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Gas Chromatography-Mass Spectrometry (GC-MS) Analysis of Aqueous Extract of *Daniellia oliveri* Stem Bark

Ojochenemi E Yakubu*, Olawale Otitoju and Joshua Onwuka

Department of Biochemistry, Federal University Wukari, Nigeria

***Corresponding author:** Ojochenemi Ejeh Yakubu, Department of Biochemistry, Federal University Wukari, Nigeria, Tel: +81-78-803-6481; E-mail: oj4real_2007@yahoo.co.uk

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Abstract

A novel Gas Chromatography-Mass Spectrometry (GCMS) analysis of aqueous extract of *Daniellia oliveri* stem bark was performed to identify the composition and percentage abundance of the various phytochemical constituents of *Daniellia oliveri* stem bark. The extract was obtained using 1:4 (w/v) of the pulverized stem bark in distilled water. Gas Chromatography-Mass Spectrometry Analysis was carried out on a Perkin Elmer Turbo Mass Spectrophotometer while measurement of peak areas and data processing were carried out by Turbo-Mass-OCPTVS-Demo SPL software and spectrums of the components were compared with the database of spectrum of known components stored in the gas chromatography-mass spectrometry library. The phytochemical constituents identified are some fatty acids such as oleic acid, fatty acid methyl esters such as 1-(hydroxymethyl)-1, 2-ethanediyl ester and some volatile organic substances such as 1, 1, 1, 4-Tetramethyl-4-chloro-4-vinyl-1, 4-disilabutane. The presence of these compounds justifies the use of some parts of the plant for various elements in folklore and can be advised as a plant of phytopharmaceutical and industrial importance.

Keywords: GC-MS; Medicinal plants; *Daniellia oliveri*; Stem bark; Phytochemicals

Introduction

Awareness of medicinal plants usage is a result of the many years of struggles against illnesses due to which man learned to pursue drugs in barks, seeds, fruit bodies, leaves and other parts of the plants [1]. Ethnobotany (the study of traditional human uses of plants) is recognized as an effective way to discover future medicines. In 2001, researchers identified 122 compounds used in modern medicine which were derived from "ethnomedical" plant sources; 80% of these have had an ethnomedical use identical or related to the current use of the active elements of the plant [2]. It has been estimated that herbal medicines serve about 80% of the world's population health need for millions of people in the rural areas of developing countries and more than 65% of the global population use traditional medicine for basic health care [3].

In Africa, *Daniellia oliveri* is found in wooded savannahs but in the Sudano-Guinean zone, it is common in dry forests. This is a tall tree with conical crown whose shape is generally tapered [4]. It is a big tree of 18.29 m-24.38 m high and reaching 3.66 m in girth, sometimes larger. Bark pale grey, thick, much fissured, flaking off in large irregular thin patches; slash dark red with fine white streaks, exuding sweet smelling gummy, substance after sometime [5].

Materials and Method

Plant specimen

The stem bark of *D. olieveri* was collected within the premises of Federal University Wukari Taraba State. They were identified and authenticated in the Department of Biological Sciences, Federal University Wukari. The stem bark was rinsed; air dried at room temperature and pulverized using pestle and mortar.

Extraction

Exactly 270 g of the sample was weighed and dissolved in 1350 ml of distilled water (1:5 w/v) for 48 h after which it was filtered: first using a clean white sieving mesh and further with Whatman No. 1 filter paper. The filtrate was concentrated using a thermostat water cabinet at 40°C for days. The concentrated extracts were then transferred to air-tight containers, corked and preserved in the refrigerator at 4°C until required for the experiment [6].

