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# PHYTOCHEMICAL AND GC-MS ANALYSES OF THE BIOACTIVE COMPONENTS OF *SECURIDACA LONGEPEDUNCULATA* (Fresen) ROOTS FOR ANTI-BREAST CANCER ACTIVITY

**Ogukwe Cynthia Ekwy[1]*, Okhale Samuel Ehiabhi[2], Ezugwu Brendan Okechukwu[1]**

[1]Department of Chemistry, Federal University of Technology, Owerri, P.M.B 1526 Owerri, Imo, Nigeria.

[2]Department of Medicinal Plant Research and Traditional Medicine, National Institute for Pharmaceutical Research and Development, Idu Industrial Area, P.M.B. 21 Garki, Abuja, Nigeria.

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***Correspondence for Author**
**Ogukwe Cynthia Ekwy**
Department of Chemistry, Federal University of Technology, Owerri, P.M.B 1526 Owerri, Imo, Nigeria.

## ABSTRACT

*Securidaca longepeduncalata* (Fresen) which belongs to the family Polygalaceae, has been known to have numerous ethno-medicinal uses. The present work evaluated the phytochemicals and bioactive components of *S. longepedunculata* roots extract using GC-MS analysis. Standard phytochemical analysis on the roots extract of *S. longepeduncalata* revealed the presence of tannins, saponins, saponin glycosides, alkaloids, flavonoids, cardiac glycosides, terpenes and steroids. GC-MS (QP2010SE) analysis of the *S. longepedunculata* ethanolic roots extract showed 45 components. Some of components were 1-Heptadecene (9.50%), 1-Nonadecene (6.83%), 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester (3.99%), 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene (2.44%), 1-Decanol, 2,2-dimethyl- (1.43%), 5-Octadecenal (3.06%), n-Nonadecanol (5.25%), n-Tetracosanol-(5.69%), Octasiloxane 1,1,3,3,5,5, 7,7,9,9,11,11,13,1315,15-hexadecamethyl- (1.92%), 1-Pentadecene (8.40%) and Bis(2-ethylhexyl) phthalate (8.49%). The presence of various bioactive components suggest the probable use of the plant in traditional medicine for the treatment of tumour related ailments and other diseases.

**KEYWORDS**: GC-MS analysis, Phytochemistry, *Securidaca longepedunculata* root.

## INTRODUCTION

Plants have consistently served as reservoir for secondary metabolites. Some of such metabolites exhibit diverse therapeutic benefits for human and animals.[1-3] According to WHO in 2008, 80% of the world population depends on traditional medicine for their health care. Therefore, evaluation of the chemical constituents of plants is quite important for the discovery of novel compound as well as for disclosing the value of such plants.[3] *Securidaca longepedunculata (Fresen)* as a medicinal plant has been reported to exhibit various therapeutic benefits. It belongs to the family Polygalaceae. It is a shrub of 8–9 m height with conspicuous violet (or white) flowers. It is common in savannah woodland from Senegal to North and South Nigeria, and generally widespread in tropical Africa.[4]

The plant is commonly known as Rhodesian violet, violet tree and also as "*Ezeogwu, Ipeta* and *Uwar Magunguna*" (King of drugs) in Igbo, Yoruba and Hausa languages in Nigeria.[5] Various parts of the plant are used for the treatment of purgative, diuretic, diaphoretic, emetics, conjunctivitis, malaria, venereal diseases, infertility problems, urethral discharges, stomach problems, dysentery, fever, rheumatism, leprosy, fibrositis, toothache, headache, sleeping sickness, cough, chest complaints, snakebite, and wound dressing, and as aphrodisiac, vermifuge and expectorant and as an arrow poison antidote.[4, 6, 7] The concoction of the roots is used in treatment of breast cancer and other diseases. Hence the present study is based on the phytochemical screening and analysis of bioactive components present in the ethanolic roots extract of *Securidaca longepedunculata* (Fresen) for anti-breast cancer using gas chromatography - mass spectrometry (GC-MS).

## MATERIALS AND METHODS

Reagents used were of JHD grade and unless otherwise stated were procured from Zayo-Sigma Abuja.

### Material Collection and Certification

The fresh roots of *Securidaca longedunculata* were harvested in the month of May, 2015 from Uhunowerre in Igbo-eze South Local Government Area, Enugu state, Nigeria. It was identified and authenticated by Mr Felix Nwafor at the Herbarium, International Centre for Ethno-medicine and Drug Development (InterCEDD), No. 110, Aku Road, Nsukka, Enugu state with voucher number, InterCEDD/1600.

**Plant Preparation And Extraction**

The fresh roots of *Securidaca longepedunculata* were sun dried for four (4) days and then air dried at room temperature of about 28-30$^{o}$C for six(6) weeks. The dried plant sample was pulverized into powder with hammer ball mill. Then 220g of the powdered material was weighed and macerated using ethanol in a stoppered vessel for 48 h; 1:5w/v of the sample and ethanol at the ambient temperature of 28-30$^{o}$C. The resultant mixture was filtered using muslin cloth and whatmann No.1 filter paper. The filtrate was dried below 40$^{o}$C over a water bath to yield *S.longepedunculata* roots ethanol extract (SLREE).

