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The GC-MS Analysis of Sudanese Seed (*Foeniculum vulgare*) Oil

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***Abstract* - *Foeniculum vulgare* is widely cultivated in many countries where it is used as a flavoring agent. The oils of this plant have been extracted by maceration, and GC-MS has characterized the constituents of the oils. It is rich in minerals such as calcium, sodium, iron, potassium, and phosphorus. The plant also contains fiber (18.5%), protein (9.5 %); fats (10%), besides niacin, riboflavin, and thiamine. Fennel hexane fraction was analyzed by GC-MS. Gas chromatogram revealed the presence of: fatty acids (87.83%); aldehydes (5.80%); ketones (2.90%); alcohols (1.44%); mono- and sesquiterpenes (1.23%); hydrocarbons (0.80%). *Foeniculum vulgare* hexane fraction was evaluated for antimicrobial activity against five standard human pathogens. The extract exhibited significant activity against *Staphylococcus aureus* in the concentration range: 100-50mg/ml. It also exhibited significant anticandidal activity at 100mg/ml.**

Keywords: *Foeniculum vulgare*, Hexane extract, GC-MS analysis, Fennel, GC-MS Analysis, Hexane Extract, Phytochemical Constituents, Fatty Acids, Antimicrobial Activity, Anticandidal Activity, *Staphylococcus aureus*, Medicinal Plants.

I. INTRODUCTION

Foeniculum vulgare Mill. (Foeniculum vulgare) It is a perennial herb in the family Apiaceae. Fennel is widely cultivated in many countries where it is used as a flavorings agent in baked foods [1,2]. Fennel is rich in minerals such as calcium, sodium, iron, potassium, and phosphorus. The plant also contains fiber (18.5%), protein (9.5%); fats (10%), besides niacin, riboflavin, and thiamine [3]. Seeds of fennel, which are hypotensive and diuretic, are claimed to improve eyesight, while seed extract has been tested against glaucoma in experimental models [4]. Fennel essential oil contains some bioactive molecules like anethole, fenchone, estragol, p-anisaldehyde, and α-phellandrene [2,5]. Sterols, acetylated kaempferol, and some benzoisofuranone derivatives have been reported from fennel [6,7]. Also, some flavonoids have been isolated from fennel [8-10]. These phenolics seem to be responsible for the antioxidant properties of fennel. The antispasmodic, diuretic, antinflammatory, analgesic, and hepatoprotective properties of fennel essential oil have been documented [11-14]. It has been reported that fennel essential oil exhibited antimicrobial activity [15,16]. However, besides its health-promoting properties, a constituent of fennel-leugenol- has become a cause of concern since the structurally related, methylleugenol has been listed as a potential carcinogenic agent [17].

II. MATERIALS AND METHODS

Plant Material

Foeniculum vulgare seeds were purchased from the local market, Khartoum, Sudan. The plant was identified and authenticated by direct comparison with a reference herbarium sample.

Methods Hexane extract Powdered seeds of *Foeniculum vulgare* (300g) were macerated with n-hexane for 72hr. The solvent was removed under reduced pressure to give the hexane extract. **GC-MS analysis** *Foeniculum vulgare* hexane fraction was analyzed by GC-MS using a Shimadzo GC-MS-QP2010 Ultra instrument. chromatographic conditions are as follows:

Column oven temperature:	150.0 °C 300.0 °C
Injection temperature:	Split
Injection mode:	Linear
Flow control mode:	Velocity
Pressure:	139.3KPa
Total flow:	50.0ml/ min
Column flow:	1.54ml/sec
Linear velocity:	47.2cm/sec
Purge flow:	3.0ml/min

III. RESULTS AND DISCUSSION

The hexane fraction of *Foeniculum vulgare* was investigated by GC-MS. The analysis revealed the detection of 53 components. The retention times and percentages of these constituents are illustrated in Table 1. Fig. 1 shows the total ion chromatograms. The hexane fraction was dominated by fatty acids (87.83%) followed by aldehydes (5.80%), ketones (2.90%), alcohol (1.44%), mono-and sesquiterpenes (1.23%),

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and hydrocarbons (0.80%)-see Fig. 2. The essential oil of Sudanese material of *Foeniculum vulgare* has been investigated by Omnia *et al.*[18]. These authors reported that monoterpenoids were the major constituent (98.06%), while sesquiterpenes were present as a minor constituent (0.66%).

