The Pharmaceutical and Chemical Journal, 2020, 7(2):23-27

Available online www.tpcj.org

Research Article

ISSN: 2349-7092
CODEN(USA): PCJHBA

Constituents and Antimicrobial Activity of Sudanese *Lycopersicum esculentum (*Solanaceae) Oil

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Abstract *Lycopersicum esculentum* is worldwide cultivated for its nutritional value. Fruits of *Lycopersicum esculentum* is rich in lycopene which is a carotenoid with beneficial health effects. This plant is rich in vitamins and contains many minerals including iron, calcium and phosphorus. Fruit juice is used traditionally against wound bleading, scorpion bite and edema. In this study *Lycopersicum esculentum* seed oil was analyzed by GC-MS. The analysis revealed the presence of 27 components. The fatty acids constituted 94.48% of the oil; acid chloride (3.00%); aldehydes (1.63%); hetreocycles (0.44%); ketones (0.20) and phenols (0.19%). The following major constituents have been detected by GC-MS analysis: 9,12-octadecadienoic acid (35.16%); 9,12-octadecadienoic acid methyl ester (19.79%) and 9-octadecenoic acid methyl ester (10.84%). The studied oil was screened for antimicrobial activity against five standard microbial strains. The oil showed significant activity against *Bacillus subtilis.* It also exhibited moderate activity against *Pseudomonas aeroginosa, Escherichia coli, Staphylococcus aureus* and the yeast *Candida albicans.*

Keywords *Lycopersicum esculentum*, Oil, GC-MS analysis, Antimicrobial Activity

Introduction

Lycopersicum esculentum (Tomato) is a warm –season plant reaching 1-3m in height in the family Solanaceae. The fruit is red and edible. The plant is worldwide cultivated for its economic value and about 130 million tons of tomato are produced annually [1]. In its native habitat , the plant is perennial. The fruit is rich in lycopene which is a carotenoid with beneficial health effects [2]. Lycopene has antioxidant activity [3]. *Lycopersicum esculentum* is rich in vitamins and contains many minerals including iron, calcium and phosphorus [4]. Some observational studies indicated that intake of lycopene-rich tomato may reduce the risk of prostate [5] and pancreatic cancers [6-8]. Tomato juice is used traditionally to stop wound bleading. It is used against scorpion bite and edema. The juice is also used by local healers against liver and kidney disorders [9]. Intake of tomato- which is rich in potassium- may reduce the risk of heart diseases [10].

Materials and Methods

Materials

Plant material

Fruits of *Lycopersicum esculentum* were purchased from the local market, Khartoum, Sudan. The plant was authenticated by The Medicinal and Aromatic Plants Research Institute, Khartoum (Sudan).Seeds were shade-dried and powdered.

Instruments

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

Test organisms

The studied oil was screened for antibacterial and antifungal activities using the standard microorganisms: *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeroginosa*, *Escherichia coli* and *Candida albicans*.

Methods

Extraction of oil

Powdered plant material (300g) was exhaustively macerated with n-hexane. The solvent was removed under reduced pressure to afford the oil.

GC-MS analysis

The target oil was analyzed by the hyphenated technique gas chromatography-mass spectrometry. A Shimadzo GC-MS-QP2010 Ultra instrument with a RTX-5MS column (30m, length; 0.25mm diameter; 0.25 µm, thickness) was used. Helium (99% pure) was used as carrier gas. Oven temperature program and other chromatographic conditions are presented below:

Table 1: Oven temperature program

Rate	Temperature (^oC)	Hold Time ($min.^{-1}$)
1.00	150.0	-
0.00	300.0	4.00

Table 2: Chromatographic conditions

Column oven temperature	150.0^{o}C
Injection temperature	300.0^{o}C
Injection mode	Split
Flow control mode	Linear velocity
Pressure	139.3KPa
Total flow	50.0ml/ min
Column flow	1.54ml/sec.
Linear velocity	47.2cm/sec.
Purge flow	3.0ml/min.
Spilt ratio	- 1.0

Antimicrobial assay

Antimicrobial activity was performed by the well diffusion method . Four strains of bacteria(*Bacillus subtilis, Staphylococcus aureus*, *Pseudomonas aeroginosa* and *Escherichia coli*)and one yeast(*Candida albicans*) were used in the antimicrobial assay.. The bacterial and yeast strains were inoculated into Mueller Hinton broth - MHb agar plates. A volume of(100mg/ml)of the test sample was applied into 6.0 mm diameter wells. After holding the plates at room temperature for 2 hours to allow diffusion of test-drug into the agar, they were incubated at 37 °C for 24 hours. Tests were performed in duplicates. After incubation the diameters the inhibition zones were measured in millimeters (mm) and averaged.

