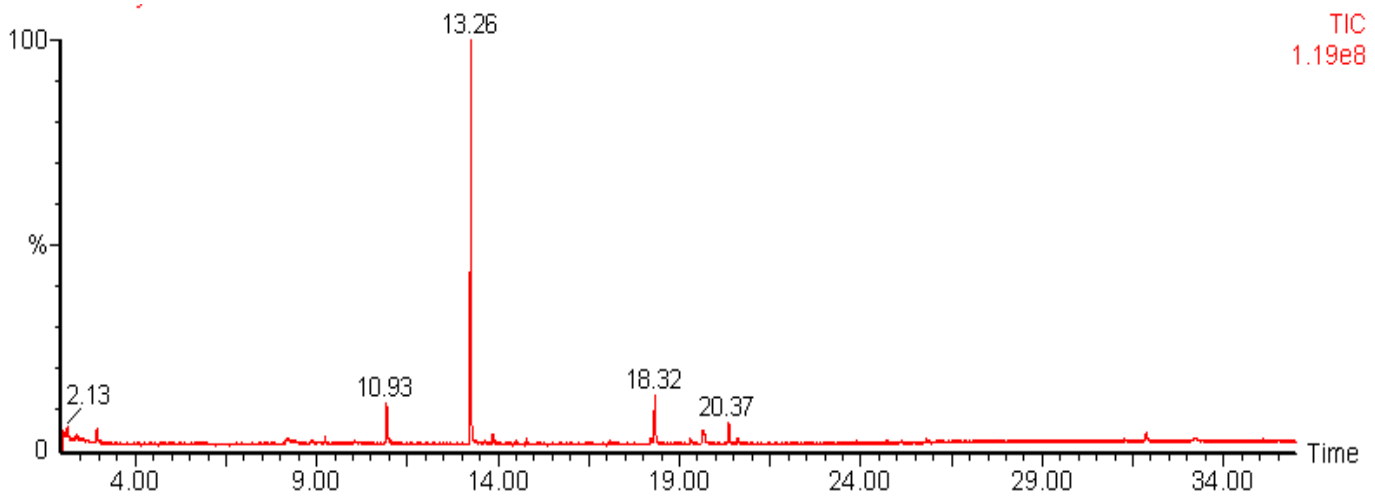



**Fig. 2:** GC-MS chromatogram of ethanol extract of bark of *Feronia elephantum.*

**Table. 1:** Components detected in *Feronia elephantum* leaf extract.

| S.No. | RT | Name of the compound | Molecular Formula | MW | Peak Area % |
|---|---|---|---|---|---|
| 1 | 2.50 | Octane, 3,5-dimethyl- | $C_{10}H_{22}$ | 142 | 10.42 |
| 2 | 2.95 | Propane, 1,1,3-triethoxy- | $C_9H_{20}O_3$ | 176 | 10.42 |
| 3 | 4.78 | Dodecane | $C_{12}H_{26}$ | 170 | 3.26 |
| 4 | 5.35 | Octadecane,3-ethyl-5-(2-ethylbutyl)- | $C_{26}H_{54}$ | 366 | 2.93 |
| 5 | 5.55 | 9-Octadecene, (E)- | $C_{18}H_{36}$ | 252 | 8.14 |
| 6 | 5.66 | 2-Isopropyl-5-methyl-1-heptanol | $C_{11}H_{24}O$ | 172 | 11.40 |
| 7 | 5.76 | 1-Octanol, 2-butyl- | $C_{12}H_{26}O$ | 186 | 8.47 |
| 8 | 7.80 | Phenol, 4-[2-(dimethylamino)ethyl]- | $C_{10}H_{15}NO$ | 165 | 4.56 |
| 9 | 8.36 | 2-Nonadecanone2, 4-dinitrophenylhydrazine | $C_{25}H_{42}N_4O_4$ | 462 | 1.95 |
| 10 | 9.23 | 9,12,15-Octadecatrienoic acid, 2-phenyl-1, 3-dioxan-5-yl ester | $C_{28}H_{40}O_4$ | 440 | 2.93 |
| 11 | 10.12 | 7-Norbornadienyl t-butyl ether | $C_{11}H_{16}O$ | 164 | 17.26 |
| 12 | 10.21 | 9-Octadecen-12-ynoic acid, methyl ester | $C_{19}H_{32}O_2$ | 292 | 3.58 |
| 13 | 11.93 | 2,3-Dimethylquinolin-4(1H)-one | $C_{11}H_{11}NO$ | 173 | 3.58 |
| 14 | 13.39 | Octadecanoic acid, 4-hydroxybutyl ester | $C_{22}H_{44}O_3$ | 356 | 2.61 |
| 15 | 15.29 | 2-Nonadecanone2,4-dinitrophenyl- hydrazine | $C_{25}H_{42}N_4O_4$ | 462 | 2.61 |
| 16 | 17.38 | Ethyl iso-allocholate | $C_{26}H_{44}O_5$ | 436 | 1.63 |
| 17 | 23.97 | 1,1 Cyclobutanedi carboxamide, 2-phenyl-N,N'-bis(1-phenylethyl)- | $C_{28}H_{30}N_2O_2$ | 426 | 2.28 |
| 18 | 25.14 | 2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl-, (E,E)- | $C_{15}H_{26}O$ | 222 | 1.95 |