Gas Chromatography-Mass Spectrometry (GC-MS) analysis

This was carried out on a Perkin Elmer Turbo Mass Spectrophotometer (Norwalk, CTO6859, and USA) which includes a Perkin Elmer Auto sampler XLGC (Table 1). The column used was Perkin Elmer Elite-5 capillary column measuring 30 m × 0.25 mm with a film thickness of 0.25 mm composed of 95% Dimethyl polysiloxane. The carrier gas used was Helium at a flow rate of 0.5 ml/min. 1 µl sample injection volume was utilized. The inlet temperature was maintained as 250°C. The oven temperature was programmed initially at 110°C for 4 min, then an increase to 240°C. And then programmed to increase to 280°C at a rate of 20°C ending with a 5 min. Total run time was 90 min. The Mass Spectrometry transfer line was maintained at a temperature of 200°C. The source temperature was maintained at 180°C. Gas Chromatography-Mass Spectrometry was analysed using electron impact ionization at 70 eV and data was evaluated using total ion count (TIC) for compound identification and quantification. The spectrums of the components were compared with the database of spectrum of known components stored in the GC-MS library. Measurement of peak areas and data processing were carried out by Turbo-Mass-OCPTVS-Demo SPL software [7].

Results and Discussion

The aqueous extract of *Daniellia oliveri* stem bark revealed several peaks which represents different compounds as shown in the total ion chromatogram by Gas Chromatography-Mass Spectrometry analysis. The peaks in the chromatogram were integrated and were compared with the database of spectrum of known components stored in the Gas Chromatography-Mass Spectrometry library.

Gas Chromatography-Mass Spectrometry analysis of the aqueous extract of *Daniellia oliveri* stem bark revealed the presence of different fatty acids, fatty acids methyl esters and some volatile organic compounds. Glycidyl palmitate is a fatty acid with the molecular formula C19H36O3 is essential in the preparation of lysophosphatidic acids which inhibit apoptosis. Heptadecanolide is a fatty acid with the molecular formula C17H32O2 is a component of flavouring agent and perfumes [8].

Dodecanoic acid, 1-(hydroxymethyl)-1, 2-ethanediyl ester is a fatty acid ester with the molecular formula C35H68O5 which is used as emulsifiers for cream, milky lotion and hair conditioner. Tetrahydrofuran-2-carboxylic acid, dibenzofuran-3-ylamide is a volatile organic compound is a component of chemotherapeutic agents. Lauric anhydride is a fatty acid with the molecular formula C24H46O3 which is used to increase high density lipoprotein, investigate molar mass of unknown substance, **treatment of wool in presence of cresol and in wafer form as a carrier in the study of drug release.**

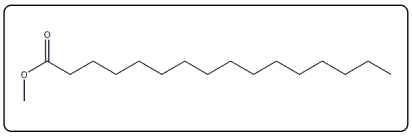
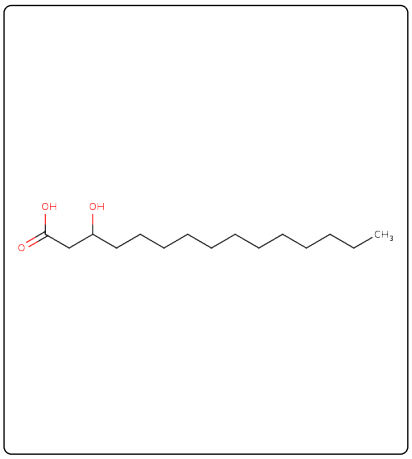
Tetradecanoic acid is a fatty acid with the molecular formula $C_{14}H_{28}O_2$ which are lipid anchors in biomembranes [9]. Vanadium, (eta.7-cycloheptatrienylium) (eta.5-2, 4-cyclopentadien-1-yl)-is a volatile organic compound with the molecular formula $C_{12}H_{12}V$-8 which enhances nutrient uptake in plants. cis-Vaccenic acid is a fatty acid with the molecular formula C18H34O2 which lowers total cholesterol and triglycerides levels.