Results and Discussion

Lycopersicum esculentum seed oil was analyzed by GC-MS. Figure 1 presents the total ions chromatograms, while Table 4 displays the different constituents of the oil.

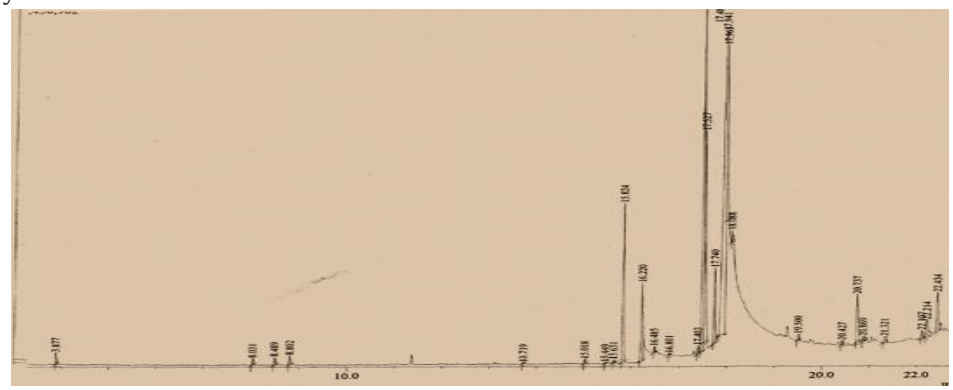


Figure 1: Total ions chromatograms

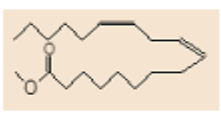
The following major constituents have been detected by GC-MS analysis:

i)9,12-Octadecadienoic (Z,Z)- (35.16%).

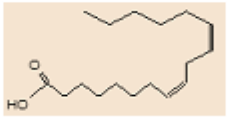
ii)9,12-Octadecadienoic (Z,Z), acid methyl ester (19.79%).

iii)9-Octadecenoic acid (Z)- methyl ester (10.84%)

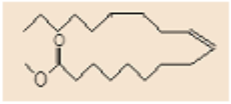
The mass spectrum of 9,12-octadecadienoic acid is shown in Fig. 2. The peak at m/z 280 (R.T. 17.941) is due to the molecular ion : $M^+[C_{18}H_{32}O_2]^+$. The mass spectrum of 9,12,-octadecadienoic acid(Z,Z) methyl ester is shown in Fig. 3. The peak at m/z 294, which appeared at R.T. 17.486 in total ion chromatogram, corresponds $M^+[C_{19}H_{34}O_2]^+$. The signal at m/z263 is due to loss of a methoxyl function. The mass spectrum of 9-octadecenoic acid methyl ester is displayed in Fig.4.The peak at m/z 296, which appeared at R.T. 17.527 accounts for: $M^+[C_{19}H_{36}O_2]^+$ .The signal at m/z265 is due to loss of a methoxyl.



