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Research Article

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GC-MS Analysis and Antimicrobial Activity of *Coriandrum sativum* L. (Apiaceae) Grown in Sudan

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Abstract *Coriandrum sativum* L. seed oil was studied by GC-MS. The oil was also screened for antimicrobial activity. Fourty five components were detected by GC-MS analysis. The alcohols constituted the major bulk of the oil (62.94%), followed by terpenoids (12.87%), aldehydes (10.21%), hydrocarbons (6.34%), ketones (5.93%) and others (0.81%). The antibacterial activity of the oil was evaluated via the diffusion assay against five standard human pathogens (Gram positive: *Staphylococcus aureus* and *Bacillus subtitlis; Gram* negative: *Esherichia coli* and *Pseudomonasa aeruginosa* and the fungus *Candida albicans*). *Foeniculum vulgare* oil showed moderate activity against *Esherichia coli* and *Pseudomonasa aeruginosa*. It also exhibited weak activity against *Staphylococcus aureus* and the yeast *Candida albicans*. It seems that this oil is a lead for further optimization.

Keywords *Coriandrum sativum L.*, GC-MS Analysis, Antimicrobial Activity

Introduction

Coriandrum sativum is an annual herbaceous plant in the family Apiaceae which comprises around 300 genera. The plant is considered as one of the oldest spices [1-2]. *Coriandrum sativum* is native to the Mediterranean region but it is widely cultivated around the world for its fruit which is a valuable spice and for the production of *Coriandrum sativum* essential oil [3-4]. This oil is a common ingredient in detergents, creams, emulsions, surfactants and perfumes [5]. *Coriandrum sativum* fruit is used traditionally against rheumatism worms and indigestion [6]. Fruit extracts are used in the manufacture of shampoos and lotions mainly due to their antibacterial properties [4]. Fruits are said to relief anxiety, convulsions and insomnia [7]. Fruits are also useful in cases of diarrhea and intestinal parasites. *Coriandrum sativum* fruits possess stomachic properties [8 9]. Leaves of this plant are used in phytotherapy as digestive, galactagogue, carminative and spasmolytic [10]. It has been reported that *Coriandrum sativum* possesses diverse pharmacological effects including antimicrobial, antioxidant, anthelmintic, anticonvulsant, hypotensive and hepatoprotective properties [1-13].

Materials and Methods

Plant material

The seeds of *Coriandrum sativum* were purchased from the local market, Omdurman, Sudan. The plant was identified and authenticated by the Medicinal and Aromatic Plants Research Institute, Khartoum, Sudan.

Instruments

A Shimadzo GC-MS-$QP_2$2010 Ultra instrument with RTX-5MS coloumm (30m, length; 0.25m, diameter; 0.25mm, thickness) was used for GC-MS analysis.

Test Organism

Coriandrum sativum oil was screend for antimicrobial activity using the standard bacterial strains: Gram positive: *Staphylococcus aureus* and *Bacillus subtilis;* Gram negative: *Esherichia coli* and *Pseudomonasa aeruginosa* and the fungus *Candida albicans.*

Methods

Extraction of *Coriandrum sativum* oil

Coriandrum sativum essential oil was extracted by hydrodistillation. For GC-MS analysis, the oil was esterified with alcoholic sodium hydroxide and alcoholic sulphuric acid.

GC-MS analysis

A Shimazdo ultra instrument (Japan) was used for GC-MS analysis of *Coriandrum sativum* oil. Analytical grade helium (purity; 99.99%) was the carrier gas. Chromatographic conditions are shown in Table 1.

Table 1: Chromatographic conditions

Coloumn oven temperature	1300 ^{0}C
Injection temperature	280 ^{0}C
Injection mode	Split
Flow control mode	Linear velocity
Pressure	93.1KPa
Total flow	50.0ml\sec
Coloumn flow	44.7cm\sec
Linear velocity	3.0ml\mint
Purge flow	-1.0
Split ratio	

Antimicrobial assay

Preparation of bacterial suspensions

Diffusion method was used for screening *Coriandrum sativum* oil for antimicrobial potency. Meuller Hinton and Sabouraud dextrose agars were used as growth media for the bacteria and fungi respectively. The media were prepared according to the manufacturer's instructions.