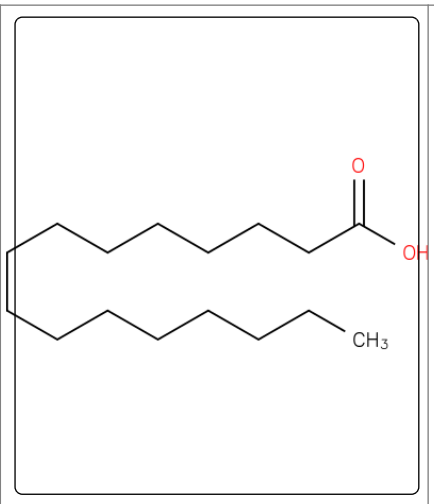
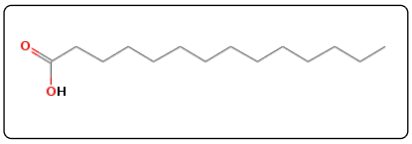
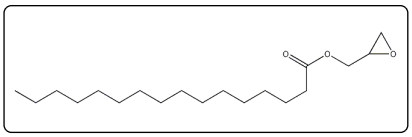
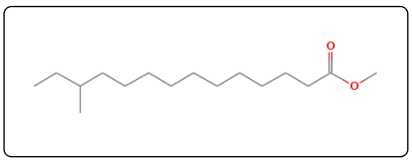
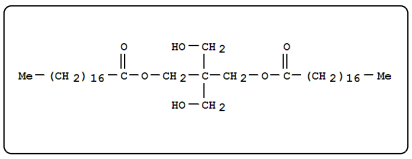
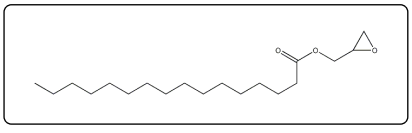
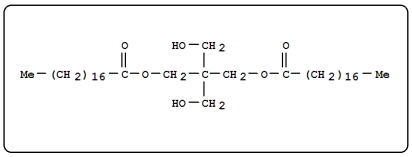
Dodecanoic acid, 1-(hydroxymethyl)-1, 2-ethanediyl ester is a fatty acid ester which is used as emulsifiers for cream, milky lotion and hair conditioner is an important raw material in the cosmetic industry.

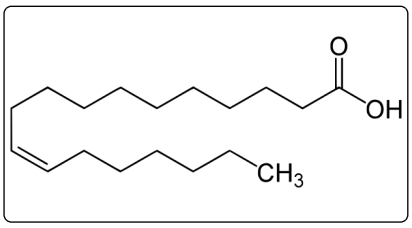
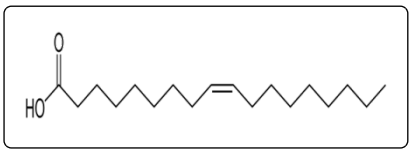
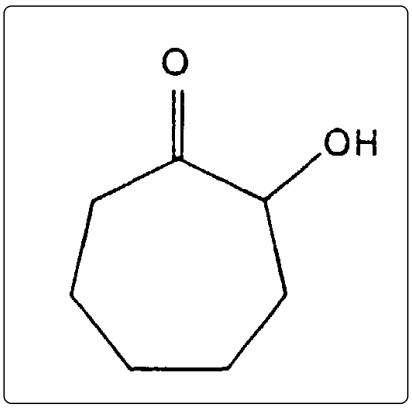
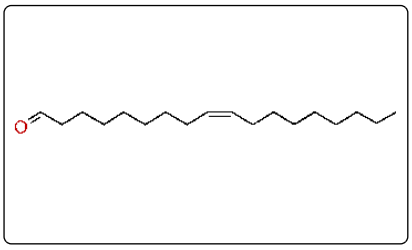
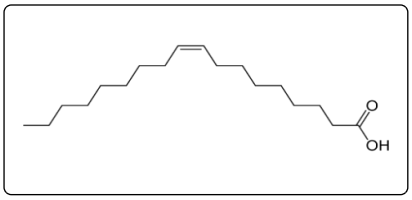
Lauric anhydride is a fatty acid which is used to increase high density lipoprotein, investigate molar mass of unknown substance, treatment of wool in presence of cresol and in wafer form as a carrier in the study of drug release; is an important part of human diet and used in analytical chemistry. Tetrahydrofuran-2-carboxylic acid, dibenzofuran-3-ylamide is a volatile organic compound used in chemotherapy. In the food industry, Heptadecanolide is an important component of food additive.

