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Phytochemical Composition of Cuminum Cyminum and its Biological Activity

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Abstract

Cumin (*Cuminum cyminum*) seeds were extracted by methanol to examine the properties of bioactive compounds and the antioxidant activity of the plant extracts. GC/MS analysis enabled the identification of 31 bioactive compounds from *C. cyminum*. The major phytochemical constituents in the *C. cyminum* extract are Adamantane methanol; 14.15 %, Octanal dimethyl acetal; 11.34 %, S,S-dimethyl 1,2-hydrazine; 8.24% and 2,6-dimethyl, 2,4-heptadiene, was represented as 6.24%. In order to develop biobactericides and biofungicides, the antibacterial, antifungal activity and action mode of cumin against some pathogenic bacteria and fungi were evaluated. The highest antibacterial activity value was 16 mm recorded against *E. coli* and *P. aeruginosae*. Moreover, petroleum ether extracts of *C. cyminum* gave antifungal activity against *C. albicans*, *P. notatum* and *A. niger* (2 - 8 mm) but, there was no action against *A. alternata* and *F. oxysporium*. The chloroform extract of *C. cyminum* showed excellent antioxidant activity (30.486 mg ascorbic acid equivalent/g dry wt.) and deserves further investigations.

Keywords: Cuminum cyminum; Extraction; Antibacterial activity; Antifungal activity; Antioxidant.

Introduction

Food preservation, medicines, alternative medicine, and natural cures have all used essential oils and extracts from aromatic plants. Currently, scientific research is needed to determine the composition of essential oil (EO) and its biological activities, which have been employed in traditional medicine to improve healthcare quality **(Mendal and Mendal, 2015)**. Because the EO contents of different species vary naturally, and are influenced substantially by cultivation conditions and environment, as well as crop and post-crop processing, numerous medicinal plant oils are being evaluated **(Mendal and Mendal, 2015)**. *Cuminum cyminum* L, a member of the Apaiaceae family, was one of the first plants to be cultivated in Asia, Africa, and Europe (**Alzoreky and Nakahara 2003)**. *C. cyminum* is a slender, glabrous annual that grows to a height of 10 to 50 cm. The stem is glabrous and

forked at the base. The leaves are glabrous and delicately pinnatifid, with oblong-linear ends and generally double trifoliate lower leaves. The blooms are arranged in umbels that radiate in groups of three to five. White or red petals with a long indented tip are rectangular and strongly edged. The bracts of the involucral bracts are simple and lengthy. The style is short and ends with a turn outward. The ovary is 3-iocular and inferior. The fruit is a schizocarp with awl-shaped calyx ends that is about 6 mm long and 1.5 mm wide. In transverse section, the pericarp is practically spherical, with 5 thread-like, bristly main ribs and bristly secondary ribs **(Thomas Fleming, 2000)**.

Cumin seeds from *C. Cyminum* have remained popular as culinary spices and have been widely employed in folkloric therapy in several geographical areas since antiquity. Researchers from all around the world have been studying the aromatic compounds found in these herbs in order to empirically validate the therapeutic properties of cumin, which have been reported in numerous indigenous healing systems. Cumin is used as an abortive, galactagogue, antibacterial, and antihypertensive herb in Tunisian and Egyptian traditional medicine, whereas it is used as a bitter tonic, carminative, and purgative in Italian traditional medicine **(Tahraoui *et al.* 2007).**

Materials and Methods

Plant Material

Cuminum cyminum (Fig. 1) was purchased from a local market in New Damietta ،Egypt, in August 2019 and identified by Dr. Mamdouh Salem Serag, professor of Ecological Botany, University of Damietta, Laboratory of Ecological Botany.

Fig.1: Cuminum cyminum

Extraction of Cuminum cyminum

About 200 grams of air-dried *Cuminum cyminum* was soaked in methanol and kept at room temperature overnight before being filtered. As **Chiheb *et al.* (2009) and Perumal *et al.* (2012)** mentioned, the marc was washed many times with methanol, then the filtrate was evaporated under low pressure to get the crude extract, which was then kept in dark containers at 4°C until use. Each one was packed in a separating funnel apparatus. Successive extraction to exhaustion was done with solvents of increasing polarity in the following order: petroleum ether (60-80°C), chloroform and ethyl acetate. The obtained extracts were separately concentrated under reduced pressure, dried to constant weight in vacuum desiccators, weighted (Pet. Ether fraction; 19.19 g, Chloroform fraction; 34.21 g and Ethyl Acetate fraction; 21.45 g) and reserved in the refrigerator until further investigation.