**Phytochemical Screening**

Phytochemical analyses were conducted on ethanol extract of *S. longepedunculata* roots (SLREE) for the presence of tannins, alkaloids, Anthraquinone derivatives, saponins, Saponin glycosides, cardiac glycosides, terpenes, steroids and flavonoids using standard methods.[8-12]

**Column Chromatography**

The ethanol extract of *S. longepedunculata* roots was separated and purified through silica gel G (60- 200 mesh size) column chromatography with various solvent of increasing polarity (n-hexane, ethyl acetate and methanol) in gradient step starting with n-hexane, n-hexane: ethyl acetate, ethyl acetate: metthanol and final elution was performed with 100% methanol. All the fractions were applied on to the precoated silica gel TLC plates and chromatographed using the solvent system of ethyl acetate: methanol in the ratio of 9:1. Plates were examined under UV and visible light to combine similar fractions. 36 different fractions were obtained and that were designated from Fraction 18 to Fraction 54. Finally the fractions were combined and concentrated over a water bath at temperature below 40$^{o}$C. The fractions were subjected to GC-MS analysis to determine the bioactive constituents.[13]

**Gas Chromatography - Mass Spectrometry (GC-MS) Analysis**

GC-MS analysis was carried out on GCMS-QP2010SE Shimadzu, Japan and gas chromatograph interfaced to a mass spectrometer (GC-MS) instrument employing the following conditions: Column Elite-1 fused silica capillary column (30x0.25mm 1Dx1µ df, composed of 100% dimethyl polysiloxane). For GC-MS detention, an electron ionization system with ionization system with ionization energy of 70eV was used. Helium gas (99.999%) was used as the carrier gas at constant flow rate 1ml/min and an injection volume of 1µl was employed (split ratio of 10:1) injector temperature- 250$^{o}$C; ion source temperature

280°C. The oven temperature was programmed from110°C (isothermal for 2 min.) with an increase of 10°C/min. to 200°C then 5°C/min. to 280°C/min, ending with a 9 min. isothermal at 280°C. Mass spectra were taken at 70eV; a scan of 0.5s and fragment from 40 to 550Da. Total GC running time was 10.9 minutes. The relative percentage amount of each component was calculated, by comparing its average peak areas and heights to their total respectively, software adopted to handle mass spectra and chromatogram was a turbo-mass. NIST version 1.0 year 2011 library was used for detection.

**Identification of Components**

Interpretation on mass spectrum of GC-MS was done using the data base of National Institute of Standard and Technology (NIST) having more than 62, 000 patterns. The mass spectrum of the known components were stored in the NIST library. The name, molecular weight and structure of the components of the test materials were determined by applying standard interpretation techniques.

## RESULTS AND DISCUSSION

**Extractive Value and Phytochemical analyses**

The extraction yielded 11.6% w/w of the plant sample (**Table 1**)

**Table 1: Extractive value of the *S. longepedunculata* roots.**

| Sample | Sample (wt)g | Wt of empty dish (g) $W_2$ | Wt of dish + extract $W_3$ | Wt of dried extract ($W_3$ -$W_2$) W4 | % yield |
|---|---|---|---|---|---|
| ***S. longepedunculata*** **root(Ethanol extract)** | **220** | **37.5** | **63.1** | **25.6** | **11.6** |

The phytochemical analyses of *S. longepedunculata* ethanol roots extract were found to show the presence of tannins, alkaloids, saponins, saponin glycosides, cardiac glycosides, Terpenes, steroids and absence of anthraquinone (**Table 2**).

**Table 2: Phytochemical results of *S. longepedunculata* ethanol roots extract.**

| Test | Inference |
|---|---|
| **Tannins** | + |
| **Alkaloids** | + |
| **Saponins** | + |
| **Saponin glycosides** | + |
| **Cardiac glycosides** | + |
| **Flavonoids** | + |
| **Anthraquinone derivatives** | - |
| **Terpenes and Steroids** | + |

Key: + presence of secondary metabolites
- absence of secondary metabolites

The therapeutic value of medicinal herbs largely depends on their secondary metabolites, especially alkaloids, terpenoids, flavonoids and phenolic compounds. Results given in (**Table 2**) show that the occurrence of different secondary metabolites suggests a wide range of biological application of the plant. Several alkaloids like vinblastine, vincristine, camptothecin and taxol are successfully employed in cancer treatment.[14] Alkaloids have many medicinal uses as drugs for malaria, colds, cough, hypertension, diabetes, cancer, and other diseases.[15]

Kunle and Egharevba suggested to consider the presence of flavonoids in a plant as indication of its antioxidant, anti-allergic, anti-inflammatory, antimicrobial and anticancer properties. Tannins were reported to exhibit antiviral, antibacterial and anti-tumour activities. It was also reported that certain tannins are able to inhibit HIV replication selectively and is also used as diuretic.[16]

However, glycoside derivatives showed very promising activity in vitro and in vivo and two of them, ethylidene derivative etoposide and theylidene derivative teniposide were developed as anticancer drugs. Terpenoids and steroids are capable of preventing cancer, because of their anti-carcinogenic effects. Some researchers have also reported that some saponins have anticancer and immunemodulatory properties.[14]

Saponin is used as mild detergents and in intracellular histochemistry staining to allow antibody access to intracellular proteins. In medicine, it is used in hypercholesterolemia, hyperglycaemia, antioxidant, anti-cancer, anti-inflammatory and weight loss.[16] Medicinal plants depend largely on their secondary metabolites that they contain.[14-18]

**GC-MS Analysis**

Forty five (45) compounds were characterized and identifed in the combined eluent fractions (18-54, 80:20% n-hexane: ethyl acetate to 90:10% ethyl acetate: methanol) from column chromatography of *S. longepedunculata* ethanolic root extract (**Figure 1**).

