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Constituents and Antimicrobial Activity of Sudanese *Sterculia setigera* Oil

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Abstract *Sterculia setigera* is a rich source of alkaloids, saponins and flavonoids. These phytochemicals showed a wide spectrum of biological activities including: antioxidant, antiinflammatory, antimicrobial, insecticidal and cytotoxic activities.

Sterculia setigera is a key species in African system of medicine. It is also used in human nutrition and cosmetics. In this study the GC-MS analysis of *Sterculia setigera* oil revealed the presence of 20 components. Major constituents are: i)-cis-9-hexadecenal (32.66%); ii)-oleic acid (20.29%). The antimicrobial potential of the oil has been assessed using the agar diffusion bioassay. *Sterculia setigera* oil showed partial activity against *Staphylococcus aureus* and *Escherichia coli*.

Keywords *Sterculia speciesare*, GC-MS analysis, Antimicrobial Activity

Introduction

Sterculia is considered as one of the largest Malvaceae genera, with about 300 species[1]. *Sterculia setigera* is a tree belonging to the family Sterculiaceae which comprises more than one thousand species.[1] *Sterculia setigera* is widely distributed in savannah areas of tropical Africa [1-4]. This plant may grow up to 24m in height. Wood is fibrous and has high moisture content [5]. *Sterculia setigera* has a wide distribution in savanna woodland of Sudan [6].

Sterculia setigera is a rich source in alkaloids, saponins and flavonoids. These phytochemicals showed a wide spectrum of biological activities including: antioxidant, anti-inflammatory, antimicrobial, insecticidal and cytotoxic activities [7-9].

Sterculia setigera is a key species in African system of medicine. It is also used in human nutrition and cosmetics [10-13]. For some African ethnic groups, this plant has a cultural importance [11, 14-15].

Root bark and fruits of *Sterculia setigera* are used traditionally against boils, inflammation, chickenpox, measles, dysentery, syphilis, epilepsy, jaundice, malaria and leprosy. Leaves are used for the treatment of infections [16-17]. Stem bark decoction is a natural remedy for asthma, bronchitis, wounds, fever, toothache, gingivitis, abscess, and diarrhea [18-20]. In Sudanese ethnomedicine, bark is used as a remedy for jaundice [21, 22] and wounds [23]. Stem bark decoction is traditionally claimed to treat diarrhea [21] and dysentery [24-25].

Materials and Methods

Plant material

Sterculia setigera seeds were collected from, Folla, western Sudan. The plant was authenticated by the Medicinal and Aromatic Plants Research Institute, Khartoum, Sudan.

Instruments

For GC-MS analysis a Shimadzo GC-MS-QP2010 Ultra instrument with RTX-5MS column (30m length; 0.25mm diameter; 0.25 µm, thickness) was used**.**

Test organisms

Test organisms used for antimicrobial assay are: *Bacillus subtilis* (Gram +ve), *Staphylococcus aureus* (Gram +ve), *Pseudomonas aeroginosa* (Gram –ve), *Escherichia coli* (Gram –ve) and the fungal species *Candida albicans.*

Methods

Extraction of oil

Powdered shade –dried seeds of *Sterculia setigera* (350g) were extracted-by maceration- with n-hexane. The solvent was removed under reduced pressure yielding the oil.

Antimicrobial assay

The oil was assessed for antimicrobial activity against five standard pathogenic bacteria (*Escherichia coli, Bacillus subtilis, Staphylococcus aureu, Pseudomonas aeruginosa* and *Candida albicans*).

The paper disc diffusion method was used to screen the antimicrobial activity of the oil and performed by using Mueller Hinton agar (MHA)-for bacterial culture- and Sabouraud dextrose agar for fungal culture. Bacterial suspension was diluted with sterile physiological solution to 10^8cfu/ ml (turbidity = McFarland standard 0.5). One hundred microliters of bacterial suspension were swabbed uniformly on surface of MHA and the inoculum was allowed to dry for 5 minutes. Sterilized filter paper discs (Whatman No.1, 6 mm in diameter) were placed on the surface of the MHA and soaked with 100mg/ml of a solution of the oil. The inoculated plates were incubated at 37 °C for 24 h in the inverted position. The diameters (mm) of the inhibition zones were measured. For fungus incubation continued for 72h at 25^{o}C.

