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Gas Chromatography-Mass Spectrometric Fingerprints of Bioactive Phytochemicals from Hexane Extract of *Securidaca longipedunculata* Leaves

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Securidaca longipedunculata (Fresen.) is a Nigerian medicinal plant commonly used to fever, inflammation, infections, and pain-related ailments. Despite its significant role in ethnomedicine, the phytoconstituents for its pharmacological activities remain inadequately characterized. The aim of this study is to identify and characterize the bioactive compounds from *n*-hexane extract of *S. longipedunculata* using Gas Chromatography–Mass Spectrometry (GC–MS). The plant materials were collected, authenticated and cold macerated with *n*-hexane for 48hrs. The resulting *n*-hexane extract was profiled using GC–MS analysis for compound's identifications. A total of 29 Compounds were identified and belong to different class of natural products of fatty acids, flavonoids, terpenoids, esters, and phenolic derivatives with a long history of antimicrobial, antioxidant, anti-inflammatory, and anticancer properties. These compounds included: 9,19-cycloergost-24-(28)-en-3-ol, 4,14-dimethyl-, acetate, (3-beta,4-alpha,5-alpha)-urs-12-en-3-ol, acetate-(3-beta); 1,6,10,14,18,22-tetracosahexen-3-ol; 2,6,10,15,19,23-hexamethyl; (all-E)-(+/-); olean-12-en-3-ol; acetate-(3-beta). The findings of the study show that, *S. longipedunculata* contains bioactive compounds with potential therapeutic properties that further validate its myriad its traditional uses. Thus, the phytochemical profiles reported in this work provides scientific insight into various class of compounds present in *S. longipedunculata* which will inform future research to explore other pharmacological properties.

Keywords: *Securidaca longipedunculata*, GC–MS analysis, phytochemical characterization, medicinal plant.

1. Introduction

Medicinal plants remain an important source of bioactive compounds for drug research (Chaachouay and Zidane, 2024). Recently, certain plant-derived compounds have shown biological activity with little adverse effects. Such findings have piqued the interest of many scientists, prompting them to screen a large number of plants for biological features. Plant extracts contain a wide range of metabolites and bioactives that may have synergistic effects, allowing for multi-target effects in disease therapy (Chaachouay, 2025). Herbal medicines often known as traditional medicines are chief and most common source of novel chemotherapeutic drugs such as antimalarial drugs artemesinine and anticancer taxol (Che, 2024).

Natural products scientists around the world are now turning to phytochemicals from plants for new drugs as a result of their potency and less side effects compared to synthetic chemical compounds (Olaoye

et al., 2021; Halder and Jha, 2023). Plant-based natural products can be derived from any part of the plant like barks, leaves, flowers, roots, fruits and seeds (Godlewska *et al.*, 2022). Nigeria is one of the tropical nations blessed with abundant flora of medicinal plants that have been found to possess different potential biological activities, and there is an increasing awareness in linking the phytochemical compounds to their biological activities (Evbuomwan *et al.*, 2023).

Securidaca longipedunculata (Plate 1) belong to the family of *Polygalaceae*, known with different names such as violet tree, fiber tree (South Africa) or Rhodesian violet (English), Sanya (Hausa), Ipeta (Yoruba) (Egga *et al.*, 2023). It is a moderately sized tree, ranging from 6 to 12 m in height, displaying a pale grey, smooth bark and leaves that cluster together (Oladimeji and Babu, 2025).



Plate 1: *S. longipedunculata* in its Natural Habitat

The plant is traditionally called 'Uwar maguguna' by the Hausa speaking people in Northern Nigeria and other West African countries in tropical regions (Egga *et al.*, 2023). The plant has a long history in ethno-medicine for the treatment of many diseases in Africa such as cancers, inflammation, pain and snakebites (Olaoye *et al.*, 2021). Additionally, *S. longipedunculata* Fresen (Polygalaceae) is a multipurpose plant that is well-known in African traditional medicine for treating a wide range of conditions, such as hernias, coughs, fever, ascariasis, constipation, headaches, rheumatism, stomach pains, malaria, TB, pain, epilepsy, and pneumonia (Wakeel *et al.*, 2025). Root bark extracts are used to treat dental pain, chest problems, TB, and grain insects (Egga *et al.*, 2023). The aim of this work is to use gas chromatography–mass spectrometry (GC–MS) to identify and characterize the bioactive chemicals in the *n*-hexane extract of *S. longipedunculata*.