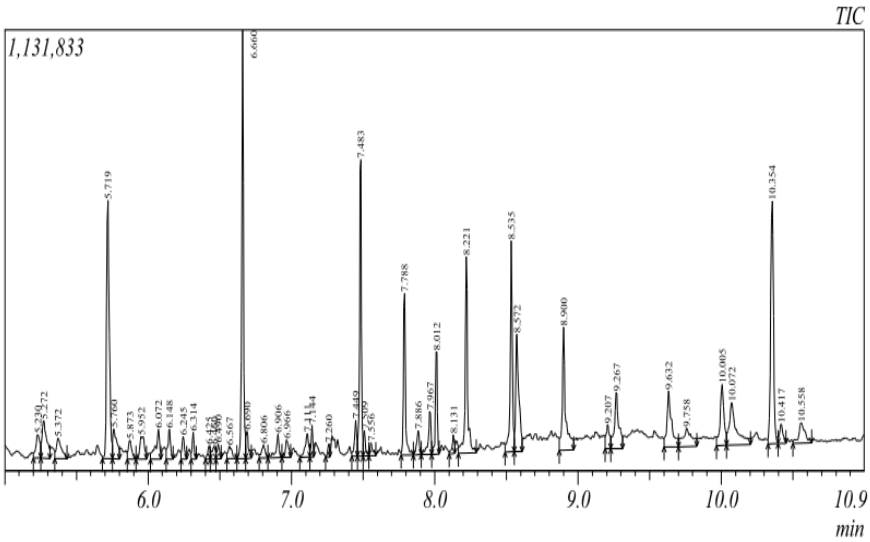


**Fig. 1: GC-MS Chromatogram of Combined Eluent Fractions from Column Chromatography 18-54 of *S. longepedunculata* root extract (80:20% n-hexane: ethyl acetate to 90:10% ethyl acetate: methanol)**

The active principles with their retention time (RT), molecular formula, molecular weight (MW) and percentage composition are presented in **Table 3**. The compounds were: Hexadecane (1.11%), Naphthalene, 1-(2-hydroxypropyl) (2.05%), 1-Hexanamine, 2-ethyl-N-(2-ethylhexyl)- (1.19%), 1-Pentadecene (8.40%), 1-Octanol, 2-butyl- (1.41%), 1,3,5-Triazine-2,4(1H,3H)-dione, 6(ethylamino) (0.70%), 1,3,5-Triazine-2,4(1H,3H)-dione, 6-(ethylamino) ( 1.27%), 1-Decanol, 2,2-dimethyl- (1.43%), Acetic acid, 2,6,6-trimethyl-3-.

**Table 3: Components detected in combined eluent fractions from column chromatography 18-54 of *S. longepedunculata* root extract (80:20% n-hexane: ethyl acetate to 90:10% ethyl acetate: methanol)**