Peak#	R.Time	Area	Area%	Name
1	4.203	84570	0.06	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-meth
2	4.525	30413	0.02	.alpha.-Phellandrene
3	4.680	11635	0.01	1,3-Cyclohexadiene, 1-methyl-4-(1-methyle
4	4.781	117328	0.08	o-Cymene
5	5.239	790094	0.53	.gamma.-Terpinene
6	7.169	1770355	1.20	1-Cyclohexene-1-carboxaldehyde, 4-(1-met
7	7.254	32642	0.02	Ethanol, 2-(3,3-dimethylcyclohexylidene)-,
8	7.838	7377623	4.98	Benzaldehyde, 4-(1-methylethyl)-
9	8.340	105596	0.07	1-Cyclohexene-1-carboxaldehyde, 4-(1-met
10	8.461	978631	0.66	2-Caren-10-al
11	8.500	84529	0.06	p-Cymen-7-ol
12	8.736	65607	0.04	3-Cyclopenten-1-one, 2-hydroxy-3-(3-meth
13	8.786	151033	0.10	Bicyclo[2.2.1]heptan-2-ol, 7,7-dimethyl-, ac
14	9.014	107999	0.07	1,4-Cyclohexadiene-1-methanol, 4-(1-meth
15	9.496	139965	0.09	Silane, (4-ethylphenyl)trimethyl-
16	9.625	73030	0.05	Benzoic acid, 4-(1-methylethyl)-, methyl es
17	9.685	88198	0.06	2,4-Pentadienoic acid, 3,4-dimethyl-, isopr
18	9.738	172439	0.12	Naphthalene, 1,2,3,4,4a,5,6,8a-octahydro-7
19	9.998	98576	0.07	Benzaldehyde dimethyl acetal
20	10.188	29159	0.02	2,5-Dimethylbenzenethiol, S-pentafluoropr
21	10.310	177806	0.12	Caryophyllene
22	10.421	65563	0.04	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4
23	10.605	255455	0.17	(E)-.beta.-Famesene
24	10.750	30200	0.02	1,4,7,-Cycloundecatriene, 1,5,9,9-tetrameth
25	10.804	24453	0.02	.beta.-copaene
26	10.964	129754	0.09	1H-Cyclopenta[1,3]cyclopropa[1,2]benzene
27	10.999	453512	0.31	Di-epi-.alpha.-cedrene
28	11.320	94523	0.06	.beta.-Bisabolene
29	11.374	209527	0.14	Butylated Hydroxytoluene
30	11.408	113605	0.08	Dodecanoic acid, methyl ester
31	12.520	377438	0.25	Carotol
32	13.726	605076	0.41	Methyl tetradecanoate
33	14.642	54816	0.04	5-Octadecenoic acid, methyl ester
34	14.802	246515	0.17	Pentadecanoic acid, methyl ester
35	14.922	100059	0.07	5H-3,5a-Epoxynaphth[2,1-c]oxepin, dodeca
36	15.023	44048	0.03	2-Pentadecanone, 6,10,14-trimethyl-
37	15.534	42935	0.03	7,10-Hexadecadienoic acid, methyl ester
38	15.607	1058379	0.71	7,10,13-Hexadecatrienoic acid, methyl este
39	15.637	1395519	0.94	Methyl hexadec-9-enoate
40	15.834	9906577	6.69	Hexadecanoic acid, methyl ester
41	16.598	463306	0.31	Methyl 18-fluoro-octadec-9-enoate
42	16.809	180927	0.12	Heptadecanoic acid, methyl ester
43	17.361	817919	0.55	Methyl 5,11,14-eicosatrienoate
44	17.411	860594	0.58	Methyl 6,11-octadecadienoate
45	17.519	40550698	27.38	9,12-Octadecadienoic acid (Z,Z)-, methyl e
46	17.600	59585782	40.24	9-Octadecenoic acid (Z)-, methyl ester
47	17.671	817221	0.55	Phytol
48	17.750	2720097	1.84	Methyl stearate
49	19.141	399938	0.27	Methyl 5,13-docosadienoate
50	19.243	2970620	2.01	3-Hydroxy-2,6,6-trimethyl-hept-4-enoic aci
51	19.430	4046234	2.73	1H-Indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4
52	19.501	533479	0.36	Methyl 18-methylnonadecanoate
53	19.659	417377	0.28	6,9,12,15-Docosatetraenoic acid, methyl est

