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Research Article

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Antimicrobial Activity of *Solanum melongena* L. (Solanaceae) Grown in Sudan

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Abstract In this study the GC-MS analysis of the studied *Solanum melongena* oil revealed the presence of 16 components. Constituents which appeared in total ions chromatogram as major components are: 9, 12-octadecadienoic acid methyl ester (47.38%); 9-octadecenoic acid methyl ester (21.71%); hexadecanoic acid is a major constituent (15.54%) and methyl stearate (9.63%). The oil was evaluated for its antimicrobial activity. It showed significant activity against G+ve *Bacillus subtilis*, moderate activity against *Staphylococcus aureus* and *Escherichia coli*. Ampicilin, gentamycin and clotrimazole were used as positive controls and DMSO as negative control.

Keywords *Solanum melongena*, Oil, GC-MS Analysis, Antimicrobial Activity

Introduction

Solanum melongena is a flowering plant in the family Solanaceae which comprises 75 genera and more than 2000 species [1]. Members of this family are known for their nutritional and medicinal values [2]. Various parts of *Solanum melongena* are used traditionally against inflammation, neuralgia, cholera, nose ulcers and asthma [3].

The leaves of *Solanum melongena* contain acids (chlorogenic, hydrocaffeic and protocatechuric acids), alkaloids and flavonoids while seeds contain among others saponins [4]. The alkaloid fraction of seeds exhibited significant analgesic effect [5]. Leaves demonstrated a dose-dependent analgesic property [6]. Leaves also showed significant *in vivo* antipyretic activity [3].

The antioxidant potential of *Solanum melongena* fruits has been reported [6]. A Significant antiinflammatory activity of the aqueous extract has been demonstrated [7]. *Solanum melongena* fruits significantly reduced asthma symptoms [8]. Some flavonoids isolated from this plant showed significant hypolipidaemic activity [9]. It has been shown that *Solanum melongena* could be beneficial for patients suffering from intraocular pressure [2]. *Solanum melongena* extracts demonstrated a dose-dependent hypotensive responses in experimental models [10].

Materials and Methods

Plant material

Solanum melongena seeds were collected from Khartoum state- Sudan. The plant was identified and authenticated by the Medicinal and Aromatic Plants Research Institute, Khartoum, Sudan.

Instruments

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

Test organisms

Test organisms used in this study are: *Bacillus subtilis* (G+ve), *Staphylococcus aureus* (G+ve), *Pseudomonas aeroginosa* (G-ve), *Escherichia coli* (G-ve) and *Candida albicans* (fungus).

Extraction of oil

Powdered seeds of *Solanum melongena* (300g) were macerated with n-hexane for 48h. The solvent was removed under reduced pressure giving the oil.

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Table 1: Oven temperature program

Rate	Temperature (^{o}C)	Temperature (^{o}C)
-	150.0	1.00
4.00	300.0	0.00

Antimicrobial assay

The paper disc diffusion method was used to screen the antibacterial activity of the oil and performed by using Mueller Hinton agar (MHA). The experiment was carried out according to the National Committee for Clinical Laboratory Standards Guidelines[11] with some minor modifications. Bacterial suspension was diluted with sterile physiological solution to 10^{8}cfu/ 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 (Whitman No.1, 6 mm in diameter) were placed on the surface of the MHA and soaked with 20 µl of a solution of test sample. The inoculated plates were incubated at 37 °C for 24 h in the inverted position. The diameters (mm) of the inhibition zones were measured and recorded as average of two replicates.

Results and Discussion

GC-MS Analysis

Solanum melogena oil was analyzed by GC-MS . Retention times and the observed fragmentation pattern were used for identification of constituents. Sixteen constituents were identified by GC-MS analysis. The typical total ion chromatogram (TIC) is outlined in Fig. (1). The constituents of the oil are presented in Table 2.

Table 2: Constituents of *Solanum melogena* oil

No.	Name	R. Time	Area%
1.	Methyl tetradecanoate	14.259	0.23
2.	Pentadecanoic acid, methyl ester	15.392	0.05
3.	7,10-Hexadecadienoic acid, methyl ester	16.163	0.03

4.	7-Hexadecenoic acid, methyl ester, (Z)-	16.223	0.06
5.	9-Hexadecenoic acid, methyl ester, (Z)-	16.269	0.83
6.	Hexadecanoic acid, methyl ester	16.482	15.54
7.	cis-9-Hexadecenal	17.288	0.20
8.	Heptadecanoic acid, methyl ester	17.501	0.22
9.	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	18.284	47.38
10.	9-Octadecenoic acid (Z)-, methyl ester	18.319	21.71
11.	Methyl stearate	18.497	9.63
12.	cis-11-Eicosenoic acid, methyl ester	20.134	0.55
13.	Eicosanoic acid, methyl ester	20.335	1.27
14.	Docosanoic acid, methyl ester	22.043	0.42
15.	Tetracosanoic acid, methyl ester	23.621	0.52
16.	.gamma.-Sitosterol	24.166	1.36