| Peak | RT | Name of Compound | Molecular Formula | MW | % Composition | |
|---|---|---|---|---|---|---|
| | | | | | Area | Height |
| 1 | 5.230 | Hexadecane | $C_{16}H_{34}$ | 226 | 1.11 | 0.77 |
| 2 | 5.272 | Naphthalene, 1-(2-hydroxypropyl) | $C_{13}H_{14}O$ | 186 | 2.05 | 1.23 |
| 3 | 5.372 | 1-Hexanamine, 2-ethyl-N-(2-ethylhexyl)- | $C_{16}H_{35}N$ | 241 | 1.19 | 0.67 |
| 4 | 5.719 | 1-Pentadecene | $C_{15}H_{30}$ | 210 | 8.40 | 8.44 |
| 5 | 5.760 | 1-Octanol, 2-butyl- | $C_{12}H_{26}O$ | 186 | 1.41 | 0.99 |
| 6 | 5.873 | 1,3,5-Triazine-2,4(1H,3H)-dione, 6-(ethylamino)- | $C_5H_8N_4O_2$ | 156 | 0.70 | 0.61 |
| 7 | 5.952 | 1,3,5-Triazine-2,4(1H,3H)-dione, 6-(ethylamino)- | $C_5H_8N_4O_2$ | 156 | 1.27 | 0.74 |
| 8 | 6.072 | 1-Decanol, 2,2-dimethyl- | $C_{12}H_{26}O$ | 186 | 1.43 | 0.97 |
| 9 | 6.148 | Acetic acid, 2,6,6-trimethyl-3-methylene-7-(3-oxobutylidene)oxepan-2-yl ester | $C_{16}H_{24}O_4$ | 280 | 1.00 | 0.98 |
| 10 | 6.245 | Sulfurous acid, dodecyl 2-propyl ester | $C_{15}H_{32}O_3S$ | 292 | 0.67 | 0.74 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | 6.314 | Phenol, 2,6-bis(1,1-dimethylethyl)- | $C_{14}H_{22}O$ | 206 | 0.60 | 0.88 |
| 12 | 6.425 | 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- | $C_6H_6N_2O_4$ | 170 | 0.38 | 0.43 |
| 13 | 6.460 | 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- | $C_6H_6N_2O_4$ | 170 | 0.53 | 0.43 |
| 14 | 6.490 | 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- | $C_6H_6N_2O_4$ | 170 | 0.44 | 0.48 |
| 15 | 6.567 | 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- | $C_6H_6N_2O_4$ | 170 | 0.58 | 0.40 |
| 16 | 6.660 | 1-Heptadecene | $C_{17}H_{34}$ | 238 | 9.50 | 13.99 |
| 17 | 6.690 | 1-Octanol, 2-butyl- | $C_{12}H_{26}O$ | 186 | 0.81 | 0.89 |
| 18 | 6.806 | 2,2,7-Trimethyl-octa-5,6-dien-3-one | $C_{11}H_{18}O$ | 166 | 0.56 | 0.44 |
| 19 | 6.906 | Dodecane, 2-methyl-8-propyl- | $C_{16}H_{34}$ | 226 | 0.87 | 0.78 |
| 20 | 6.966 | Sulfurous acid, 2-propyl tridecyl ester | $C_{16}H_{34}O_3S$ | 306 | 0.73 | 0.58 |
| 21 | 7.111 | 2-methyltetracosane | $C_{25}H_{52}$ | 352 | 1.01 | 0.77 |
| 22 | 7.144 | Pentadecane, 2,6,10,14-tetramethyl- | $C_{19}H_{40}$ | 268 | 0.63 | 1.04 |
| 23 | 7.260 | Pterin-6-carboxylic acid | $C_7H_5N_5O_3$ | 207 | 0.26 | 0.41 |
| 24 | 7.449 | Benzyl Benzoate | $C_{14}H_{12}O_2$ | 212 | 0.95 | 1.17 |
| 25 | 7.483 | 1-Nonadecene | $C_{19}H_{38}$ | 266 | 6.83 | 9.68 |
| 26 | 7.509 | 2-methyltetracosane | $C_{25}H_{52}$ | 352 | 0.54 | 0.83 |
| 27 | 7.556 | Sulfurous acid, dodecyl 2-propyl ester | $C_{15}H_{32}O_3S$ | 292 | 0.47 | 0.43 |
| 28 | 7.788 | 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester | $C_{16}H_{22}O_4$ | 278 | 3.99 | 5.29 |
| 29 | 7.886 | 2-methyltetracosane | $C_{25}H_{52}$ | 352 | 0.77 | 0.78 |
| 30 | 7.967 | Undecanoic acid, 10-methyl-, methyl ester | $C_{13}H_{26}O_2$ | 214 | 1.36 | 1.41 |
| 31 | 8.012 | 7,9-Di-tert-butyl-1-oxaspiro(4,5) deca-6,9-diene-2,8-dione | $C_{17}H_{24}O_3$ | 276 | 2.44 | 3.34 |
| 32 | 8.131 | Phthalic acid, butyl undecyl ester | $C_{23}H_{36}O_4$ | 376 | 0.50 | 0.62 |
| 33 | 8.221 | n-Tetracosanol-1 | $C_{24}H_{50}O$ | 354 | 5.69 | 6.42 |
| 34 | 8.535 | n-Nonadecanol-1 | $C_{19}H_{40}O$ | 284 | 5.25 | 6.90 |
| 35 | 8.572 | 1,4-Hexadien-3-one, 5-methyl-1-[2,6, 6-trimethyl-2,4-cyclohexadien-1-yl]- | $C_{16}H_{22}O$ | 230 | 4.50 | 3.83 |
| 36 | 8.900 | n-Tetracosanol-1 | $C_{24}H_{50}O$ | 354 | 4.55 | 4.02 |
| 37 | 9.207 | Octasiloxane,1,1,3,3,5,5,7,7,9,9,11,11, 13,13,15,15-hexadecamethyl- | $C_{16}H_{50}O_7Si_8$ | 578 | 0.97 | 0.78 |
| 38 | 9.267 | Docosanoic acid, docosyl ester | $C_{44}H_{88}O_2$ | 648 | 2.88 | 1.84 |
| 39 | 9.632 | 5-Octadecenal | $C_{18}H_{34}O$ | 266 | 3.06 | 1.83 |
| 40 | 9.758 | Octasiloxane,1,1,3,3,5,5,7,7,9,9,11,11, 13,13,15,15-hexadecamethyl- | $C_{16}H_{50}O_7Si_8$ | 578 | 1.92 | 0.59 |
| 41 | 10.005 | Tetradecanoic acid, 3,3a,4,6a,7,8,9,10,10a,10b-decahydro-3a10a-dihydroxy-5-(hydroxymethyl)-2,10-dimethyl-3- oxobenz[e]azulen-8-yl ester | $C_{31}H_{50}O_6$ | 518 | 2.73 | 1.99 |
| 42 | 10.072 | 2-(2-(2-Butoxyethoxy)ethoxy) ethyl benzoate | $C_{17}H_{26}O_5$ | 310 | 3.66 | 1.39 |
| 43 | 10.354 | Bis(2-ethylhexyl) phthalate | $C_{24}H_{38}O_4$ | 390 | 8.49 | 7.92 |
| 44 | 10.417 | Cyclodecasiloxane, eicosamethyl- | $C_{20}H_{60}O_{10}Si_{10}$ | 740 | 0.83 | 0.63 |
| 45 | 10.558 | 4-Tetradecanol | $C_{14}H_{30}O$ | 214 | 1.50 | 0.66 |
| | | **Total Percentage Compostion** | | | **100** | **100** |