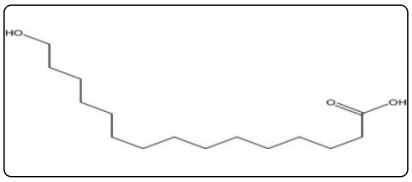
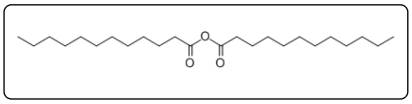
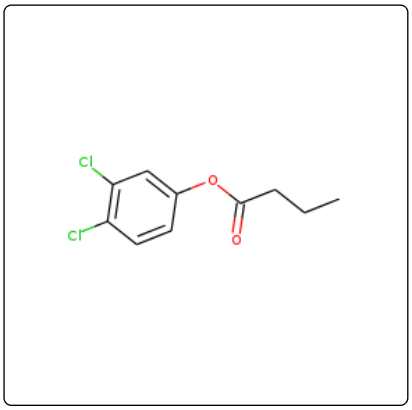
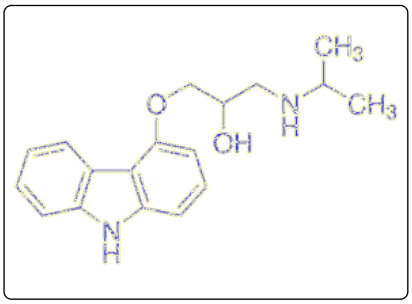
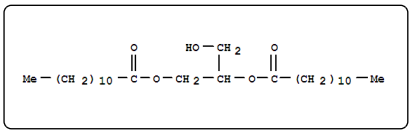
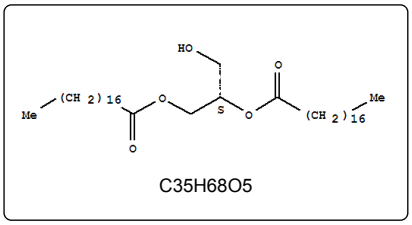
Conclusion

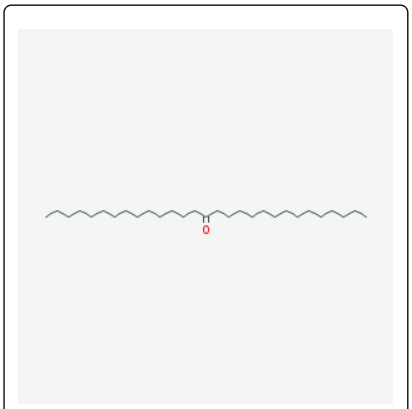
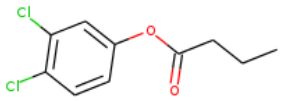
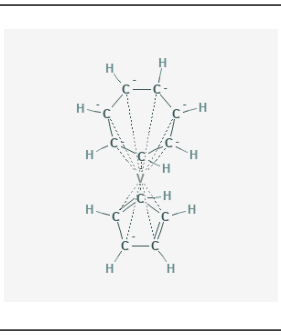
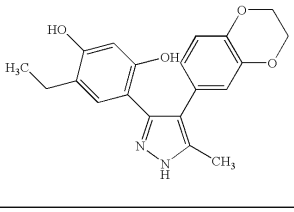
Plants are natural reservoirs of several phytonutrients and compounds which are inevitable and essential to life in general. The phytochemical constituents of aqueous extract of *Daniellia oliveri* stem bark revealed by Gas Chromatography-Mass Spectrometry **analysis depicts its importance in folklore, phytopharmaceuticals, cosmetic and food industries (Figure 1).**

Peak	Retention time	IUPAC name	Chemical structure	Nature and uses
1	32.3716	n-Hexadecanoic acid	 C16H32O2	Fatty acid; soaps, cosmetics
2	32.7906	15-Hydroxypentadecanoic acid	 C15H30O3	Fatty acid; lactonization, ω-hydroxyl-ase studies

3	33.0809	n-Hexadecanoic acid	 C16H32O2	Fatty acid; as an anti-inflammatory agent and antioxidant
4	33.1148	Tetradecanoic acid	 C14H28O2	Fatty acid; lipid anchor in biomembranes, topical medicinal preparations
5	36.9148	Glycidyl palmitate	 C19H36O3	Fatty acid; preparation of lysophosphatidic acids which inhibit apoptosis,
6	37.0637	Tetradecanoic acid	 C14H28O2	Fatty acid; component of cosmetics, shaving cream
7	39.8625	Octadecanoic acid, 2-hydroxy-1, 3-propanediyl ester	 C39H76O5	Fatty acid; antiseptic and haemostatic activity
8	40.6906	Glycidyl palmitate	 C19H36O3	Fatty acid; preparation of lysophosphatidic acids which inhibit apoptosis
9	40.9025	Octadecanoic acid, 2-hydroxy-1, 3-propanediyl ester		Fatty acid; Fatty acid; antiseptic and haemostatic activity