**Table. 2:** Components detected in *Feronia elephantum* bark extract.

| S. No | RT | Name of the compound | Molecular Formua | MW | Peak Area % |
|---|---|---|---|---|---|
| 1 | 2.94 | Propane, 1,1-diethoxy- | $C_7H_{16}O_2$ | 132 | 2.37 |
| 2 | 9.23 | Propane, 1,1,3-triethoxy- | $C_9H_{20}O_3$ | 176 | 1.15 |
| 3 | 10.93 | Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy- | $C_{10}H_{12}O_3$ | 180 | 9.35 |
| 4 | 13.26 | 2-Propenenitrile, 3-(3,4-dimethoxyphenyl)- | $C_{11}H_{11}NO_2$ | 189 | 60.72 |
| 5 | 18.32 | Columbianetin | $C_{14}H_{14}O_4$ | 246 | 9.78 |
| 6 | 19.31 | 3-(2-N-Acetyl-N-methylaminoethyl)indol | $C_{13}H_{16}N_2O$ | 216 | 1.15 |
| 7 | 19.63 | Tricyclo[4.2.1.1(2,5)]dec-3-ene-9,10-dione | $C_{10}H_{10}O_2$ | 162 | 2.30 |
| 8 | 20.37 | Tetracyclo[6.3.0.0(2,11).0(3,7)undecane-5,10-dione, 7-methyl-3-[(2-methoxyethoxy) methoxy]- | $C_{16}H_{22}O_5$ | 294 | 4.03 |
| 9 | 20.61 | Tryptamine, N-[4-hydroxyhydrocinnamoyl]- | $C_{19}H_{20}N_2O_2$ | 308 | 1.58 |
| 10 | 23.89 | Sarreroside | $C_{30}H_{42}O_{10}$ | 562 | 2.54 |
| 11 | 24.72 | 9,12,15-Octadecatrienoic acid, 2-phenyl-1,3-dioxan-5-yl ester | $C_{28}H_{40}O_4$ | 440 | 0.58 |
| 12 | 25.14 | Cholesta-8,24-dien-3-ol, 4-methyl-, (3á,4à)- | $C_{28}H_{46}O$ | 398 | 0.86 |
| 13 | 31.87 | 24,25-Dihydroxyvitamin D3 | $C_{27}H_{44}O_3$ | 416 | 1.87 |
| 14 | 33.22 | Ethyl iso-allocholate | $C_{26}H_{44}O_5$ | 436 | 1.72 |

The active principles with their retention time (RT), molecular formula, molecular weight (MW) and concentration (%) in the ethanol extracts of leaves and bark of *F. elephantum* are presented in Tables 1 and 2. Eighteen compounds were identified in the ethanol extracts of leaves of *F. elephantum*. The prevailing compounds were 7–Norbornadienyl t-butyl ether (17.26%) , 2–isopropyl–5-methyl–1– heptanol (11.40%), 1–Octanol,2–butyl (8.47%), Phenol, 4–[2–(dimethylamino)–ethyl]– (4.56%), 2,3–Dimethylquinolin-4(1H)–one (3.58%), Ethyl iso–allocholate (1.63%). Fig 3 and 4 shows the mass spectrum and structures of Ethyl iso-allocholate, 2–Nonadecanone 2,4–dinitrophenylhydrazine. Fourteen compounds were identified in the ethanol extract of bark of *F. elephantum*.