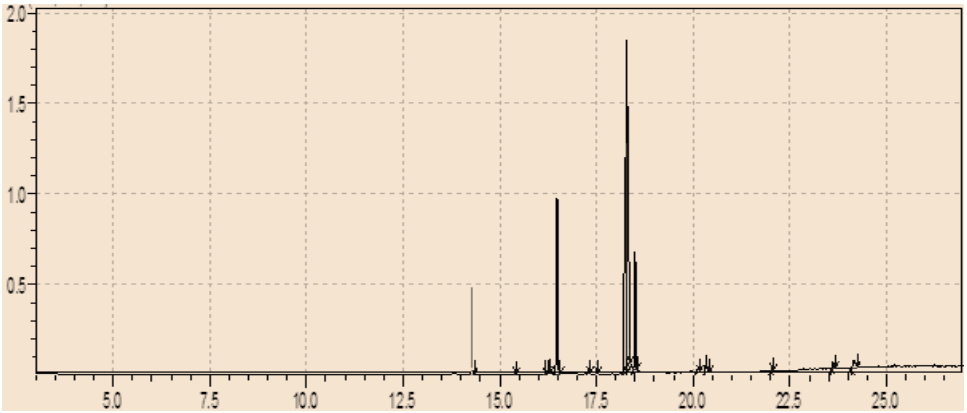
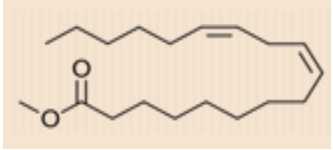


Figure 1: Total ion chromatograms

Components which appeared in total ions chromatogram as major constituents are: 9, 12-octadecadienoic acid methyl ester (47.38%); 9-octadecenoic acid methyl ester (21.71%); hexadecanoic acid is a major constituent (15.54%) and methyl stearate (9.63%).

Fig. 2 shows the mass spectrum of 9, 12-octadecadienoic acid methyl ester. The molecular ion M^+ $[C_{19}H_{34}O_2]^+$ appeared at m/z 294 (R.T. 18.284). The peak at m/z 263 is attributed to loss of methoxyl. The mass spectrum of 9-octadecenoic acid methyl ester is shown in Fig. 3. This compound is another major constituent of the oil (21.71%). The peak at m/z 296 (R.T. 18.319) corresponds M^+ $[C_{19}H_{36}O_2]^+$. The peak at m/z 266 corresponds to loss of a methoxyl . Hexadecanoic acid is a major constituent (15.54%). The mass spectrum of this component is displayed in Fig. 4. The peak at m/z 270, which appeared at R.T. 16.482 accounts for M^+ $[C_{17}H_{34}O_2]^+$. The signal at m/z 239 is due to loss of methoxyl. Methyl stearate represented 9.63% of the mass of the oil. The mass spectrum of methyl stearate is shown in Fig. 5. The peak at m/z 298 (R.T.18.497) is due to M^+ $[C_{19}H_{38}O_2]^+$, while the signal at m/z 267 correspond to loss of a methoxyl.



9, 12-octadecadienoic acid methyl ester

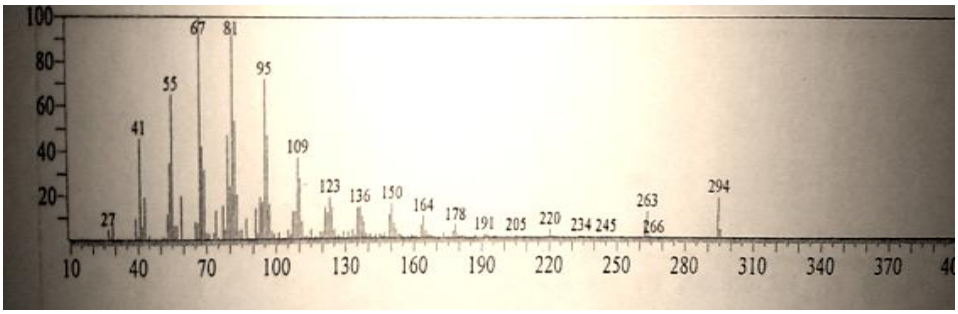
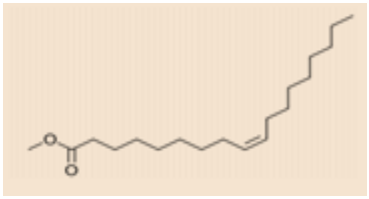