2. Materials and Methods

2.1 Sample Collection, Identification and Preparation

The leaves of *S. longipedunculata* were collected from Zuru local government area of Kebbi State, Nigeria in August, 2021. The sample was then transported to the laboratory and identified by a taxonomist (Musa Magaji) at the Department, Pharmacognosy and Ethnopharmacy, Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University, Sokoto. The voucher specimen with the number PCG/UDUS/POLY/0001 was prepared and deposited for future reference at the herbarium. The leaves were properly washed, shaded-dried and pulverized using a clean pestle and mortar. The pulverized sample was then stored in an air-tight container until it was needed for analysis.

2.2 Preparation of the Extract

In accordance with the maceration and exhaustive percolation method described by Hassan *et al.*, (2024), the pulverized sample (200 g) of *S. longipedunculata* leaves were soaked in 2500 cm³ of *n*-hexane (plant material to solvent ratio was 1:10, w/v) in an extractive tank of 3000 cm³ capacity. The tank was closed with coke tightly sealed for 72 hours with occasional shakings to facilitate free solubility of secondary metabolites. The mixture was then filtered twice and pre-concentrated by evaporating

the solvent using Rotary evaporator and then stored for further analysis. The percentage yield of the extract was calculated using the formula in equation 1.

$$\% \text{Yield} = \frac{\text{Weight of the Extract}}{\text{Weight of the Sample}} \times 100 \dots \dots \dots (1)$$

2.3 Gas Chromatography–Mass Spectrometry (GC–MS) Profiling of the Extract

The *n*-hexane extract was analyzed using GC–MS (Agilent Technologies 7890A gas chromatograph and an Agilent Technologies MSD 5975C mass spectrometer, TG 5MS column: 30x250µm). Helium was used as carrier gas at 1 mL/min while Split/Splitless (S/SL) injector oven temperature of 250 °C was maintained. A sample injection volume of 1.0 cm³ was used. The temperature of the ion source was maintained at 230 degrees Celsius. The oven temperature was originally set to 80 °C for 2 minutes, and then programmed to increase to 280 °C at a rate of 5 °C per minute. The process concluded with a 5-minute period at a constant temperature of 280 °C. The overall duration for *S. longipedunculata* was 36.12 minutes. The temperature of the MS transfer line was consistently maintained at 250 °C. The TSQ 8000 Triple Quadrupole MS detector was used for the investigation, and the data was assessed utilising the total ion count (TIC) method for both identifying and quantifying compounds. The mass spectra of the components were compared to the data in the National Institute of Standards and Technology (NIST) library. The XCALIBER software was employed for peak picking and data processing (Gupta and Kumar, 2017).

3. Results and Discussion

3.1 Results

3.1.1 Percentage Yield

The cold maceration of 200 g samples afforded 9.62 g of hexane extract with percentage yield of 4.81% as represented in Table 1.

Table 1: Percentage yield of *S. longipedunculata* leaves extract

Extracts	Yield (g)	Yield (%)
<i>n</i> -Hexane	9.62	4.81

3.1.2 GC–MS Analysis of *S. longipedunculata* Leaves Extracts

A total of twenty-nine (29) compounds were identified from the extract of *S. longipedunculata* leaves using GC–MS analysis as shown in total ion chromatogram (TIC) in figure 1. The list of the compounds and their formulas are presented in Table 2.