The results revealed that, 2–Propenenitrile, 3–(3.4-dimethoxyphenyl)–(60.72%) was found as major component followed by phenol, 4–(3-hydroxy-I-propenyl)-2-methoxy–(9.35%), 3-(2-N-Acetyl–N-methylaminoethyl)indol (1.15%), cholesta–8,24–dine–3–ol, 4–methyl–(3a'- 4a')– (0.86%) in the ethanol extract of bark of *F. elephantum.*

Fig 5, 6 and 7 shows the mass spectrum and structures of cholesta–8, 24–dien–3-ol, 4– methyl– (3a', 4a'), 2–propenenitrile, 3–(3,4–dimethoxyphenyl)-, phenol, 4– (3– hydroxyl– 1– propenyl) –2–methoxy–respectively.

Major phytocompounds and its biological activities obtained through the GC–MS study of leaves and bark of *F. elephantum* have been tabulated (Table 3 and 4).

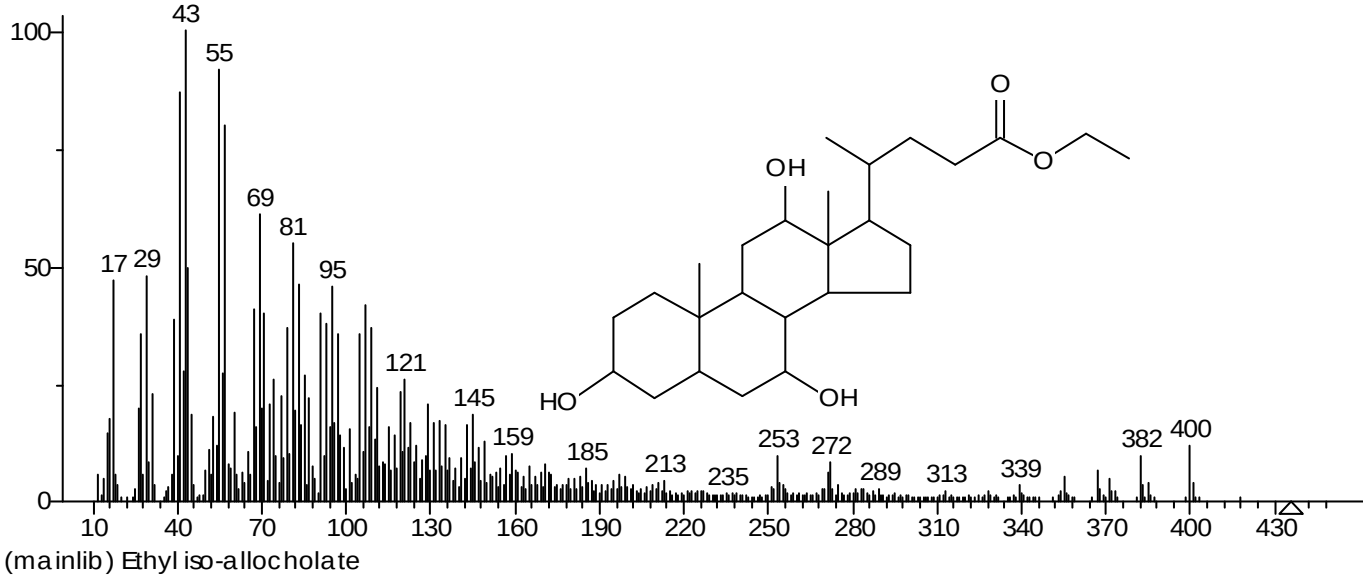



**Fig. 3:** Mass Spectrum of Ethyl iso–allocholate (RT:17.38).

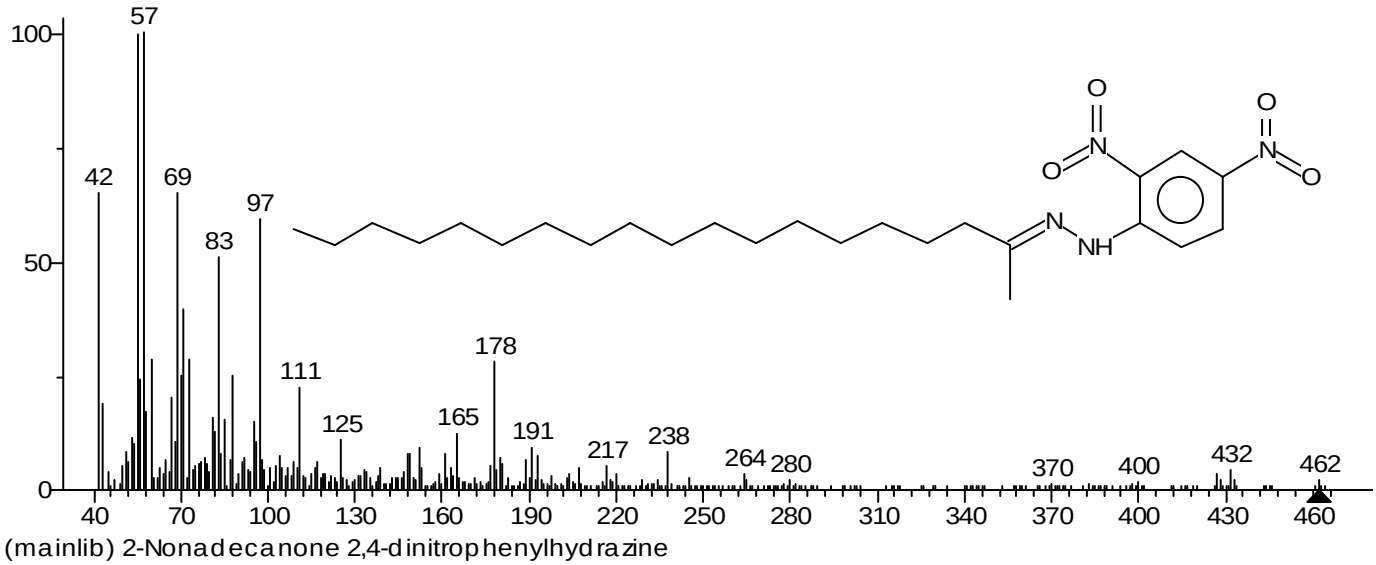



**Fig. 4:** Mass Spectrum of 2-Nonadecanone 2,4-dinitropheylhydrazine(RT: 8.36).

**Table. 3:** Activity of phytocomponents identified in the ethanol leaf extract of *Feronia elephantum.*

| S.No | Name of the compound | Nature of compound | **Activity |
|---|---|---|---|
| 1 | 2-Isopropyl-5-methyl-1-heptanol | Alcoholic compound | Antimicrobial |
| 2 | 1-Octanol, 2-butyl- | Alcoholic compound | Antimicrobial |
| 3 | Phenol,4-[2-(dimethylamino) ethyl] - | Phenolic compound | Antimicrobial<br>Antioxidant<br>Anti-inflammatory |
| 4 | 2-Nonadecanone2,4-initrophenyl hydrazine | Nitrogen compound | Antimicrobial |
