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Research Paper

Analysis of Essential Oil from the Stem of *Chansmanthera dependens*

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ABSTRACT

The essential oil from the stems of *Chasmanthera dependens* was obtained by hydro-distillation and collected into hexane. Analysis of the oil was carried out on a combined gas chromatograph–mass spectrometer equipped with an HP-5 MS (5% phenylmethsiloxane) capillary column at a temperature programme of 120^0C (5 min) increased at 5^0C /min to 320^oC and held for 5 min. Two components n-hexadecanoic acid and oleic acid eluted at retention times 21.413 and 24.308 min respectively amounted to a total concentration of 56.92%. Some other minor components, namely, tetradecanoic acid, 1, 2-benzenedicarboxylic acid butyl-8-methylnonylester, heptadecanoic acid and estra-1, 3, 5(10)-trien-17á-ol, a steroid, were identified. Some of these components have been reported to have antibacterial, antifungal, antiviral and anti-inflammatory activities.

Keywords: *Chasmanthera dependens*; Stem; Essential oil; GC-MS; Medicinal properties.

INTRODUCTION

Chasmanthera dependens (Hochst), (Family-*Menispermaceae*) commonly called Chasmanthera, is a medicinal plant used for the treatment of several diseases that include red-eye infections (Ogunlesi, et al., 2008), veneral diseases and management of fractures (Odugbemi, 2008) and as a general tonic for physical and nervous debilities (Iwu, et al., 1999). The methanolic extract of the dried leaves has also been reported to have anti-inflammatory and analgesic effects on laboratory animals (Onabanjo, et al., 1991; Morebise, et al., 2001) while the aqueous and ethanolic crude extracts of the leaves have been reported to have antifungal activity (Adekunle and Okoli, 2002). The constituents of the plant include berberine-type alkaloids, palmatine, colombamine and jateorhizine (Iwu, et al., 1999). A phytochemical investigation of the stem led to the isolation of quaternary alkaloids including pseudocolumbamine, magnoflorine and non-phenolic alkaloids including tetrahydropalmatine, liriodenine, lysicamine, oxoglaucine, glaucine, anonaine, nornuciferine, norglaucine and O, O-dimethlcorytuberine (Ohiri, et al., 1982). Berberine sulphate in the plant has been reported to inhibit leishmania (Iwu, et al., 1999). A furanoid diterpene, 8-hydroxlcolombin, was isolated from the bark of

Chasmanthera dependens (Oguakwa, et al., 1986). The aqueous extract of the leaves mixed with local alcohol is claimed to be aphrodisiac (Chukwuma, 2008).
The purpose of this study is to identify the constituent compounds present in the essential oil obtained from the stem and discuss their relevance to the medicinal uses of the plant.

MATERIALS AND METHODS

***Sample collection*:** Several batches of fresh plant samples were collected from Olokemeji Forest Reserve, Oyo State, Nigeria in August 2008 and were identified by Mr. Olufemi Shasanya of Forestry Research Institute of Nigeria (FRIN), Ibadan. A voucher specimen no. FHI 107965 was deposited at FRIN.
***Hydro-distillation of samples*:** Batches of 3.5 kg of the fresh stem were cut into small pieces, air-dried at room temperature in a dust-free environment and pulverized yielding 900 g of fine powder. A batch of 100 g of the powder was mixed with 3 L of water in a 5 L round-bottomed flask and subjected to hydro-distillation for 4 h and the essential oil obtained was collected into hexane, yielding a pale-yellow liquid. The hexane layer was isolated and concentrated by evaporation.
GC-MS analysis of Oil: Analysis of the essential oil was carried out by injecting 2 µL on gas chromatograph Model HP6890 and MS model 5973 series (Agilent Technologies Ltd) fitted with HP-5 MS (5% phenylmethylsiloxane) capillary column 30 m x 250 µm x 0.25 µm. Automatic injection in splitless mode was adopted. Helium was used as carrier gas. Initial column temperature was 120^{o}C, held for 5 min and increased at 5^{o}C /min to 320^{o}C and held for 5 min. For the MS, electron impact ionization was carried out at 70 ev. Identification of the constituent compounds was by the Chem-Office software along with the MS library.