Gas Chromatography Mass Spectrophotometry

The GC/MS is a direct and fast analytical method for the identification of *Cuminum cyminum* volatile components. Extracts of *C. cyminum* was performed using Trace GC-TSQ Quantum mass spectrometer (Thermo Scientific, Austin, TX, USA) with a direct capillary column TG–5MS (30 m x 0.25 mm x 0.25 µm film thickness). The temperature of column oven was initially held at 50°C and then increased by 5°C /min to 200°C hold for 2 min. Increased to the final temperature of 290°C by 30°C /min and hold for 2 min. The injector and MS transfer line temperatures were kept at 270, 260°C, respectively. The carrier gas was Helium at a constant flow rate of 1 ml/min.

Biological analysis

Antimicrobial Activity

After being decolorized with activated charcoal, the crude extracts of plant components were filtered. Each filtrate was dried at 40°C under decreased pressure. Thick tarry residues were generated, and the artwork remains were diluted with dimethyl sulfoxide (DMSO) to create concentrations of 1, 10, 25, and 50 mg/ml, which were then kept in the refrigerator **(Mohanta *et al.* 2007 and Patra *et al.* 2008)**. Agar disc diffusion method was used to study the biological activity of plant extracts against five pathogenic bacteria (two Gram-positive and three Gram-negative) and five pathogenic

fungi.

Antibacterial Testing

As test organisms, the listed microorganisms were used: *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia,* and *Bacillus cereus*. Egypt's Faculty of Science at the University of Damietta's Bacteriology Laboratory provided the bacterial samples.
The bacteria have been cultured on a medium created specifically for this study **(Hornsey and Hide, 1974)**, containing 5 grams of glucose, 15 grams of agar, 5 grams of peptone, 3 grams of beef extract, 5 grams of sodium chloride and distilled water (1 L). 15 ml aliquot of this cell suspension was planted of 0.1 ml of an 18-hour-old nutrient culture broth of the bacteria tested in sterile Petri dishes. Under analogous conditions, the bactericidal activity of penicillin G was evaluated in a control experiment **(Tajbakhsh *et al.* 2011; Soltani *et al.* 2011)**.

Antifungal assay

The following fungi were used to screen for antifungal activity according to **Calvo et al. (1986).** *Fusarium oxysporium- pisi, Penicillium notatum, Candida albicans, Alternaria alternata,* and *Aspergillus niger* were used as the fungi test. The fungi were taken from the Mycology Laboratory at Damietta University's Faculty of Science.
A fragment of the each to-be-examined fungus was inoculated into 10 ml of sterile water to produce the inoculum (saline solution). One milliliter of the solution was placed to Petri-dishes containing DOX Agar medium (sucrose, 30 g; KH_2PO_4, 0.5 g; $NaNO_3$, 3 g; $MgSO_4.7H_2O$, 0.5 g; KCl, 1 g; $FeSO_4.7H_2O$, traces; agar, 15 g; distilled water to 1 liter) and gently inverted to produce a uniform inoculum. To remove excess inoculum, a sterile pipette is utilized.

Testing procedure

10 mm "wells" has been cut from a plate with the sterile cork borer. In each well, 0.3 ml of plant extract was added. 0.3 ml DMSO was used as control. For bacteria, the zones of inhibition were measured one day after incubation at 37°C, and for fungi, after 5-6 days at 28°C. Antibiotics containing miconazole were employed as positive controls under similar settings, and the assay was done three times with the mean values reported **(Bhalodia & Shukla, 2011)**.