methylene-7-(3-oxobutylidene)oxepan-2-yl ester) (1.00%), Sulfurous acid, dodecyl 2-propyl ester (0.67%), Phenol, 2,6-bis(1,1-dimethylethyl)- (0.60%), 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- (0.38%), 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- (0.53%), 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- (0.44%), 2,4,6,(1H,3H,5H)-Pyrimidinetrione, 5-acetyl- (0.58%), 1-Heptadecene (9.50%), 1-Octanol, 2-butyl- (0.81%), 2,2,7-Trimethyl-octa-5,6-dien-3-one ( 0.56%), Dodecane, 2-methyl-8-propyl- (0.87%), Sulfurous acid, 2-propyl tridecyl ester (0.73%), 2-methyltetracosane (1.01%), Pentadecane, 2,6,10,14-tetramethyl- (0.63%), Pterin-6-carboxylic acid (0.26%), Benzyl Benzoate (0.95%), 1-Nonadecene (6.83%), 2-methyltetracosane (0.54%), Sulfurous acid, dodecyl 2-propyl ester (0.47%), 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester (3.99%), 2-methyltetracosane (0.77%), Undecanoic acid, 10-methyl-, methyl ester (1.36%), 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene (2.44%), Phthalic acid, butyl undecyl ester (0.50%), n-Tetracosanol- (5.69%), n-Nonadecanol (5.25%), 1, 4-Hexadien-3-one, 5-methyl-1-[2,6,6-trimethyl-2,4-cyclohexadien-1-yl]- (4.50%), n-Tetracosanol-(4.55%), Octasiloxane,1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15-hexadecamethyl- (0.97%), Docosanoic acid, docosyl ester (2.88%), 5-Octadecenal (3.06%), Octasiloxane 1,1,3,3,5,5, 7,7,9,9,11,11,13,1315,15-hexadecamethyl- (1.92%), Tetradecanoic acid,3,3a,4,6a,7,8,9,10,10a,10b-decahydro-3a,10a-dihydroxy-5-(hydroxymethyl)- 2,10-dimethyl-3-oxobenz[e]azulen-8-yl ester, (2.73%), 2-(2-(2-Butoxyethoxy)ethoxy)ethyl benzoate (3.66%), Bis(2-ethylhexyl) phthalate (8.49%), Cyclodecasiloxane, eicosamethyl- (0.83%), 4-Tetradecanol (1.50%).

The individual fragmentation patterns of some components with their peaks at different (M/Z) ratios were illustrated in **Figures 2$_{a-j}$**. The mass spectrum of the compound with retention time 6.660 min (9.50%) gave 13 major peaks (M/Z) at 55, 57, 43, 83, 69, 41, 97, 111, 102, 27, 126, 140 and 154 (**Figure 2$_a$**). The mass spectrum of the compound with the retention time 7.483 min (6.83%) gave 13 major peaks (M/Z) at 43, 83, 97, 67, 41, 70, 111, 125, 126, 27, 140, 154 and 168 (**Figure 2$_b$**).