RESULTS

The gas chromatogram of the essential oil obtained from *Chasmanthera dependens* is shown in Figure 1 and the constituent compounds having abundances above 1% of total with their corresponding mass spectra are reported in Table-1.

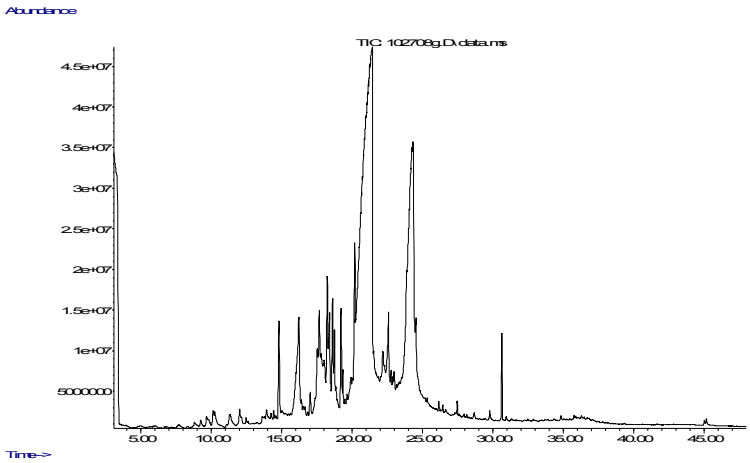

Figure-1: The gas chromatogram of the essential oil from the dried stem of *Chasmanthera dependens*.

The two major compounds present in the oil are n-hexadecanoic acid, a fatty acid, (R_T 21.413; 38.72%) and oleic acid, an unsaturated fatty acid, (R_T 24.308; 18.20%) both constituting 56.92% of total. Nine other compounds constituting 17.79% of total are tetradecanoic acid, a fatty acid, (R_T 16.000; 3.54%), 1,2-

benzenedicarboxylic acid butyl-8-methylnonylester (R_T 20.171; 2.34%), heptadecanoic acid, a fatty acid, (R_T 22.576; 2.34%), phthalic acid butyltetradecylester (R_T 18.226; 1.90%), pentadecanoic acid, a fatty acid, (R_T 18.395; 1.78%), cis 3-octyl oxtra neotanoic acid, a fatty acid epoxide (R_T 17.529; 1.65%), estra-1,3,5 (10)-trien-17á-ol, a steroid, (R_T 22.176; 1.53%), 9,17-octadecadienal (Z), a long chain unsaturated aldehyde, (R_T 18.599; 1.51%) and 13-heptadecyn-1-ol, a long chain unsaturated alcohol, (R_T 14.827; 1.20%). All the eleven compounds add up to 74.71% of total.

DISCUSSION

The constituent compounds in the essential oil are long chain aliphatic carboxylic acids, (saturated and unsaturated) and their derivatives including alcohols, aldehyde as well as benzene carboxylic acid ester and a steroidal compound.

It is now pertinent to identify the possible roles of these constituent compounds in the curative properties attributed to the plant by herbal medical practitioners. Oleic acid is an unsaturated fatty acid present in several plants and being unsaturated is considered as a healthy source of fat in the diet. Many fatty acids are known to have antibacterial and antifungal properties (Russel, 1991). Dodecanoic acid, tetradecanoic acid, hexadecanoic acid, octadecanoic acid and oleic acids are among the fatty acids known to have potential antibacterial and antifungal activity (McGraw, et al., 2002; Seidel and Taylor, 2004).

Oleic acid has been found to be fungistatic against a wide spectrum of moulds and yeasts. For example, it was observed to cause a delay of 6-8 h in the germination of fungal spores, and was also found to be effective at concentrations as low as 0.7% v/v (Sheba, et al., 1999). It has also been proposed that these fatty acids have potential antibacterial and antifungal principle for clinical application (Altieri, et al., 2008). Triterpene-fatty acid esters and free fatty acids including long chain C16-C20 unsaturated fatty acids were suggested to be responsible for the anti-inflammatory activity in the extract from *Tinospora smilacina,* Benth, also of the Menispermaceae family (Li, et al., 2004).