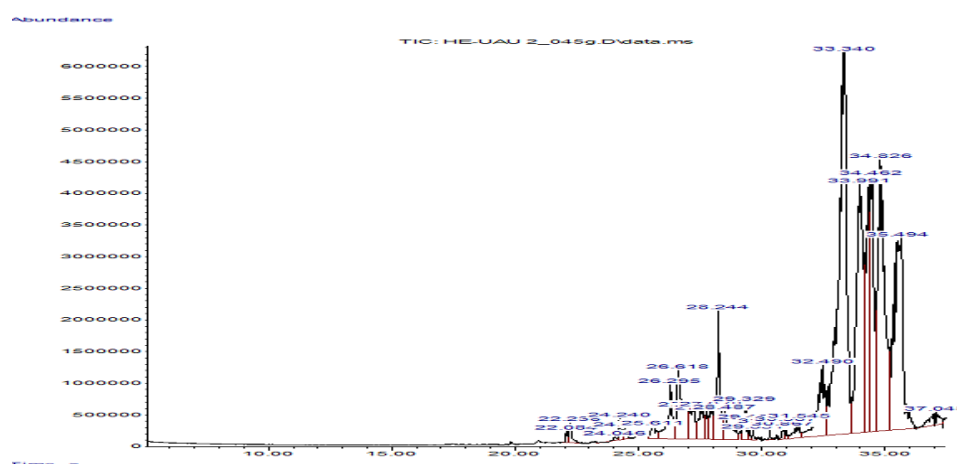


Figure 1: GC Spectrum of the *S. longipedunculata* Leaves Extract

Table 2: Phytocomponents of the *S. longipedunculata* Leaves Extract

Peak	RT (mins)	Area (%)	Molecular formula	Chemical Constituents
1	22.084	0.162	C ₁₇ H ₃₆	Heptadecane
2	22.238	0.395	C ₁₉ H ₄₀	Pentadecane, 2,6,10,14-tetramethyl-
3	24.046	0.075	C ₁₉ H ₃₆ Cl ₂ O ₂	Dichloroacetic acid, heptadecyl ester
4	24.240	0.345	C ₁₈ H ₃₈	Octadecane
5	24.443	0.201	C ₂₉ H ₆₀	2-methyloctacosane
6	25.611	0.485	C ₅ H ₁₁ NO	Butanal, 3-methyl-, oxime
7	26.295	1.878	C ₁₉ H ₄₀	Nonadecane
8	26.618	3.205	C ₁₇ H ₃₄ O ₂	Hexadecanoic acid, methyl ester
9	27.086	1.321	C ₉ H ₁₆ BrNO	2-Piperidinone, N-[4-bromo-n-butyl]-
10	27.616	1.387	C ₉ H ₁₆ BrNO	2-Piperidinone, N-[4-bromo-n-butyl]-
11	27.767	0.366	C ₁₇ H ₃₂ O ₂	7-Methyl-Z-tetradecen-1-ol acetate
12	27.978	0.807	C ₁₅ H ₂₈ O ₂	Z-8-Methyl-9-tetradecenoic acid
13	28.244	2.929	C ₂₀ H ₄₂	Eicosane
14	28.488	1.213	C ₁₈ H ₃₄ O ₂	Oleic Acid
15	29.329	0.758	C ₁₉ H ₃₆ O	trans-13-Octadecenoic acid, methyl ester
16	29.489	0.189	C ₂₁ H ₄₄	Heneicosane
17	29.651	0.099	C ₁₉ H ₃₈ O ₂	Methyl stearate
18	30.329	0.116	C ₂₂ H ₄₆	Docosane
19	30.867	0.191	C ₁₉ H ₃₆ O ₃	9-Octadecenoic acid, 12-hydroxy-, methyl ester, [R-(Z)]-
20	30.987	0.111	C ₂₃ H ₄₈	Tricosane
21	31.545	0.607	C ₂₄ H ₅₀	Tetracosane
22	32.490	3.556	C ₁₈ H ₃₆	1-Octadecene
23	33.340	23.871	C ₃₂ H ₅₂ O ₂	9,19-Cycloergost-24 (28)-en-3-ol, 4,14-dimethyl-, acetate, (3.β.,4.α.,5.α.)-
24	33.990	12.483	C ₃₂ H ₅₂ O ₂	Olean-12-en-3-ol, acetate, (3.β.)-
25	34.368	7.791	C ₁₈ H ₃₀ O ₂	5H-3,5a-Epoxy-naphth[2,1-c]oxepin, dodecahydro-3,8,8,11a-tetramethyl-, [3S-(3.α.,5a.α.,7a.α.,11a.β.,11b.α.)]
26	34.462	6.660	C ₂₂ H ₄₂ O ₂	Erucic acid
27	34.826	13.965	C ₃₂ H ₅₂ O ₂	Urs-12-en-3-ol, acetate, (3.β.)-
28	35.494	13.927	C ₃₀ H ₅₀ O	1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19,23-hexamethyl-, (all-E)-(+/-)-
29	37.048	0.911	C ₁₉ H ₃₆	1H-Indene, 5-butyl-6-hexyloctahydro-