			C39H76O5	
10	42.0927	cis-Vaccenic acid	 C18H34O2	Fatty acid; lowers total cholesterol and triglycerides levels
11	42.8762	Oleic acid	 C18H34O2	Fatty acid; as emulsifying agent, as an emollient
12	42.9755	Cyclopentadecanone, 2-hydroxy-	 C15H28O2	Volatile organic compound; component of paint, varnishes and glue
13	43.7866	9-Octadecenal, (Z)-	 C18H34O	Volatile organic compound; component of flavouring agent in foods
14	43.9923	trans-13-Octadecenoic acid	 C18H34O2	Fatty acid; component of margarines

15	44.1598	15-Hydroxypentadecanoic acid	 C15H30O3	Fatty acid; lactonization, ω-hydroxylase studies
16	44.2778	Lauric anhydride	 C24H46O3	Fatty acid; increase high density lipoprotein, investigate molar mass of unknown substance
17	44.5425	Lauric acid, 3, 4-dichlorophenyl ester	 C10H10Cl2O2	Fatty acid; refatting agents for cosmetic formulations
18	44.6384	Carazolol	 C18H22N2O2	Pale yellow crystalline powder; act as beta adrenoceptor antagonist to prevent stress, to alleviate stress
19	44.8747	Dodecanoic acid, 1-(hydroxymethyl)-1, 2-ethanediyl ester	 C35H68O5	Fatty acid; used as emulsifiers for cream, milky lotion and hair conditioner.
20	45.1196	Dodecanoic acid, 1-(hydroxymethyl)-1, 2-ethanediyl ester	 C35H68O5	Fatty acid; as superfattening agent, thickeners and reforming agent.

21	46.2486	Nonacosan-14-one	 C29H58O	As a composition of wax; prevent dehydration
22	46.9733	Lauric acid, 3, 4-dichlorophenyl ester	 C10H10Cl2O2	Fatty acid; refatting agents for cosmetic formulations
23	48.3694	Vanadium, (.eta.7-cycloheptatrienylium)(.eta.5-2, 4-cyclopentadien-1-yl)-	 C12H12V-8	Enhance nutrient uptake in plant
24	48.9428	Tetrahydrofuran-2-carboxylic acid, dibenzofuran-3-ylamide		Component of chemotherapeutic agents

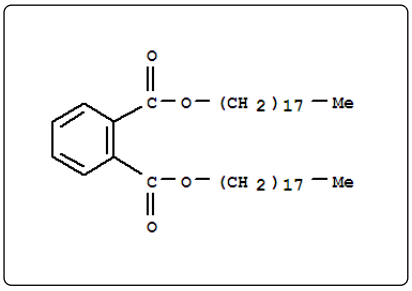
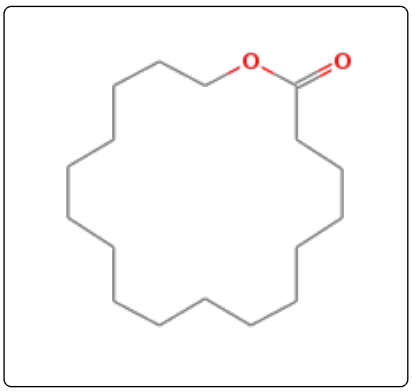
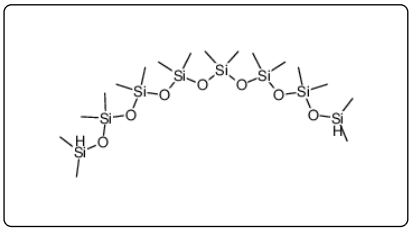
25	49.243	Dodecanoic acid, 1-(hydroxymethyl)-1, 2-ethanediyl ester	 C35H68O5	Fatty acid; as superfattening agent, thickeners and reforming agent.
26	49.6507	Heptadecanolide	 C17H32O2	Fatty acid; flavouring agent, as perfume
27	50.8762	Octasiloxane, 1, 1, 3, 3, 5, 5, 7,7, 9, 9, 11, 11, 13, 13, 15, 15-hexadecamethyl	 C16H48O7Si8	Volatile organic compound; Anti microbial activity