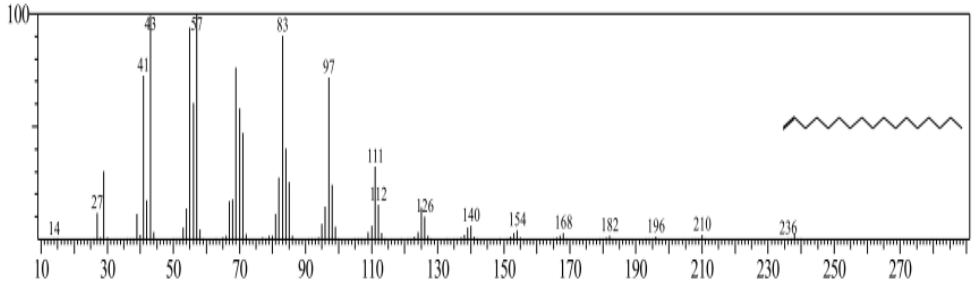


**Fig. 2$_a$: Mass spectrum of 1-Heptadecene**

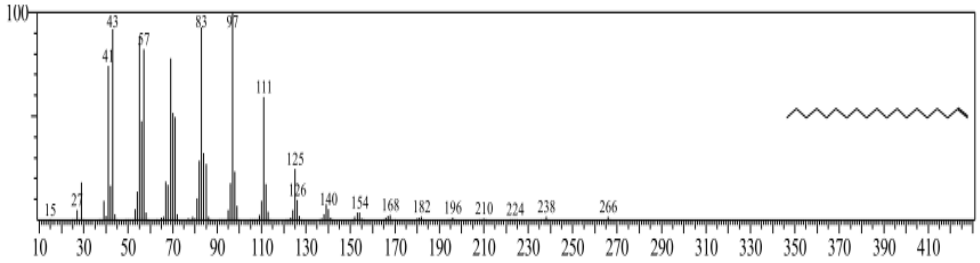

**Fig. 2$_b$: Mass spectrum of 1-Nonadecene**

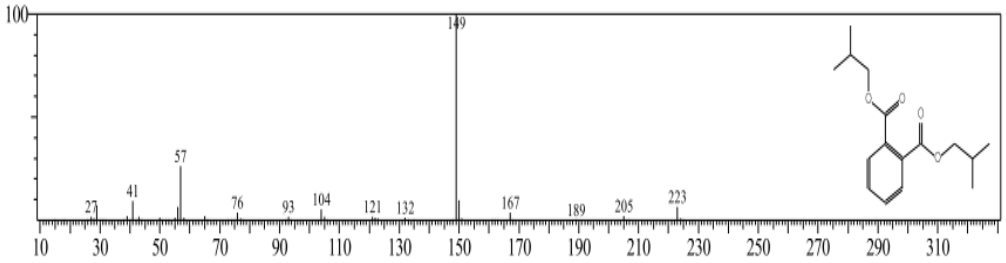

**Fig. 2$_c$: Mass spectrum of 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester.**

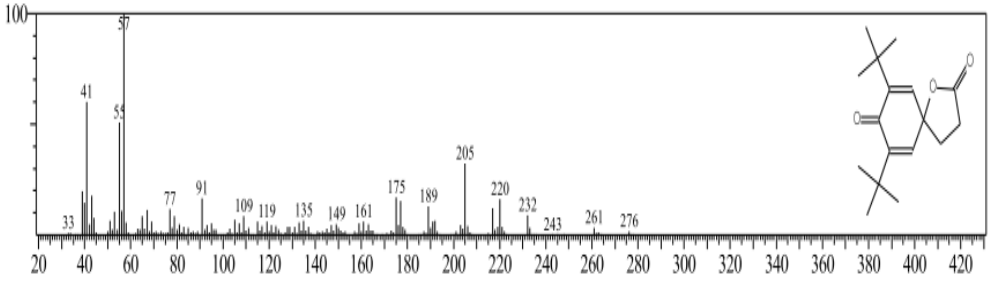

**Fig. 2$_d$: Mass spectrum of 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione**

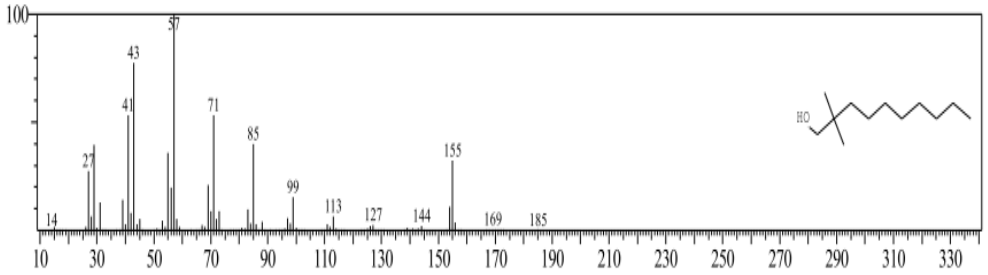

**Fig. 2$_e$: Mass spectrum of 1-Decanol, 2,2-dimethyl-**

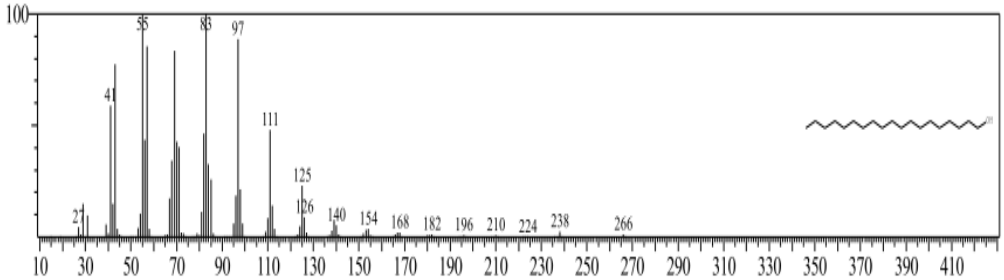

**Fig. 2$_f$: Mass spectrum of n-Nonadecanol-1**

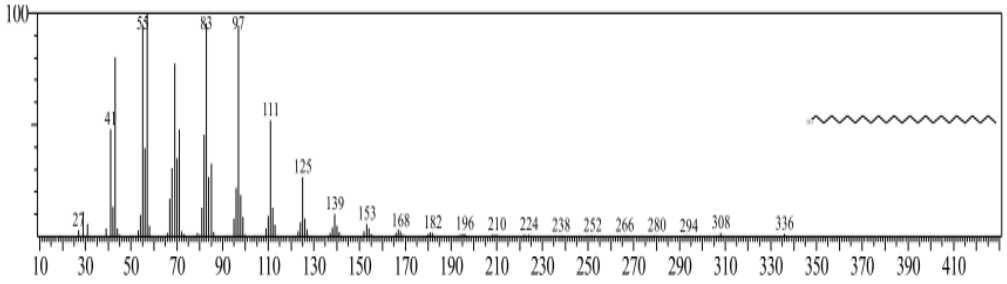

**Fig. $2_g$: Mass spectrum of n-Tetracosanol-1**

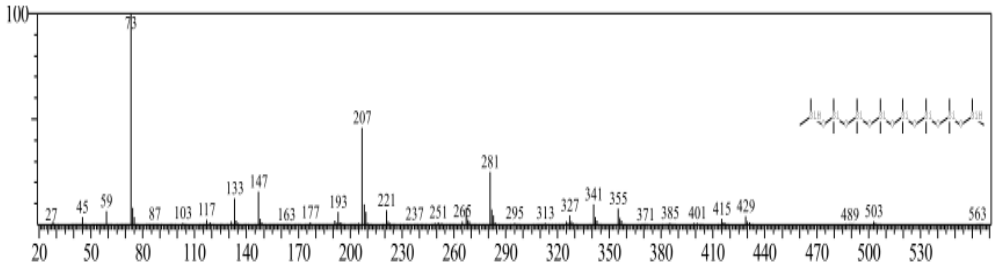

**Fig. $2_h$: Mass spectrum of Octasiloxane,1,1,3,3,5,5,7,7,9,9,11,11,13,13, 15,15-hexadecamethyl-**

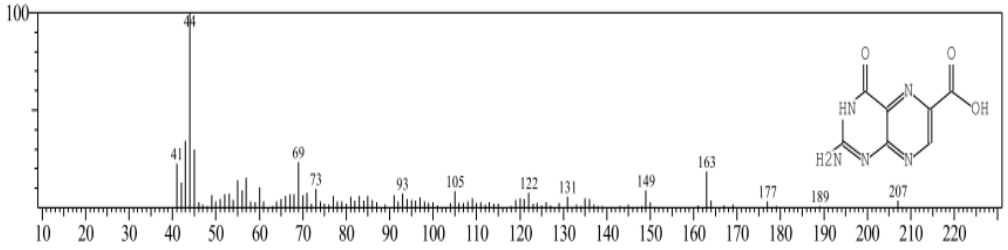