| 5 | 2,3-Dimethylquinolin-4(1H)-one | Alkaloid | Antimicrobial<br>Anti-inflammatory |
| 6 | Ethyl iso-allocholate | Steroid | Antimicrobial<br>Diuretic<br>Anti-inflammatory<br>Antiasthma |
| 7 | 1,1-Cyclobutanedicarboxamide, 2-phenyl-N,N'-bis(1-phenylethyl)- | Amino compound | Antimicrobial |
| 8 | 2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl-, (E,E)- | Alcoholic compound | Antimicrobial |

**Activity Source: Dr.Duke's Phytochemical and Ethnobotanical Databases

**Table. 4:** Activity of phytocomponents identified in the ethanol bark extract of *Feronia elephantum.*

| S.No | Name of the compound | Nature of compound | *Activity |
|---|---|---|---|
| 1 | Phenol, 4-(3-hydroxy-1-propenyl)-2-methoxy- | Phenolic compound | Antimicrobial<br>Antioxidant<br>Anti-inflammatory |
| 2 | 2-Propenenitrile,3-(3,4-dimethoxy- phenyl)- | Nitrogen compound | Antimicrobial |
| 3 | Columbianetin | Ketone compound | Colour pigment |
| 4 | 3-(2-N-Acetyl-N-methylaminoethyl)indol | Steroid | Antimicrobial<br>Diuretic<br>Anti-inflammatory<br>Antiasthma |
| 5 | Tryptamine,N-[4-hydroxyhydro- cinnamoyl]- | Amino compound | Antimicrobial |
| 6 | Cholesta-8,24-dien-3-ol,4-methyl-, (3á,4à)- | Steroid | Antimicrobial<br>Diuretic<br>Anti-inflammatory<br>Antiasthma |
| 7 | 24,25-Dihydroxyvitamin D3 | Vitamin compound | Nutrient |
| 8 | Ethyl iso-allocholate | Steroid | Antimicrobial<br>Diuretic<br>Anti-inflammatory<br>Antiasthma |