Aliquots (ml) of 24 hours broth culture of the test microorganism were aseptically distributed onto nutrient agar slopes and incubated at 37^0 C for 24 hours. Bacterial growth was harvested and washed off with sterile normal saline, then it was suspended in (100ml) of normal saline. Average number of viable organism per ml of the stock suspension was determined by the means of surface viable counting technique. Serial dilutions of the stock suspension were made in sterile normal saline. (0.02ml) of the appropriate dilutions were transferred onto the surface of dried nutrient agar plates. The plates were allowed to stand for two hours at room temperature and then incubated at 37^o C for 24 hours.

Fungal culture was maintained on Sabouraud dextrose agar incubated at 25^o C for 72h. The fungal growth was harvested and washed with sterile normal saline, and suspension was stored in the refrigerator unit used.

Testing for antimicrobial activity

(2ml) of standardized bacterial stock suspension were mixed with (200ml) of sterile molten agar which was maintained at 45^o C. (20ml) aliquots of the incubated agar were distributed into sterile Petri dishes. The agar was left to settle. Each plate were was divided into two halves. In each half two cups (6mm in diameter) were cut using

sterile cork borer (No 4). Each half was designed for a test solution. Agar discs were removed, alternate cups were filled with (0.1ml) sample of each test solution and allowed to diffuse at room temperature for two hour. The plates were then incubated at 37^{o} C for 24 hours. After incubation, the diameter of resultant growth inhibition zone were measured as an average of two replicates.

Result and Discussion

GC-MS analysis of *Coriandrum sativum* oil

The GS-MS spectrum of the studied oil revealed the presence of 48 components (Table 3). The alcohols constituted the major bulk of the oil (62.94%), followed by terpenoids (12.87%), aldehydes (10.21%), hydrocarbons (6.34%), ketones (5.93%) and others (0.81%) - Chart 1.

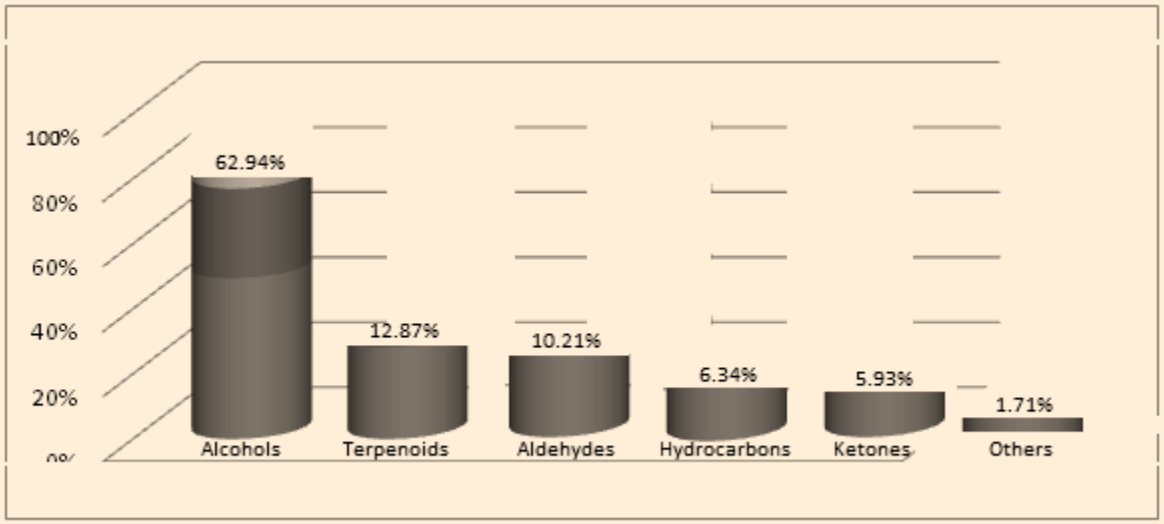

Chart 1: Composition of Coriandrum sativum essential oil

Antimicrobial activity

Coriandrum sativum oil was screened for antimicrobial activity against five standard microbes. The diameters of the growth of inhibition zones are shown in Table (2). Conventional terms were used for interpretation of the results: (<9mm: inactive; 9-12mm: partially active; 13-18mm: active; 13-18mm: active; very active). *Foeniculum vulgare* oil showed moderate activity against *Esherichia coli* and *Pseudomonasa aeruginosa*. It also exhibited weak activity against *Staphylococcus aureus* and the yeast *Candida albicans.*