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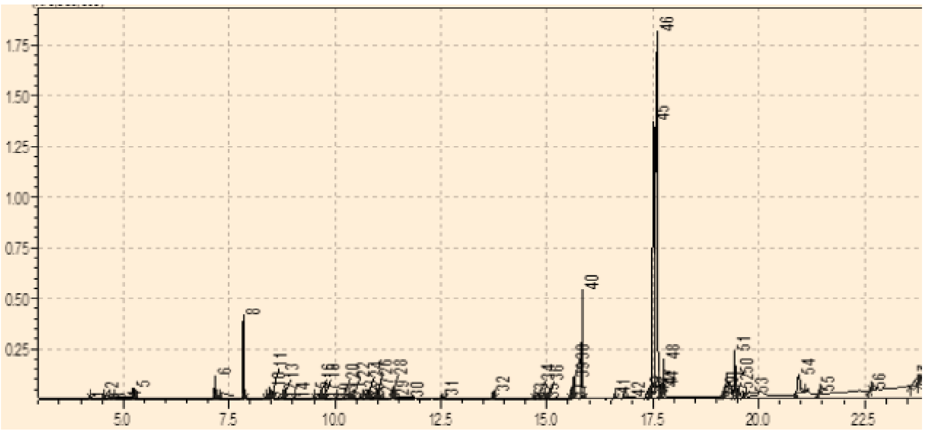

Figure 1: Total ions chromatograms

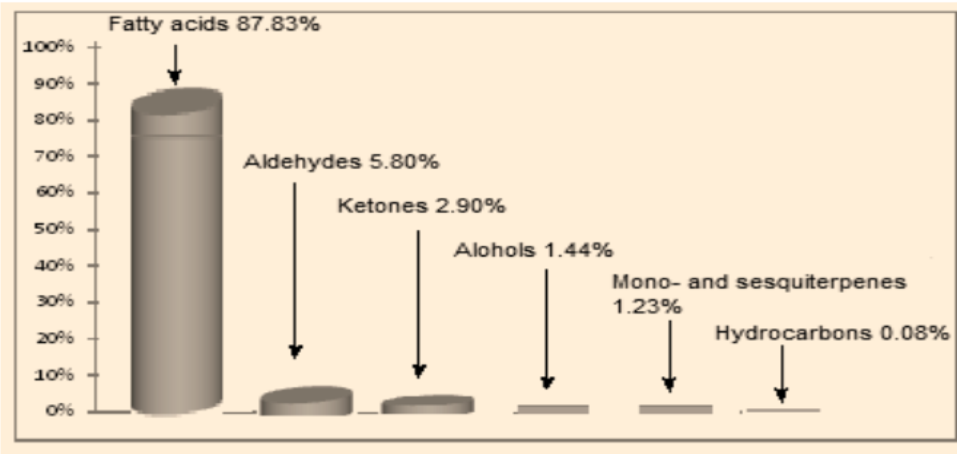

Figure 2: Abundance of oil constituents

Major constituents of the hexane fraction are discussed below:

a. **9-Octadecenoic acid methyl ester (40.24%)** Fig. 3 shows the mass spectrum of 9-octadecanoic acid methyl ester .The peak at m/z 296 (R.T. 17.600) accounts for: M+[C19H36O2]+ , while the signal at m/z265 corresponds to loss of a methoxyl.
b. **9,12-Octadecadienoic acid methyl ester (27.38%).**The EI mass spectrum of 9,12-octadecanoic acid methyl ester is shown in Fig. 4. The peak at m/z 294, which appeared at R.T. 17.519 in the total ion chromatogram, is due to the molecular ion: M+[C19H34O2]+.The peak at m/z263 corresponds to loss of a methoxyl group.
c. **Hexadecanoic acid methyl ester (6.69%)** The EI mass spectrum of hexadecanoic acid methyl ester is shown in Fig. 5. The peak at m/z 270, which appeared at R.T. 15.834 in the total ion chromatogram, corresponds to M+[C17H34O2]+ .The peak at m/z239 corresponds to loss of a methoxyl function.