Total antioxidant capacity (TAC)

According to **Prieto et al. (1999)**, the total antioxidant capacity of several plant extracts was measured using the phosphomolybdenum technique. The test relies on the reduction of Mo (VI) to Mo (V) by the chemicals, followed by the formation of a green phosphate/Mo (V) complex at an acidic pH.
The TAC reaction were increased by mixing 7.45 ml of 0.6 M H_2SO_4 to 0.9942 g sodium phosphate and 12359 g ammonium molybdate, followed by reducing the solution to a 250 ml with the distilled water, providing 28 mM sodium phosphate and 4 mM ammonium molybdate. Three milliliters of TAC reagent were mixed with 0.3 milliliters of plant extract and incubated at 95 degrees Celsius for 90 minutes in a water bath. The positive control was TAC reagents without chemicals extract, and the blank was solvent (0.3 ml). A 50, 100, 250, 500, 750, and 1000 g/ml of ascorbic acid were processed and measured at 695 nm in the same manner as the sample. Total antioxidant capacity was computed in the following manner:

$$\frac{\text{Concentration*Total volume}}{\text{Volume used*Dry weight}}$$

The total capacity of antioxidant (g ascorbic acid equivalent/g dry wt.) =

Statistical analysis

Three replicates of the result reported as the mean standard deviation (SD). Using SPSS, the statistical analyses were conducted (version 22). Using a two-way variance analysis (ANOVA) with a probability threshold of $p<0.05$, collected data were statistically examined to assess the degree of significance.

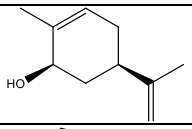
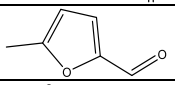
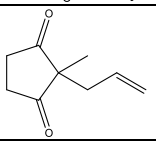
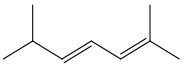
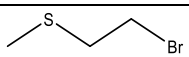
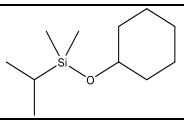
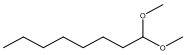
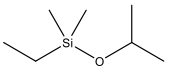
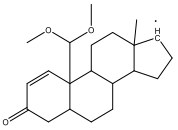
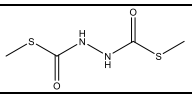
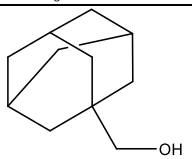
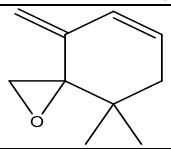
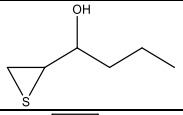
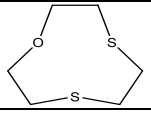
Results and Discussion

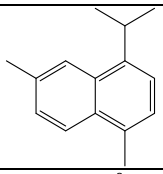
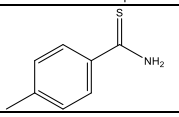
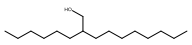
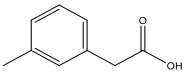
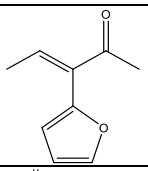
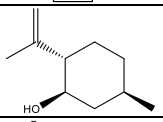
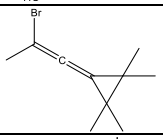
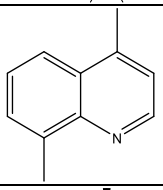
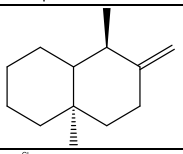
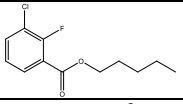
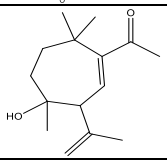
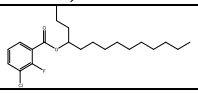
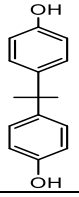
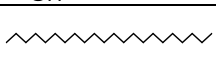
GC/MS analysis of the extracts of Cumin

Profile of metabolites has been established as a new technology platform for describing and identifying complicated chemical matrices in biological samples. **(Rohloff, 2015)**.

The present study contributes valuable information on the bioactive compounds in *Cuminum cyminum*, as summarized in Table 1. *C. cyminum* contained numerous bioactive compounds which belong to different classes as monoterpenes, sesquiterpenes and some fatty acids.