Results and Discussion

The total ion chromatograms of *Sterculia setigera* oil is shown in Fig. 1 and the constituents of the oil are depicted in Table 1. The GC-MS analysis revealed the presence of 20 components.

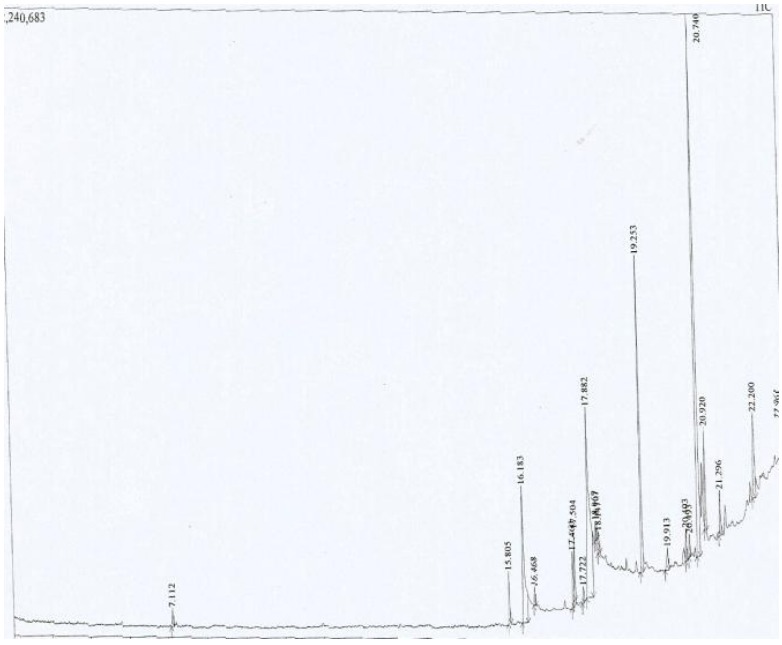

Figure 1: Total ion chromatograms

Table 1: Constituents of *Sterculia setigera* oil

No.	R. Time	Area %	Name
1	7.112	0.66	Alpha-Terpineol
2	15.805	1.72	Hexdecanoic acid methyl ester
3	16.183	10.07	Pentadecanoic acid methyl ester
4	16.468	0.59	Hexadecanoic acid ethyl ester
5	17.460	1.96	9,12-Octadecadienoic acid (Z,Z)-methyl ester
6	17.504	2.17	9-Octadecenoic acid (Z) methyl ester
7	17.722	0.59	Methyl stearate
8	17.882	20.29	Oleic acid
9	18.067	0.71	9,12-Octadecadienoic acid(Z)-methyl ester
10	18.107	0.52	Ethyl oleate
11	18.147	0.81	Methyl 2-octylcyclopropene-1-octanoate
12	19.253	12.39	1-(+)-Ascorbic acid 2,6-dihexadecanoate
13	19.913	1.28	9-Octadecenoic acid, 1,2,3-propanetriyl ester
14	20.403	1.08	Phenol , 2,2`-methylene – bis 6–(1,1–dimethyl)–4–ethyl-
15	20.493	0.71	Methyl 10-trans, 12-cis-octadecadienoate
16	20.740	32.66	Cis-9-Hexadecenal
17	20.920	3.49	Tristearin
18	21.296	1.78	E-11(12-Cyclopropyl)dodecen-1-ol acetate
19	22.200	4.70	Cis-6-Octadecenoic acid, trimethyl silyl ester
20	22.961	1.80	Decyl sulfide
		100.00	

The following components were detected as major constituents:

i)-cis-9-Hexadecenal (32.66%)

ii)-Oleic acid (20.29%)

Fig. 2 represents the mass spectrum of cis-9-Hexadecenal. The peak at m/z 236 (RT, 20.740) is attributed to: M^+ $[C_{16}H_{30}O]^+$ - 2H. The mass spectrum of oleic acid is presented in Fig. 3. The signal at m/z 282 (RT.17.882) is due to the molecular ion: $M^+[C_{18}H_{34}O_2]^+$, while the peak at m/z 265 accounts for loss of a hydroxyl function.