**Fig. $2_i$: Mass spectrum of Pterin-6-carboxylic acid**

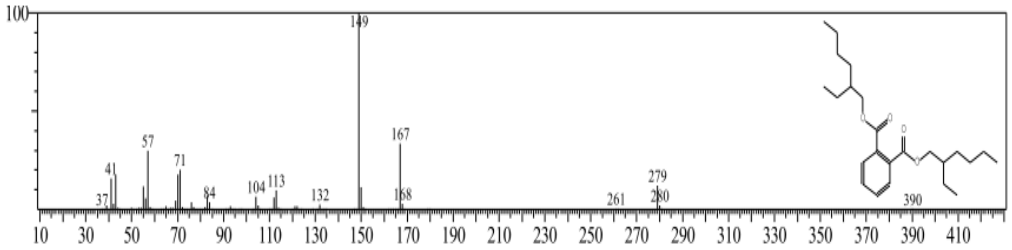

**Fig. $2_j$: Mass spectrum of Bis(2-ethylhexyl) phthalate**

The mass spectrum of the compound with retention time 7.788 min (3.99%) gave 9 major peaks (M/Z) at 49, 57, 41, 104, 223, 167, 27, 205 and 76 (**Figure $2_c$**). The mass spectrum of the compound with retention time 8.012 min (2.44%) gave 14 major peaks (M/Z) at 57, 41, 56, 205, 91, 77, 175, 220, 189, 232, 109, 119, 149 and 161 (**Figure $2_d$**). The mass spectrum of the compound with retention time 10.354 min (1.43%) gave 13 major peaks (M/Z) at 57, 43, 41, 71, 85, 155, 27, 99, 113, 127, 144, 14 and 185 (**Figure $2_e$**). The individual molecular structures of some components were illustrated in **Figures $2_{k-t}$.**