Table 1. Chemical constituents identified by GC/MS technique from the extract of *Cumin (Cuminum cyminum)*

No	Compound Name	Rt	Area %	Mol. Wt.	MS-Data	CSBC
1	cis-2-methyl-5-(1-methylethenyl)2-Cyclohexen-1-ol,	5.17	4.66	152	152(8),137(10),123(15),109(µ+)(100%),95(25),84(56),69(24),55(39),41(34),27(4).	
2	5-methyl-2-Furancarboxaldehyde,	5.35	1.37	110	110(µ+)(100%),95(2),81(10),53(53),39(12),27(23),15(2).	
3	2-Allyl-2-methyl-1,3-cyclopentanedione	5.314	0.73	152	152(24),137(9),124(37),109(96),97(30),81(98),67(58),56(53),41µ+(100%),28(49).	
4	2,6-dimethyl-2,4-Heptadiene	5.516	6.24	124	124(52),109µ+(100%),95(9),81(23),67(67),55(18),41(26),29(4).	
5	2-Bromoethyl methyl sulfide	5.659	1.80	154	154(12),107(2),93(3),75µ+(100%),61(23),45(88).	
6	Dimethyl(isopropyl)silyloxycyclohexane	5.751	5.17	200	157(26),122(5),103(6),91(34),75µ+(100%),59(23),39(28),27 (21).	
7	Octanal dimethyl acetal	6.05	11.34	174	143(9),110(3),75µ+(100%),55 (10),41(30),28(11),15(4).	
8	Ethyl(dimethyl)isopropoxysilane	6.288	16.8	146	132(17),117(78),103(3),87(26),75µ+(100%),61(33),45(26),27(5).	
9	Acetic acid, 10-dimethoxymethyl-13-methyl-3-oxo-4,5,6,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-3H-cyclopenta[a]phenanthren-17-yl (ester)	6.62	4.98	390	137(7),107(3),75µ+(100%),43(11).	
11	S,S-Dimethyl 1,2-hydrazinebis(monothioformate)	6.92	8.24	180	180(39),152(8),132(2),105(2),94(2),75µ+(100%),61(3),47(93).	
13	Adamantanemethanol	7,48	14,15	166	166(5),135µ+(100%),107(6),93(12),79(18),67(6),55(5),41(10),29(2).	
14	8,8-dimethyl-4-methylene1-Oxaspiro[2.5]oct-5-ene	7.89	1.53	150	150(30),135µ+(100%),121(33),105(52),91(50),79(38),65(14),51(14),41(25).	
15	1,2-Epithio-3-hexanol	8.228	0.4	132	132(46),114(15),99(52),89(73),81(2),71(47),57µ+(100%),43(86).	
16	1,4,7-Oxadithianonane	8.38	0.76	164	164(75),121(26),105(57),90(17),78(8),61µ+(100%),45(55),27(32).	

17	1,6-dimethyl-4-(1-methylethyl)-Naphthalene	8.88	0.28	198	198(46),183µ+ (100%),168(30),153(13),128(3),83(3).	
18	p-Toluenthioamide	11.1	0.29	151	151µ+ (100%),135(40),118(90),91(44),77(4),65(36),51(5), 39(16).	
19	2-hexyl-1-Decanol	11.2	0.29	242	224(4),196(3),139(9),111(30) 85(39),57µ+ (100%),41(8).	
20	m-Tolylacetic acid	11.4	0.16	150	150(39),105µ+ (100%),91(25),77(24),63(4),51(12),39(10), 27(3).	
21	3-(2-furanyl)-3-Penten-2-one	12.88	0.12	150	150(63),121(15),107(67),95(10),77(94),63(12),53(40),43µ+ (100%),	
23	5-methyl-2-(1-methylethenyl)-, [1R-(1.alpha.,2.beta.,5.alpha.)]-Cyclohexanol	14.2	0.10	154	154(6),136(27),121(58),107(31),93(51),81(76),67(92),55(76),41 µ+(100%),29(27).	
24	1-(2-bromo-1-propenylidene)-2,2,3,3-tetramethyl-Cyclopropane	16.153	0.15	214	199(60),135(10),120 µ+(100%),105(73),91(46),77(44),55(38), 39(53).	
25	4,8-dimethyl-Quinoline	17.1	1.77	157	157 µ+(100%),142(13),128(8),115(4),102(2),89(3),77(10),63(8).	
26	1,10-Dimethyl-2-methylene-trans-decalin	18.8	1.02	178	178(31),163(31).149(33),136(25),121(20),109 µ+(100%),95(36),81(31),67(55),55(25),41(22),27(3).	
27	3-Chloro-2-fluorobenzoic acid, pentyl ester	19.74	0.44	244	175(77),157 µ+(100%),129(21),94(4),70(37),42(18).	
28	1-(4-Hydroxy-3-isopropenyl-4,7,7-trimethyl-cyclohept-1-enyl)-ethanone	19.89	0.29	236.2	221(3),175(13),147(26),123(26),107(13),91(11),69(3),43 µ+(100%),27(3).	
29	3-Chloro-2-fluorobenzoic acid, 4-tetradecyl ester	21.9	6.51	370	196(25),175(12),157 µ+(100%),129(4),112(12),97(4),69(8),43(4).	
30	Phenol, 4,4'-(1-methylethylidene)	23.4	0.21	228	229(35),213 µ+(100%),135(5),119(18),91(9),65(4),39(4).	
31	Docosane	30.6	1.16	310	169(2),141(4),113(6),85(43),57 µ+(100%),29(6).	