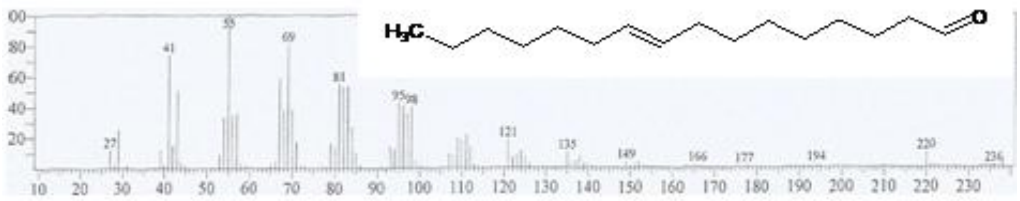

Figure 2: Mass spectrum of cis-9-hexadecenal

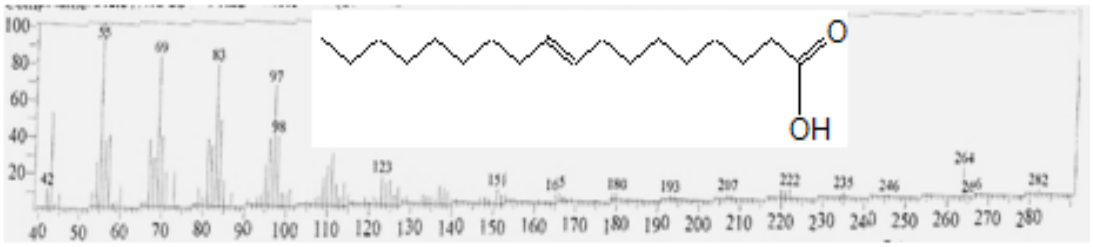

Figure 3: Mass spectrum of oleic acid

Antimicrobial activity

The oil was screened for antimicrobial activity against five standard microorganisms (Table 2). The results are depicted in Table 3. Results were interpreted in the following conventional terms: (<9mm: inative; 9-12mm: partially active; 13-18 mm: active; >18mm: very active). *Sterculia speciesare* oil showed partial activity against *Staphylococcus aureus* and *Escherichia coli*.

Table 2: Test organisms

No	Micro organism	Type	Source
1	*Bacillus subtillus*	G+ve	ATCC 2836
2	*Staphylococcus aureus*	G+ve	ATCC 29213
3	*Pseudomonas aeroginosa*	G-ve	NCTC 27853
4	*Escherichia coli*	G-ve	ATCC 25922
5	*Candida albicans*	fungi	ATCC 7596

* NCTC. National collection of type culture, Colindale, England

*ATCC. American type culture collection, Maryland, USA

Table 3: Inhibition zones of the oil

Sample	Sa	Bs	Ec	Ps	Ca
Oil(100mg/ml)	10	--	9	7	--

Sa.: *Staphylococcus aureus,* Ec.: *Escherichia coli,* Pa.: *Pseudomonas aeruginosa,* Bs.: *Bacillus subtilis;* Ca.: *Candida albicans*

Table 4: Inhibition zones of standard drugs

Drug	Sa	Bs	Ec	Ps	Ca
Ampicilin (40mg/ml)	30	15	--	--	--
Gentamicin (40mg/ml)	19	25	22	21	--
Clotrimazole (30mg/ml)	--	--	--	--	38

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