3.2 Discussion

Gas chromatography–mass spectrometry (GC-MS) is an essential analytical technique used in the phytochemicals profiling of medicinal plants with pharmacological properties. This technique aids in the discovery of potential lead compounds, which can be further developed into innovative pharmaceutical medicines. The active phytochemicals, along with their corresponding Retention Time (RT) and Area (%) values (Table 2 and Figure 1) indicated the compounds identified and characterized through comparative analysis with NIST library and Pubchem database. The phytochemical investigation of *S. longipedunculata* identified twenty nine (29) peaks representing the presence of twenty nine (29) compounds with significant medicinal relevance. The most abundant compounds observed were 9,19-Cycloergost-24 (28)-en-3-ol, 4,14-dimethyl-, acetate, (3.β.,4.α.,5.α.)-, Urs-12-en-3-ol, acetate, (3.β.)-, 1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19, 23-hexamethyl-, (all-E)-(.+/-)-, Olean-12-en-3-ol, acetate, (3.β.)- collectively representing 64.246 % of the total area. This was followed by 5H-3,5a-Epoxynaphth[2,1-c]oxepin, dodecahydro-3,8,8,11a-tetramethyl-, [3S-(3.α.,5a.α., 7a.α.,11a.β.,11b.α.)], Erucic acid, 1-Octadecene, Eicosane, Hexadecanoic acid, methyl ester (24.141 %) and others (11.613 %).

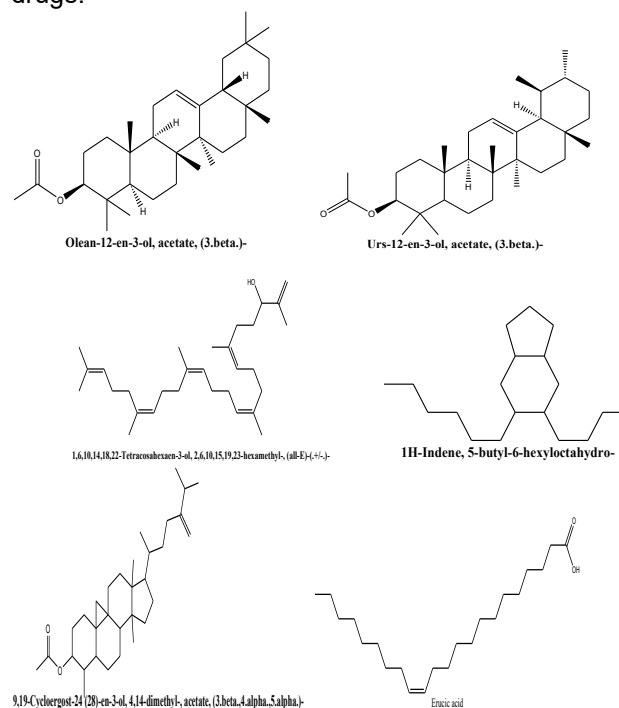
The medicinal plant's antibacterial property may be due to the high concentration of 9, 19-Cycloergost-24 (28)-en-3-ol, 4,14-dimethyl-, acetate, (3.β.,4.α.,5.α.)- and urs-12-en-3-ol, acetate, (3.β.)- Due to its well-established powerful antibacterial characteristics, it is effective against bacteria, yeast, and fungi. It possesses multiple pharmacological effects and has been discovered to hinder the growth of bacteria such as *Salmonella typhimurium* and *Staphylococcus aureus* (Koch and Lawson, 1996; Saravanan *et al.*, 2016). As stated by Arijit *et al.* (2021), the chemicals has demonstrated cancer preventive and anticancer properties in several types of cancers including breast, cutaneous, cervical, colorectal, esophageal, hepatic, prostate, and oral cancers.