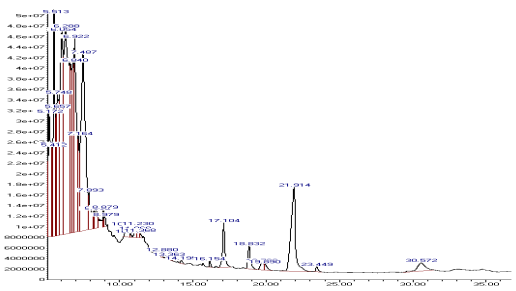


Fig. 2: GC/MS chromatogram of *C. cyminum*

Table 1 and Figure 2 demonstrate the principal ingredients, retention time (Rt, concentration (area percent), chemical structure of bioactive components (CSBC), MS-data, and molecular weight (Mol. Wt.). Thirty one bioactive compounds were identified in the Pet Ether/$CHCl_3$/MeOH extract of *Cumin (Cuminum cyminum)*. The most dominant compound was Adamantane methanol; 14.15 %, followed by Octanal dimethyl acetal; 11.34 %, followed by S,S-dimethyl 1,2-hydrazine bis (monothioformate); 8.24%, and 2,6-dimethyl-2,4-heptadiene represents as 6.24% . All these natural compounds that presented in *Cuminum cyminum* (cumin) make it possesses various therapeutic properties, including antioxidant, antibacterial, antifungal, analgesic, and anti-inflammatory properties **(Amalia et al. 2019)**.

Antimicrobial activities investigation

The infection of bacterial generates a significant death rate among humans and farmed species **(Velayutham et al. 2014)**. The antibacterial activity of *Cuminum cyminum* revealed that the three extracts examined were effective against the different tested bacteria (1 – 16 mm). In contrast, petroleum ether extract and ETOAC extract were completely devoid of any activity against *K. pneumonia*, but chloroform extract was the most effective. The data recorded in Table 2 indicated that the highest antibacterial activity value was 16 mm recorded against *E. coli* and *P. aeruginosae*. **Iacobellis et al. (2005)** reported that the main component of *Cuminum cyminum* extracts were P-menthadienal, cumin aldehyde, gamma-terpinene and beta-pinene which have a great antibacterial activity against several of gram-positive bacteria and gram-negative bacteria.

Table 2. Antibacterial activities of different plants extracts against tested bacterial organism (mean±SD)

		Antibacterial activity				
Compound	**Concentration (mg/ml)**	**width of inhibition zone (mm)**				
		S. areus	***E. coli***	***P. aeruginosae***	***K. pneumonia***	***B. cereus***
Cuminum cyminum Pet. Ether extract	1	5 ± 0.12	3 ± 0.12	1 ± 0	0	2 ± 0.12
	10	8 ± 0.58	5 ± 0.29	3 ± 0.12	0	4 ± 0.12
	25	10 ± 0.58	7 ± 0.58	5 ±0.12	0	7 ± 0.58
	50	11 ± 0.58	8 ± 0.58	6 ± 0.12	0	8 ± 0.58
Cuminum cyminum Chloroform extract	1	6 ± 0.29	8 ± 0.58	9 ± 0.58	3 ± 0.12	10 ± 0.58
	10	9 ± 0.58	10 ± 0.58	12 ± 0.58	5 ± 0.12	11 ± 0.58
	25	11 ± 0.58	15 ± 0.58	15 ± 0.58	8 ± 0.29	14 ± 0.58
	50	12 ± 0.58	16 ± 0.58	16 ± 0.58	9 ± 0.58	15 ± 0.58
Cuminum cyminum ETOAC extract	1	2 ± 0.06	0	1 ± 0	0	0
	10	5 ± 0.29	0	3 ± 0.12	0	2 ± 0.12
	25	6 ± 0.12	0	5 ± 0.29	0	3 ± 0.12
	50	8 ± 0.29	2 ± 0.06	6 ± 0.12	0	5 ± 0.29
Penicillin G	1	29±0.06	9±0.06	0	0	0
	10	31±0.06	20±0.06	0	0	0
	25	32±0.06	22±0.06	6±0.06	10±0.06	11 ±0.06
	50	32±0.06	22±0.06	8±0.06	12±0.06	15±0.06