Figure 2: Mass spectrum of 9,12-octadecadienoic acid (Z,Z)-methyl ester



9-octadecenoic acid methyl ester

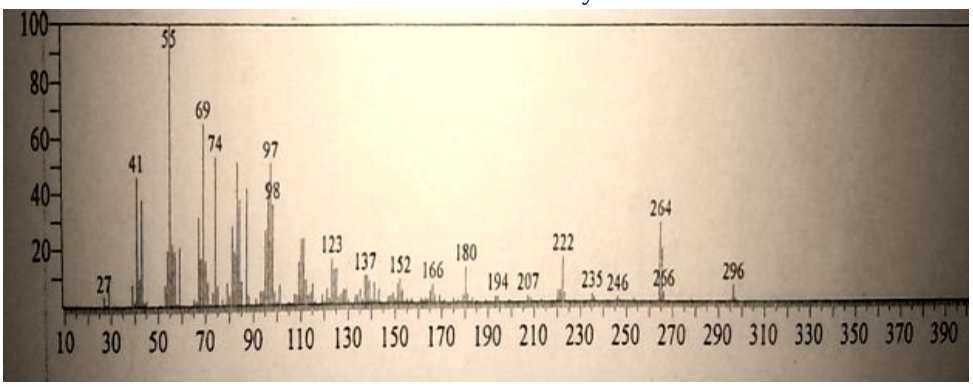


Figure 3: Mass spectrum of 9-octadecenoic acid methyl ester

Hexadecanoic acid

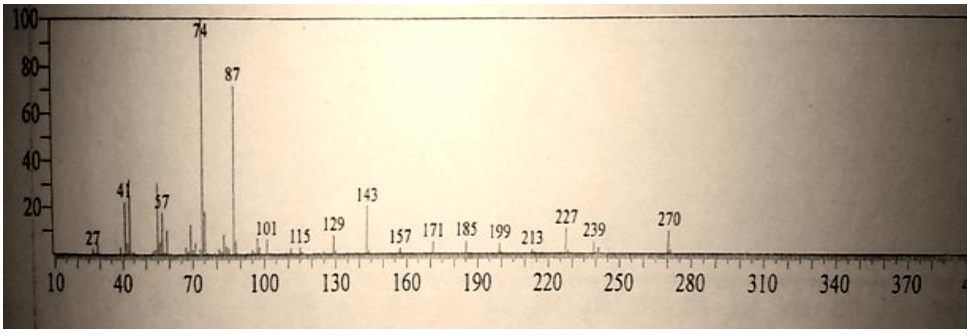
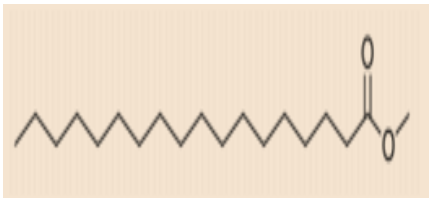


Figure 4: Mass spectrum of hexadecanoic acid, methyl ester



Methyl stearate

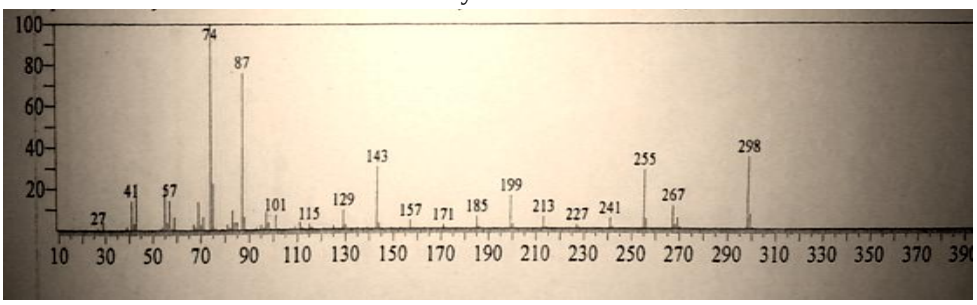


Figure 5: Mass spectrum of methyl stearate

Antimicrobial Activity of the oil

Solanum melogena fixed oil was evaluated for antimicrobial activity against five standard microbial isolates. The diameters of the growth of inhibition zones are shown in Table 3. Results were interpreted according to the following data: (< 9mm: inactive; 9-12 mm: partially active; 13- 18 mm: active; >18mm: very active). The oil showed significant activity against G+ve *Bacillus subtilis*, moderate activity against *Staphylococcus aureus* and *Escherichia coli*. Ampicilin, gentamycin and clotrimazole were used as positive controls (Tables 4 and 5) and DMSO as negative control.

Table 3: Inhibition zones (mm) of the oil

Sample	Ec	Ps	Sa	Bs	Ca
Solanum melogena oil (100mg/ml)	14	--	15	17	-

Table 3: Inhibition zones (mm) of standard drugs

Drug	Conc. (mg/ml)	Bs	Sa	Ec	Ps
Ampicilin	40	15	30	-	-
	20	14	25	-	-
	10	11	15	-	-
Gentamycin	40	25	19	22	21
	20	22	18	18	15
	10	17	14	15	12

Table 4: Inhibition zones (mm) of standard antifungal

Drug	Conc.(mg/ml)	Ca
Clotrimazole	30	38
	15	31
	7.5	29

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

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