Unsaturated monoglycerides alcohols of chain length of 16 or 18 carbons were found to be extremely potent inactivators of two envelope viruses, herpes simplex virus type 2 and bacteriophage φ6. Treatment of herpes simplex virus type 2 with these compounds at concentrations as low as 0.2µM reduced virus survival to 50% in 30 min (Sands, et al., 1979). The constituent, 13-heptadelyn-1-ol is a long chain unsaturated alcohol and the essential oil can therefore be expected to exhibit activity against the viruses thus investigated in the study.

Estra-1, 3, 5 (10)-trien-17á-ol is a steroid but differs from estradiol, a sex hormone, in the absence of an OH group at C3. Steroids, though similar in basic structure, have extreme specificity (Bruice, 1998) hence the steroid in the essential oil cannot be said to function like estradiol.

Epoxy fatty acids have been reported to have fungicidal properties in rice (Stark, et al., 1995). Cis 3-octyl-oxtra neotanoic acid is synonymous with 9, 10 epoxy-stearic acid hence will be expected to exhibit fungistatic activity.

In this study, the essential oil of the plant has been found to contain about 60% tetradecanoic, hexadecanoic and oleic acids, as well as long chain unsaturated alcohol and hence would be expected to exercise potent antibacterial (McGraw, et al., 2002), antifungal (Sheba, et al., 1999), antiviral (Sands, et al., 1979) and anti-inflammatory (Li, et al., 2004) properties which would therefore be effective in the management of some eye infections and other bacterial, fungal and viral infections. The anti-

inflammatory (Li, et al., 2004) activity would give relief in cases of sprained joints and general body pains as acclaimed by herbal medical practitioners.

CONCLUSION

The major components of the essential oil of *C. dependens* are n-hexadecanoic acid and oleic acid which are fatty acids constituting 56.92% of total. The minor components include three fatty acids namely tetradecanoic acid, pentadecanoic acid and heptadecanoic acid; a fatty acid epoxide, cis 3-octyl oxtra neotanoic acid; a long chain unsaturated fatty acid alcohol, 13-heptadecyn-1-ol, a long chain unsaturated aldehyde, 9, 17-octadecadienal, a steroid, estra-1,3,5 (10)-trien-17á-ol; carboxylic fatty acid esters namely 1,2-benzenedicarboxylic acid butyl-8-methyl nonyl ester and phthalic acid butyl tetradecyl ester.