According to the findings reported in Table 2 and Figure 3, the antibacterial activity of all extracts rose linearly with increasing concentration (mg/ml). These results concur with those of **Abou-Dobara et al (2019).**

Standard penicillin was mostly effective against Gram-positive bacteria (*S. aureus*). *E. coli, P. aeruginosa*, *K. pneumonia*, and *B. cereus* exhibited more resistance than *S. aureus*. Effects of chloroform extract of *C. cyminum* were at least twofold greater than those of penicillin G against *P. aeruginosa*, an important and ubiquitous bacterium capable of producing life-threatening disease in burnt patients **(Narayani et al. 2012)**. Furthermore, it creates mastitis, abortion, and upper respiratory problems **(Kandhasamy and Arunachalam,**

2008). Chloroform extracts of *C. cyminum* at a concentration of 50 mg/ml showed the same effect of the same concentration of penicillin G against *B. cereus* (15 mm) (Table 2 and Fig. 3). According to Table 3, the influence of the major components (concentrations and extracts) and their interaction on the antibacterial activity of *C. cyminum* extracts was extremely significant ($p<0.05$). For all bacterial species, the impact of extracts was greater (with a higher F ratio) than that of a concentration. Fig. 4 indicated the arrangements of the effective bacterial species in all extracts of *C. cyminum*. *S. aureus* was the most effective bacterial species then *P. aeruginosa*, where *K. pneumonia* was the least one.

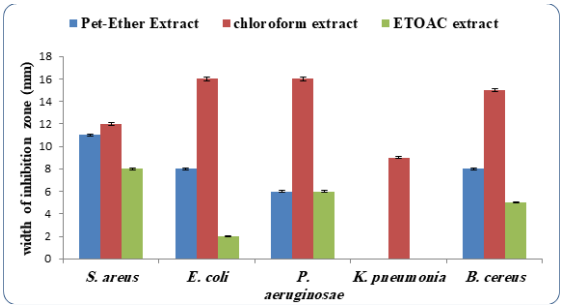


Fig. 3: Antibacterial activities of different extracts (50 mg/ml) from *Cuminum cyminum.*

Table 3. Two-way ANOVA demonstrating the influence of the primary components (concentrations and extracts) and their interaction on the width of the bacterial inhibitory zone of plant extracts.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Conc	508.455	3	169.485	68.293	.000
Bacteria	879.637	4	219.909	88.612	.000
Extracts	1998.917	2	999.458	402.728	.000
Conc * bacteria	61.088	12	5.091	2.051	.025
Conc * Extracts	48.917	6	8.153	3.285	.005
bacteria * Extracts	220.392	6	36.732	14.801	.000
Conc * bacteria * Extracts	42.412	18	2.356	.949	.522
Error	317.660	128	2.482		

Antifungal activity screening

As evident in Table 4, chloroform extract of *Cuminum cyminum* was relatively more effective against the tested fungi. This agreed with **Bhat and Rizvi (2014)** who reported that *C. cyminum* seed contains molecules such as alkaloids, anthraquinone, coumarin, flavonoid, glycoside and steroid that have a great antifungal activity. Moreover, petroleum ether extracts of *C. cyminum* gave antifungal activity against *C. albicans*, *P. notatum* and *A. niger* (2 - 8 mm) but, it was fully devoid of all the activity against *Alt. alternata* and *F. oxysporium*. The presence of antifungal compounds in *C. cyminum* may be attributed to the varying in effects according to **Orhan and Filik (2020)**.