Table 2: Inhibition zones (mm/mg sample) of the oil

Type	Conc. (mg/ml)	Sa	Bs	Ec	Ps	Ca
Oil	100	12	-	14	14	12
Ampicillin	40	30	15	-	--	--
Gentamicin	40	19	25	22	21	--
lotramizole	30					38

Table 3: Constituents of *Coriandrum sativum* oil

No.	Name	RT.	Area%
1	Alpha Pinene	4.141	0.68
2	Bicyclo[2.2.2]heptanes,2,2-dimethyl-3-methyl	4.391	0.08
3	Bicyclo[3.1.0]hexane, 4-methylene-1-(1-methyl)	4.765	0.07
4	Beta-Pinene	4.848	0.10
5	Beta -myrcene	4.992	0.25
6	Bicyclo[4.1.0]heptan-3-ol, 4,7,7-trimethyl	5.213	0.26

7	p-Cymene	5.64	0.34
8	D-Limonene	5.725	4.32
9	Gamma-Terpinene	6.284	2.53
10	1-Octanol	6.443	1.19
11	1,6-Octadien-3-ol, 3,7-dimethyl	7.040	49.22
12	(+)-2-Bornanone	8.075	1.26
13	Chronellal	8.114	0.60
14	Terpinen-4-ol	8.702	0.17
15	Alpha-Terpineol	8.965	0.19
16	Estragole	9.101	0.60
17	Decanal	9.170	3.23
18	Citronellol	9.629	0.79
19	D-Carvone	10.064	0.26
20	Geraniol	10.177	1.50
21	2-Cyclohexen-1-one,3-methyl-6-(1-methyl)	10.288	4.22
22	2-Decenal, (Z)-	10.323	3.49
23	2-Nonen-1-ol	10.459	0.22
24	1-Decanal	10.501	0.43
25	Anethole	10.889	0.90
26	2-alpha-Octylifuran	10.966	0.18
27	Undecal	11.323	0.72
28	Eugenol	12.320	0.96
29	2,6-Octadien-1-ol,3,7-dimethyl , acetate	12.714	2.83
30	Cyclohexane,1-ethenyl-1-methyl-	13.012	0.76
31	Tetradecanal	13.209	0.75
32	Bicyclo[7,2,0]undec-4-ene, 4,11,11-trimethyl	13.619	2.33
33	2-Dodecenal	14.315	1.59
34	Spiro[5.5]undec-2-ene,3,7,7-trimethyl	14.749	0.25
35	Cyclohexane, 1,2-dimethyl-3,5-bis(1-methyl)	14.938	0.51
36	Benzene, 1-methyl-4-(1.2.2trimethylcyclohexyl)	15.241	0.70
37	Phenol, 2-methoxy-4-(2-propenyl)-, acetate	16.479	0.71
38	Bicyclo[3.1.1]hept-2-ene,2,6-dimethyl	15.601	0.39
39	Bicyclo[2.2.1]heptan-2-ol, 1-methyl, acetate	15.665	0.18
40	H-Benzenecycloheptane,2,4a,5,6,7,8-hexahexyl	15.71341	0.39
41	Cyclohexanemethanol,4-ethenyl-α,α,4-trimethyl-3-(1-methylethyl)-,(1R-(1- α 3- α,4-β) - (4.12%)	15.969	4.12
42	1H-Cycloprop[e]azulen-4-ol, decahydro-1	16.681	0.45
43	Apiol	17.281	0.41
44	Gamma-eudesmol	17.476	0.73
45	Naphthalenemethanol, decahydro-, alpha	17.819	0.91
46	Naphthalenemethanol, 1,2,3,4,4a,5,6,8a-	17.856	0.63
47	1-Eicosanol	17.926	0.66
48	1-Naphthalenol, decahydro-1,4a-dimethyl-	17.980	2.02

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