9,12-Octadecadienoic acid (Z,Z) methyl ester



9,12-Octadecadienoic acid



9-Octadecenoic acid methyl ester

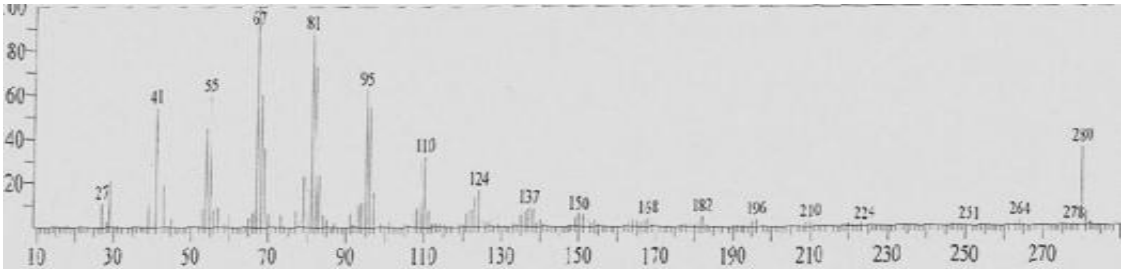


Figure 2: Mass spectrum of 9,12-octadecadienoic acid

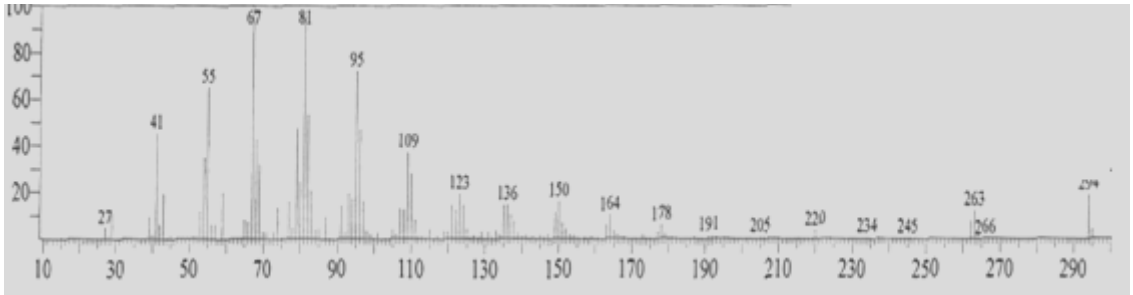


Figure 3: Mass spectrum of 9,12-octadecanoic acid(z,z), methyl ester

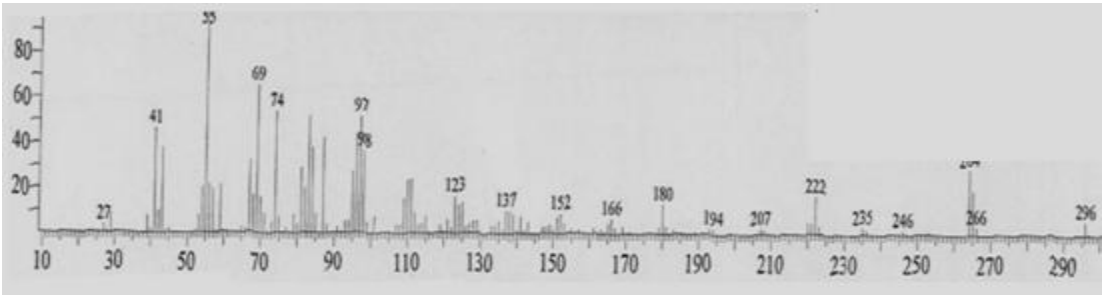


Figure 4: Mass spectrum of 9-octadecenoic acid methyl ester

Antimicrobial activity

The studied oil was screened for antimicrobial activity against five standard microbial strains. The inhibition zones are displayed in Table 3.The oil showed significant activity against *Bacillus subtilis*. It also exhibited moderate activity against *Pseudomonas aeroginosa*, *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans.*

Table 3: Inhibition zones of *Lycopersicum esculentum* oil

Type	Conc.(mg/ml)	Sa	Bs	Ec	Ps	Ca
Oil	100	15	20	16	15	16
Ampicilin	40	30	15	--	--	--
Gentacycin	40	19	25	22	21	--
Clotrimazole	30	--	--	--	--	38

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

Table 4: Constituents of the oil

Peak#	R.Time	Area	Area%	Name
1	3.877	353457	0.46	2-Heptenal, (E)-
2	8.031	235517	0.30	2-Undecenal
3	8.489	306988	0.40	2,4-Decadienal, (E,E)-
4	8.802	362228	0.47	2,4-Decadienal
5	13.719	49253	0.06	Methyl tetradecanoate
6	15.018	154974	0.20	2-Pentadecanone, 6,10,14-trimethyl-
7	15.449	43442	0.06	Pentadecanoic acid, 14-methyl-, methyl ester
8	15.631	100855	0.13	9-Hexadecenoic acid, methyl ester, (Z)-
9	15.824	5494398	7.10	Hexadecanoic acid, methyl ester
10	16.220	3581091	4.63	Pentadecanoic acid
11	16.485	194747	0.25	Hexadecanoic acid, ethyl ester
12	16.801	54968	0.07	Hexadecanoic acid, 15-methyl-, methyl ester
13	17.403	304280	0.39	Heptadecanoic acid, 16-methyl-, methyl ester
14	17.486	15317690	19.79	9,12-Octadecadienoic acid (Z,Z)-, methyl ester
15	17.527	8390651	10.84	9-Octadecenoic acid (Z)-, methyl ester
16	17.740	2568410	3.32	Methyl stearate
17	17.941	27219215	35.16	9,12-Octadecadienoic acid (Z,Z)-
18	17.965	5874065	7.59	Oleic Acid
19	18.088	357686	0.46	n-Propyl 9,12-octadecadienoate
20	19.500	220957	0.29	Eicosanoic acid, methyl ester
21	20.427	146256	0.19	Phenol, 2,2'-methylenebis[6-(1,1-dimethyl
22	20.737	2324942	3.00	9,12-Octadecadienoyl chloride, (Z,Z)-
23	20.869	204142	0.26	2-Ethylbutyric acid, eicosyl ester
24	21.321	333286	0.43	Butyl 9,12-octadecadienoate
25	22.107	339186	0.44	3-n-Butylthiophene-1,1-dioxide
26	22.214	1019723	1.32	9,12,15-Octadecatrienoic acid, methyl ester
27	22.434	1852378	2.39	Isopropyl linoleate
		77404785	100.00	

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