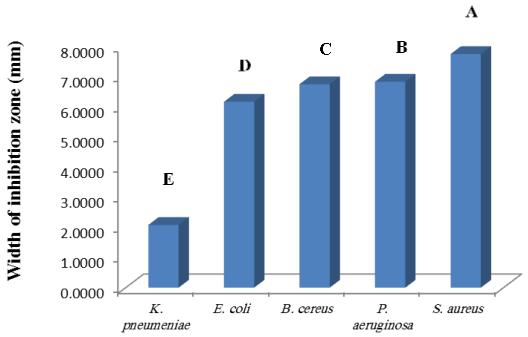


Fig. 4: Various letters indicate statistically significant changes based on a two-way ANOVA of C. *cyminum* extracts where a>b.

As compared with miconazole as a standard drug, in comparison to *P. notatum*, *C. albicans* extracts for antifungal activity shown superior performance. On the other hand, Chloroform extract of *Cuminium cyminum* gave approximately the same effect of miconazole against *C. albicans* (Table 4). In contrast **Soliman *et al.* (2013)**, our results showed that *A. niger* was the relatively sensitive fungus while *P. notatum* was the relatively sensitive one.

Table 5 showed the primary parameters (concentrations and extracts) and their interaction had a highly significant ($p<0.05$) effect on the antifungal activity of *Cuminum cyminum* extracts. For all fungal species, the effect of extracts was stronger (with a higher F ratio) than that of a concentration. In all *C. cyminum* extracts, the effective fungal species were arranged as shown in Fig. 5. The most successful fungal species was *C. albicans*, followed by *A. niger* > *P. notatum* > *F. oxysporium*> *A. alternata.*

Table 4. Antifungal activities of *C. cyminum* extracts against tested fungal organism (mean±SD)

Compound	Concentration (mg/ml)	Antifungal activity width of inhibition zone (mm)				
		Candida albicans	***P. notatum***	***A. alternata***	***A. niger***	***F. oxysporium***
Cuminum cyminum Pet. ether extract	1	2 ±0.06	1 ±0.06	0	2 ±0.12	0
	10	3 ±0.06	3 0.12±	0	4 ±0.06	0
	25	5 ±0.12	4 ±0.12	0	6 ±0.12	0
	50	7 ±0.06	6 ±0.12	0	8 ±0.29	0
Cuminum cyminum Chloroform extract	1	8 ±0.12	0	0	5 ±0.12	3 ±0.12
	10	10 ±0.29	2 ±0.09	1±0.06	7 ±0.17	5 ±0.12
	25	12 ±0.29	3 ±0.1	2 ±0.12	10 ±0.29	7 ±0.29
	50	15 ±0.12	5 ±0.1	4 ±0.06	11 ±0.29	8 ±0.17
Cuminum cyminum ETOAC extract	1	0	0	0	0	0
	10	0	0	0	0	0
	25	0	0	0	0	0
	50	0	0	0	0	0
Miconazol	1	16±0.06	14±0.03	10±0.03	18±o.o6	15±o.o6
	10	16±0.06	15±0.03	12±0.03	18±0.06	15±0.06
	25	18±0.06	16±0.03	15±0.03	20±0.06	18±0.06
	50	21±0.06	16±0.03	16±0.03	22±0.06	18±0.06

Table 5. The two way that ANOVA demonstrating the influence of the primary components (concentrations and extracts) and their interaction on the width of the fungal inhibitory zone of plant extracts.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Extracts	1230.042	2	615.021	7310.571	.000
Conc	194.325	3	64.775	769.962	.000
Fungi	524.113	4	131.028	1557.494	.000
Extracts * Conc	136.842	6	22.807	271.100	.000
Extracts * Fungi	463.613	6	77.269	918.472	.000
Conc * Fungi	25.525	12	2.127	25.284	.000
Extracts * Conc * Fungi	26.691	18	1.483	17.626	.000
Error	10.768	128	.084		

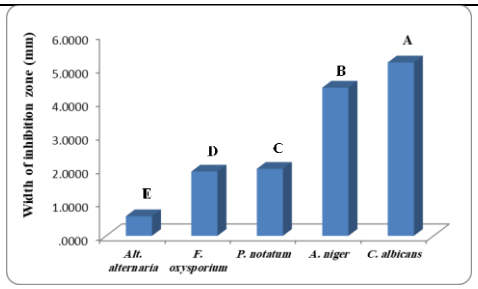


Fig. 5: Different letters denotes significant differences based on two way ANOVA analysis of plants extracts where a>b.