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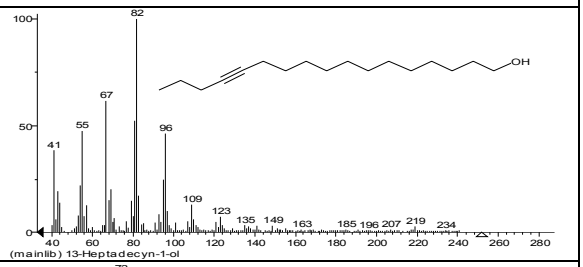
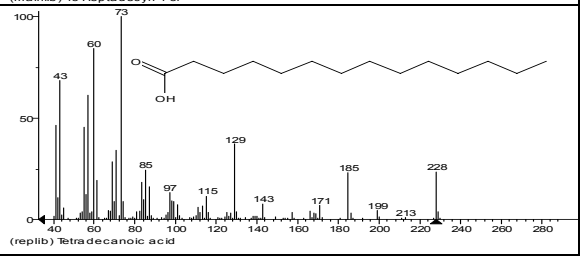
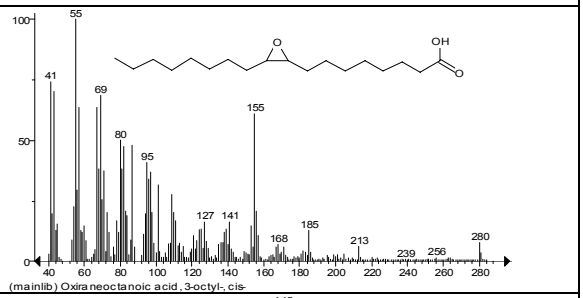
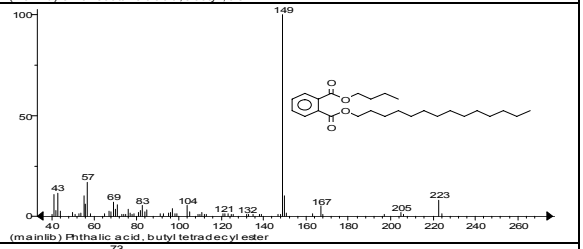
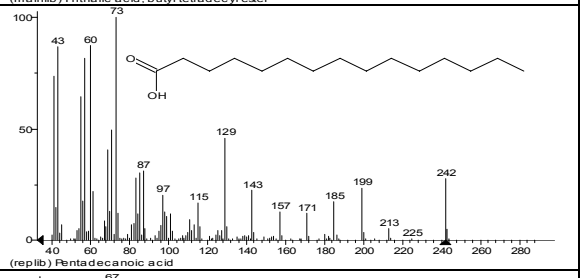
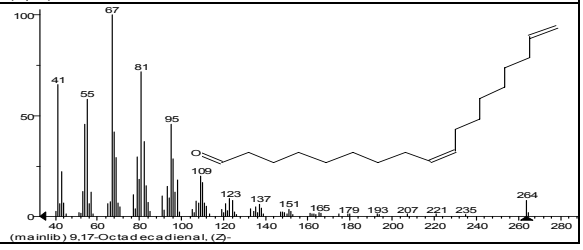
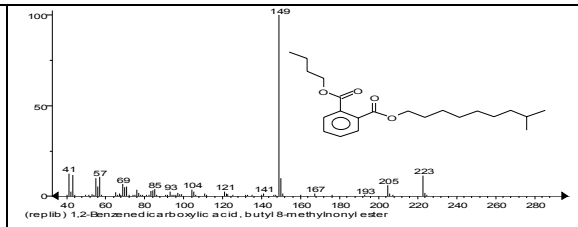
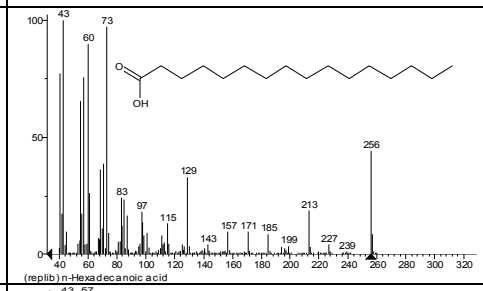
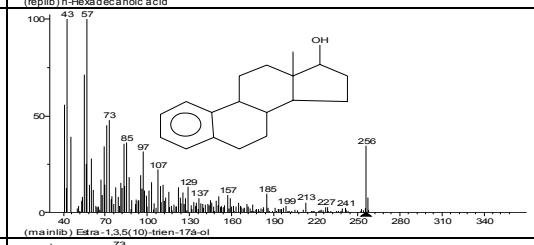
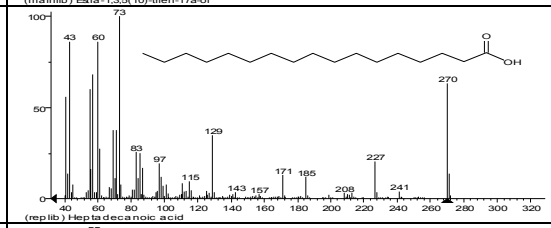
Table-1: GC-MS analysis of the essential oil of *Chasmanthera dependens* stem.

SN	Retention Time	Percentage of Total	Compound	Structure
1.	14.827	1.20	13-heptadecyn-1-ol	
2.	16.000	3.54	Tetradecanoic acid	
3.	17.529	1.65	cis 3-octyl- oxtra neotanoic acid,	
4.	18.226	1.90	Phthalic acid,butyl tetradecylester	
5.	18.395	1.78	Pentadecanoic acid	
6.	18.599	1.51	9,17-octadecadienal, (Z)-	

7.	20.171	2.34	1,2-benzenedicarboxylic acid,buty 8-methylnonylester	
8.	21.413	38.72	n-Hexadecanoic acid	
9	22.176	1.53	Estra-1,3,5(10)-trien-17á-ol	
10.	22.576	2.34	Heptadecanoic acid	
11.	24.308	18.20	Oleic acid