Table 1: Different compounds obtained from Gas Chromatography-Mass Spectrometry analysis of aqueous extract of *Daniellia oliveri* stem bark.

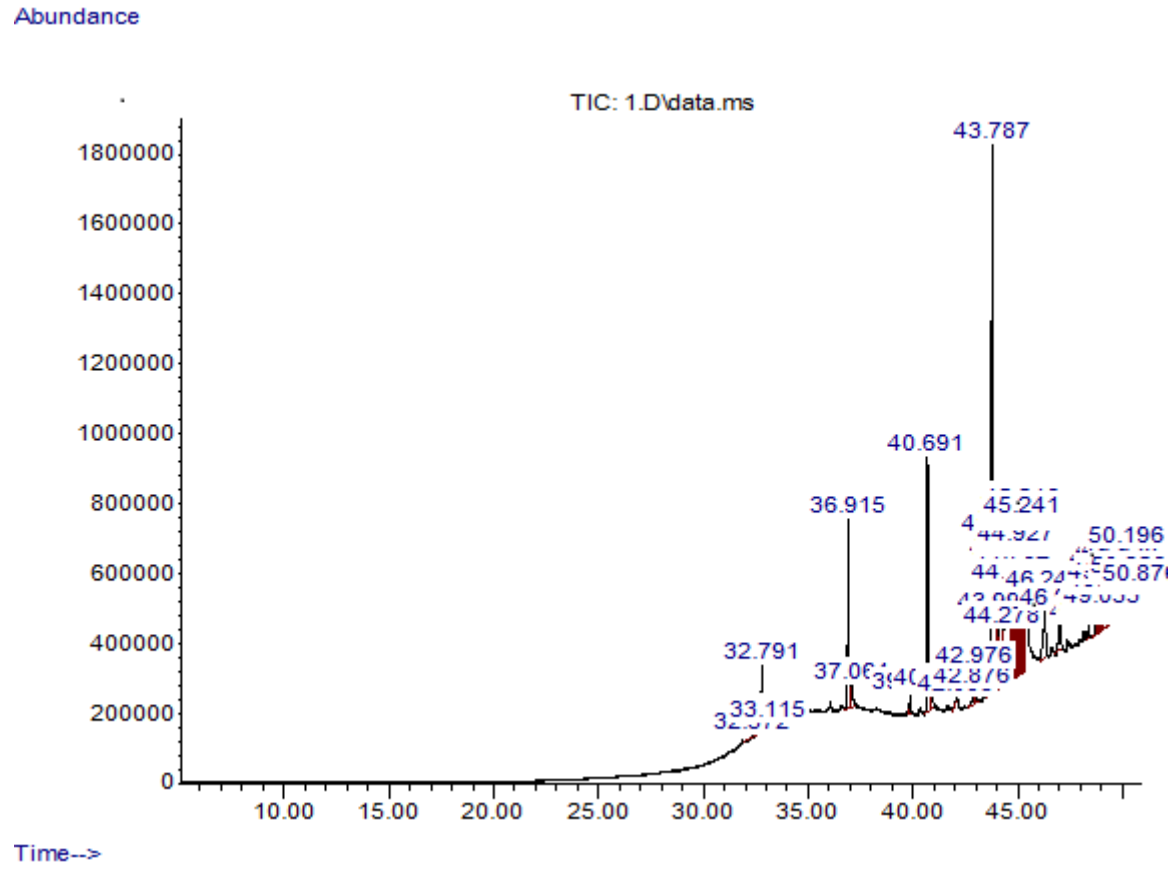


Figure 1: Total ion chromatogram of aqueous extract of *Daniellia oliveri* stem bark.

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