Antioxidant activity of the Cuminum cyminum extracts

In instance, plant extracts are often abundant in phenolic compounds such as flavonoids, phenolic acids, and tannins, which have diverse biological impacts, like as antioxidant and antibacterial capabilities **(Rvbio *et al.* 2013)**. Phenolic compounds are hydrogen donors capable of directly scavenging free radicals and reducing oxidative damage **(Kesharwani *et al.* 2012; Wintola and Afolayan, 2015)**, which makes them potent antioxidants. In this study, the total antioxidant capacity of the different extracts at various concentrations prepared from *Cuminum cyminum* has been screened as shown in Fig. 6. It was observed that as the concentration of any plant extracts increased, the antioxidant activity also increased **(Amer and Ali, 2019)**. The chloroform extract of *C. cyminum* showed excellent antioxidant activity (30.486 mg ascorbic acid equivalent/g dry wt.) and deserves further investigations. The ethanol extract proved the superior to the synthetic of antioxidants **(Kumar *et al.* 2008)**. The antioxidant capacity of the *C. cyminum* extracts was in the correct sequence Chloroform extract > Pet. ether extract > ETOAC extract.

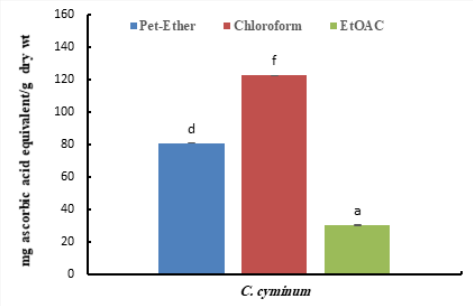


Fig. 6: The Total Antioxidant Capacity (TAC) of the *C. cyminum* extracts, Data are means ± SD, columns letters are significantly difference at $p<0.05$.

Conclusion

Cumin (*Cuminum cyminum*) extracts contained numerous bioactive compounds which belong to different classes as monoterpenes, sesquiterpenes and some fatty acids. All these compounds exhibited highly antimicrobial activity properties and antioxidant capacity. All Extracts' activities increased linearly with increasing extract concentration (mg/ml).

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الملخص العربي

عنوان البحث: التركيب الكيميائي النباتى للكمون ونشاطه البيولوجى

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تم استخلاص بذور الكمون (Cuminum cyminum)بالميثانول لفحص خصائص المركبات النشطة بيولوجيًا والنشاط المضاد للأكسدة لمستخلصات النبات. أظهر تحليل GC / MS أنه تم تحديد ٣١ مركبًا نشطًا بيولوجيًا من C. cyminumالمكونات الكيميائية النباتية الرئيسية في مستخلص C. cyminum هي أدامانتان ميثانول ؛ ١٤,١٥٪ ، أوكتانال ثنائي ميثيل أسيتال ؛ ١١,٣٤٪ ، S ، ثنائي ميثيل ١،٢-هيدرازين مكرر (monothioformate؛ ٨,٢٤٪ ، وكذلك ٢،٦-2 dimethyl،-4 heptadiene ، يمثل ٦,٢٤٪ من أجل تطوير مضادات البكتريا الحيوية ومضادات الفطريات الحيوية ، تم تقييم النشاط المضاد للبكتيريا والفطريات لمستخلص الكمون ضد بعض البكتيريا والفطريات المسببة للأمراض. أعلى قيمة نشاط مضاد للبكتريا سجلت ١٦ مم ضد E. coli و P. aeruginosae. علاوة على ذلك ، أعطت مستخلصات الإيثر البترولي لـ C. cyminum نشاطًا مضادًا للفطريات ضد C. albicans و P. notatum و A. niger ولكنها كانت خالية تمامًا من أي نشاط ضد. Alt. alternata و F. oxysporium.أظهر مستخلص الكلوروفورم لـ C. cyminum نشاطًا ممتازًا مضادًا للأكسدة (٣٠,٤٨٦ مجم مكافئ لحمض الأسكوربيك / جرام بالوزن الجاف) ويستحق المزيد من الفحوصات.