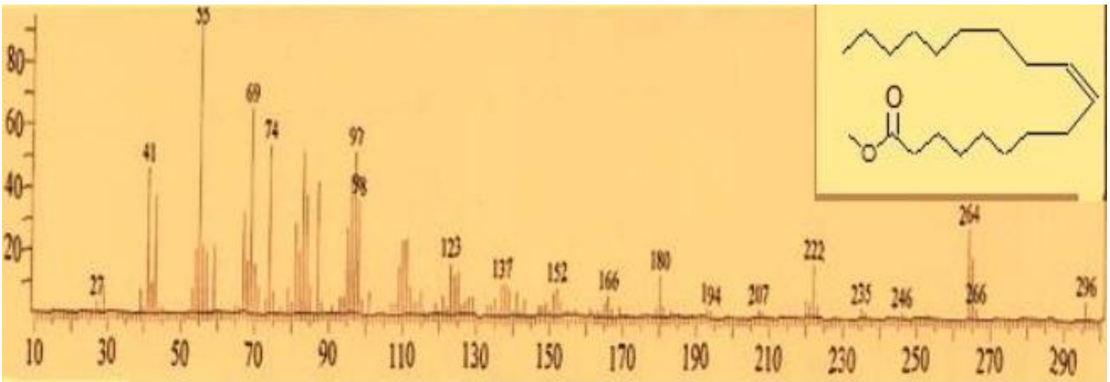

Figure 3: Mass spectrum of 9-octadecanoic acid methyl ester

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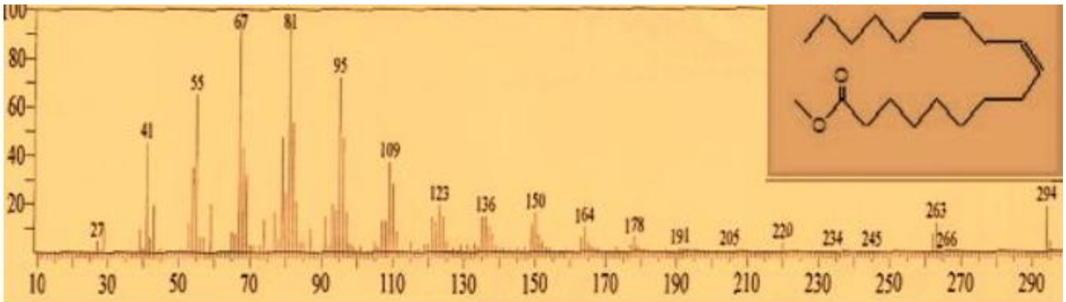

Figure 4: Mass spectrum of 9,12-octadecanoic acid methyl ester

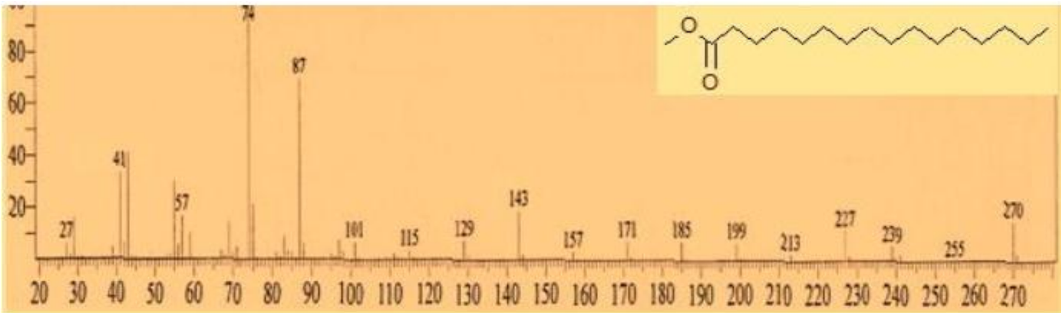

Figure 5: Mass spectrum of hexadecanoic methyl ester

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