**Activity Source: Dr.Duke's Phytochemical and Ethnobotanical Databases.

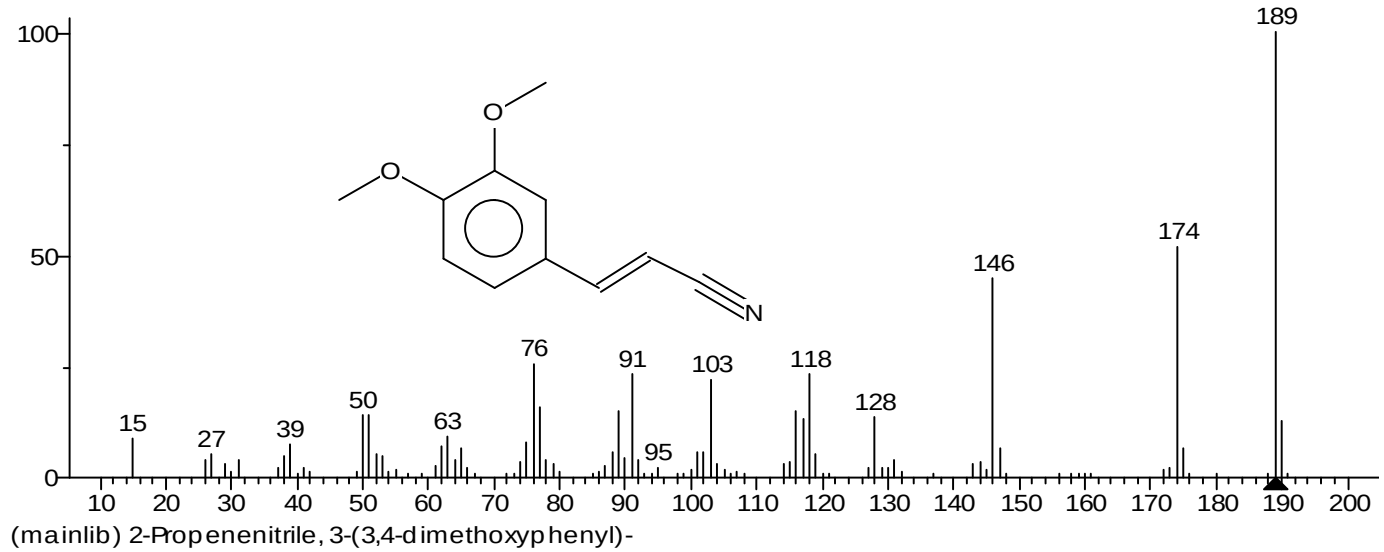



**Fig. 5:** Mass Spectrum of Cholesta-8,24-dien-3-ol,4-methyl-,(3a′,4a′)-

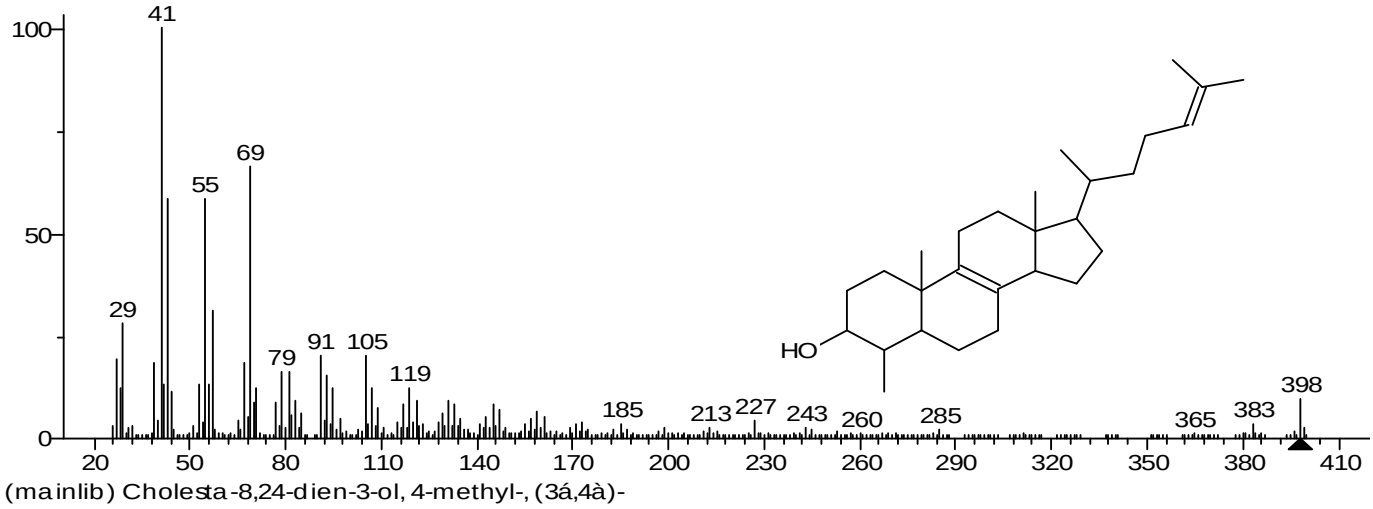
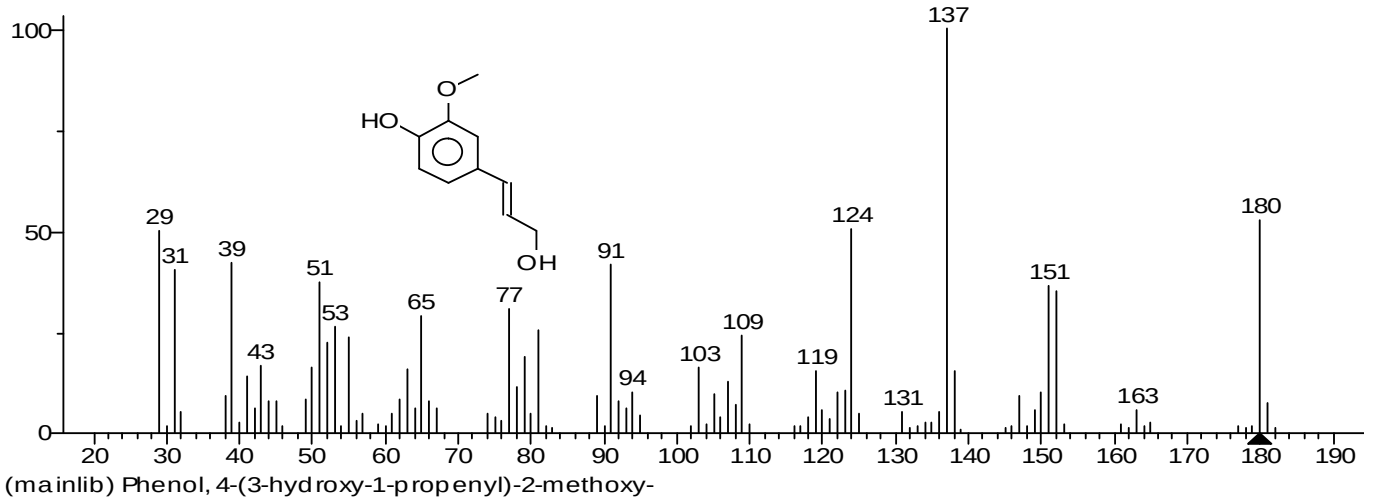



**Fig. 6:** Mass Spectrum of 2-propenenitnle,3-(3-4-dimethoxyphenyl)-




## CONCLUSION

In the present study, 18 components from leaves and 22 components from bark of the *F. elephantum*, were identified by Gas Chromatography– Mass Spectrometry (GC – MS) analysis. The presence of various bioactive compounds justifies the use of this plant for various ailments by traditional practitioners. However, isolation of individual photochemical constituents and subjecting it to biological activity will definitely give fruitful results. It could be concluded that, *F. elephantum* contains various bioactive compounds. So it is recommended as a plant of phytopharmaceutical importance. However, further studies are needed to undertake its bioactivity and toxicity profile.

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