Additionally, hexadecanoic acid, methyl ester is recommended to be a saturated fatty acid and it might act as an Antioxidant, hypocholesterolemic, anti-androgenic, hemolytic and alpha reductase inhibitor (Ravisankar and Christibai, 2017). 1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19,23-hexamethyl-, (all-E)-(.+/-)- is observed at RT 35.49 with a peak area of 13.93 %. The molecular weight of this compound is 426.7, and its formula is C₃₀H₅₀O. The compound has been shown to have antidote and anticancer properties (Davies and Stewart 1990), antitumor and in the treatment of eczema (Koch and Lawson, 1996). (Z)-docos-13-enoic acid (Erucic acid) increase zinc

bioavailability. Zinc is an essential element in the nutrition of human beings where it functions as an integral part of some enzymes, which play a central role in nucleic acid metabolism. In addition, Zinc is a membrane stabilizer and a stimulator of the immune response. Its deficiency leads to growth failure and poor development of gonadal function (Seal *et al.*, 2017).

(4,4,6a,6b,8a,11,11,14b-octamethyl 1,2,3,4a,5,6,7,8,9,10,12,12a,14,14a-tetradecahydro picen-3-yl) acetate serves as Allergenic, absorbent, ACE-inhibitors, acnegenic, additives etc (Duke 1992). These compounds are extensively documented for their pharmacological activities, including antimicrobial, antioxidant, anti-inflammatory, and anticancer properties (Dapar *et al.*, 2007). The presence of these metabolites offers significant evidence corroborating the ethnomedicinal applications of *S. longipedunculata* in the management of diverse infectious and inflammatory disorders.

Our prior study on the antimicrobial properties of *S. longipedunculata* (Hassan *et al.*, 2024) revealed substantial inhibitory effects of the plant extracts against all the test organisms. The significant antimicrobial activity noted in that study may be ascribed to the synergistic effects of the phytochemicals identified in the present GC–MS profile. Presence of these compounds gives a chemical explanation for the biological activity that was observed, which strengthens the therapeutic importance of *S. longipedunculata*. The link between the GC–MS findings and the antimicrobial results also showed that *S. longipedunculata* could be a natural source of antimicrobial agents, which could be used in the formulation of new phytotherapeutic drugs.



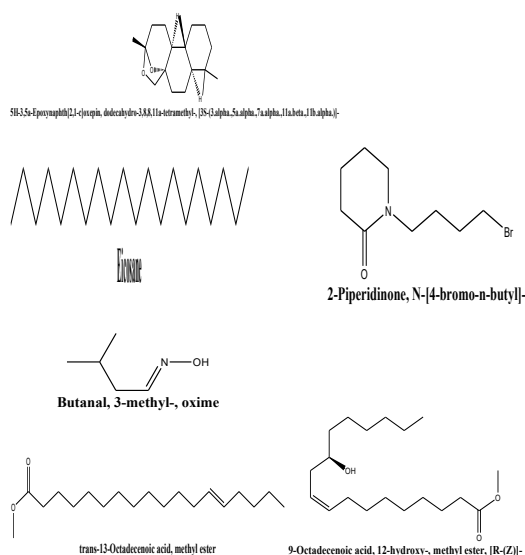


Figure 2: Chemical Structures of some compounds identified from the extract of *S. longipedunculata*

4. Conclusion

The results of this study revealed that the leaves of *S. longipedunculata* with diverse phytotherapeutic properties associated with rich phytochemicals identified from GC-MS analysis. The presence of these secondary metabolites provides scientific justification for the ethnomedicinal claims for traditional uses of the plant for management of several diseases. Further isolation and evaluation of the biological activity are required in order to utilise the medicinal potentials of the plant for applications in agrochemical, cosmetic, food and pharmaceutical industries.

Conflict of Interest

The authors declare no conflict of interest.

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