**Fig. $2_k$: 1-Heptadecene**



**Fig. $2_l$: 1-Nonadecene**

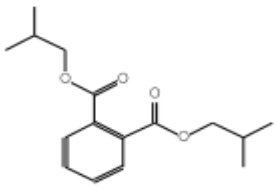

**Fig. $2_m$: 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester**

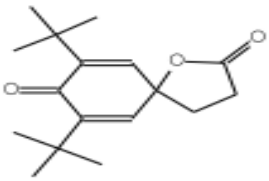

**Fig. $2_n$: 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione**

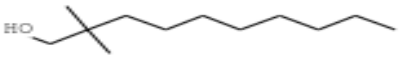

**Fig. $2_o$: 1-Decanol, 2,2-dimethyl-**



**Fig. $2_p$: n-Nonadecanol-1**



**Fig. $2_q$: n-Tetracosanol-1**

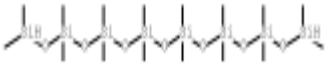

**Fig. $2_r$: Octasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15-hexadecamethyl-**

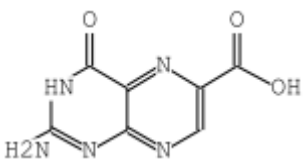


**Fig. $2_s$: Pterin-6-carboxylic acid**

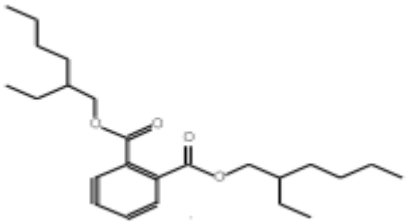

**Fig. $2_t$: Bis(2-ethylhexyl) phthalate**

The mass spectrum of the compound with retention time 8.535 min (5.25%) gave 12 major peaks (M/Z) at 83, 55, 97, 70, 41, 111, 125, 126, 27, 140, 154 and 168 (**Figure $2_f$).** The mass spectrum of the compound with retention time 8.221 min (5.69%) gave 13 major peaks (M/Z) at 57, 55, 83, 97, 43, 70, 41, 111, 125, 139, 153, 27 and 168 (**Figure $2_g$**). The mass spectrum of the compound with retention time 9.758 min (1.92%) gave 13 major peaks (M/Z) at 73, 207, 281, 147, 133, 341, 59, 355, 221, 45, 327, 415 and 429 (**Figure $2_h$**). The mass spectrum of the compound with retention time 7.260 min (0.26%) gave 13 major peaks (M/Z) at 44, 41, 69, 163, 149, 73, 93, 105, 122, 131, 177, 207 and 189 (**Figure $2_i$**). The mass spectrum of the compound with retention time 9.632 min (8.49%) gave 12 major peaks (M/Z) at 149, 167, 57, 71, 41, 279, 113, 104, 84, 132, 168 and 280 (**Figure $2_j$**). Some major phyto-compounds and their biological activities obtained through the GC-MS study of the *S. longepedunculata* root extract have been tabulated (**Table 4**).

**Table 4: Activity of some phytocomponents identified in the combined eluent fractions from column chromatography 18-54 of *S. longepedunculata* root ethanol extract (SLREE)**

| S/N | Name of the Compound | Nature of Compound | Activity |
|---|---|---|---|
| 1 | 1-Heptadecene | Long-chain fatty acid | Antibiotic[20] |
| 2 | 1- Nonadecene | Long-chain fatty acid | Antibiotic[20] Anti-fungal[3] |
| 3 | 1,2-Benzenedicarboxylicacid, bis(2-methylpropyl)ester | Organic acid | Antimicrobial, Antifouling[20] |
| 4 | 7,9-Di-tert-butyl-1-oxaspiro(4,5) deca-6,9-diene-2,8-dione | Ketone | Antimicrobial[20] |
| 5 | 1-Dodecanol | Long-chain fatty alcohol | Anti-bacterial[3][21] |
| 6 | n-Nonadecanol-1 | Aliphatic alcohol | Anti-microbial, cytotoxic [3][21] |
| 7 | n-Tetracosanol-1 | Aliphatic alcohol | Anti-bacterial [21] Anticancer [19] |
| 8 | Octasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15,-Hexadecamethyl | Volatile organic Compound | Antimicrobial[2] |
| 9 | Pterin-6-carboxylic acid | Chemical nature | Folic acid estimation [27] |

Long chain aliphatic alcohol tetracosanol has been found to exhibit inhibitory effects on the growth of CHO-K1 and human melanoma oncogenic cell lines.[19] It has been reported that long-chain fatty acids, 1-Heptadecene and 1-Nonadecene have antibiotic activity. An organic acid, 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester has antimicrobial and antifouling activities. Ketone, 7,9-Di-tert-butyl-1-oxaspiro (4,5)deca-6,9-diene-2,8-dione has antimicrobial activity.[20] It has also been reported that long-chain fatty alcohol, 1-Dodecanol has anti-bacterial activity.[3,21] Further, alcoholic compounds, n-Tetracosanol-1 has anti-bacterial activity[3] and n-Nonadecanol-1 has anti-microbial and cytotoxic properties.[3,21] Volatile organic Compound Octasiloxane, 1,1,3,3,5,5,7,7,9,9, 11,11,13,13,15,15,-Hexadecamethyl has been reported to possess anti-microbial activity.[2] (**Table 4**). Free fatty acids including long chain unsaturated fatty acids acid have been reported to exhibit antibacterial, anti-inflammatory and antifungal activity.[22] Phthalic acid derivatives were suggested to have been used to cure chronic cardiovascular and cerebrovascular diseases and had anti-tumour, anti-inflammatory, antibacterial functions [23] Phthalates are reported to have antimicrobial and other pharmacological activities.[24] The anti-microbial activities were believed to be due to phthalic acid derivative.[25] Moreover, several authors have shown that natural aromatic compounds possess important biological activities, such as antitumor, antihepatotoxic, antioxidant, anti-inflammatory, estrogenic and antibacterial activities.[26]

## CONCLUSION

The ethno-botanical uses of *S. longepedunculata* roots in the treatment of breast cancer, venereal diseases and other diseases are probably due to the presence of n-Tetracosanol, n-Nonadecanol and other bioactive components. The authors therefore recommend that further works on isolation of the individual phytochemical constituents and subjecting of each to biological activity to evaluate other therapeutic benefits of the plant.

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