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Effect of coriander extract and soaking time in culture of three barley cultivars and identification of the active compounds by a device GCMS

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Abstract

The research was carried out in one of the laboratories of the Plant Production Techniques Department at the Agricultural Technical College / Mosul, in plastic trays with dimensions (9 x 15) cm, perforated from the bottom to drain excess water. The research included three factors, the first factor was the aqueous extract of coriander plant at two levels (comparator treatment and coriander extract), the second factor was the duration of soaking at two levels (6 and 12) hours, the third factor was barley varieties with three levels (local black barley, white Rayhan barley, Zanbaqa barley), and the use of a complete randomized design (CRD) according to the factorial experiment system and with three replications, at the end of the research, the data were recorded, and they were statistically analyzed using the computer according to the SAS program, and the different averages were distinguished by different alphabets, and the results were as follows: coriander extract outperformed the comparison treatment in terms of total wet weight, dry weight, and length of gesture. However, soaking for (12) hours was significantly superior to soaking for (6) hours in total wet and dry weight and seedling length, and that the cultivar Rayhan was significantly superior to the local black and Zanbaqa cultivars in the total wet and dry weight, thickness and number of roots. The interaction between coriander extract and soaking time (12) hours significantly exceeded the total wet and dry weight and seedling length. The interaction between coriander extract and Rayhan cultivar, as well as the interaction between soaking time (12) hours and Rayhan cultivar, and triple interaction between coriander extract and soaking duration (12) hours and Rayhan cultivar, achieved significant superiority in all studied traits. GCMS and it was found that there are 8 phenolic compounds and two fatty acids. We conclude through this study that aqueous coriander extract showed the behavior of growth regulators.

Keywords coriander extract, soaking seeds, barley varieties, GCMS

Introduction

Barley (*Hordeum vulgare* L.) is one of the most important cereal field crops that are grown in order to obtain green fodder for farm animals[1] , The varieties of barley grown in the Mediterranean basin are characterized by their ability to grow rapidly in the early stages, which leads to covering the surface of the soil completely [2].Soaking barley seeds in water for 12 hours before dissemination in culture trays achieved a significant increase in many characteristics of barley cultivar, quantitative and qualitative [3] . Whereas, leaving barley seeds soaked for 24 hours with water before placing them in culture trays cause a significant increase in the qualitative and quantitative characteristics of barley cultivar [4]. added, when studying the duration of soaking barley seeds before disseminating them in culture trays, that the increase in the soaking period of barley seeds used in the production of barley cultivar from (12-24) hours was accompanied by a significant increase in all the studied traits. Chemical fertilizers and chemical pesticides that are added to plants are one of the main causes of environmental pollution, as their addition and the accompanying negative residual effects on plants and soil make them a source of concern for human life and farm animals [5], hence the shift to safer and less polluting compounds in order to preserve the environment through the use of plant extracts, which are environmentally friendly compounds [6]. Coriander (*Coriandrum sativum* L.) is one of the annual herbaceous plants belonging to the Amphibian family, which is characterized by a sharp smell as it is used in several fields, including food and medicine, as well as its uses in the field of cosmetics [7]. The original home of the coriander plant is the Mediterranean basin, from which it spread to the rest of the world's continents and its cultivation succeeded in most of the temperate and semi-hot regions [8]. *Coriandrum sativum* L. belongs to the family Umbelliferae and is a spice crop and also aromatic plant up to 2 feet in height with branched, green, smooth, two- and three-lobed stems [9]. The dry and green fruits of coriander have a distinctive smell and a volatile oil whose benefits are multiple. It is an anti-oxidant and anti-inflammatory, and it does not have any side effects when using it [10]. Coriander contains many active substances and volatile oils, the most important of which are linalool, borneol, camphor, camphor, goraniol, limonene, and alpha- pinenes. petroselinic acid and linolenic acid, as well as coumarin compounds, gum, tannin, sugars, protein and starch. The importance of the coriander plant as one of the medicinal plants producing volatile oils, fatty acids and phenolic compounds has been dealt with by animal technology and tissue culture research. The production of medicinal materials for the tissue culture method is an alternative to the traditional cultivation method for the industrial production of various organic metabolites [11]. The research aims to study the best soaking time in coriander extract to produce the highest yield of barley cultivar, and the yield of the best cultivar under study

Materials and Methods

The research was carried out in the laboratory of the Department of Plant Production Techniques in plastic trays with dimensions (9 x 15) cm, the research included three factors, the first factor is coriander extract and two levels (comparison treatment and coriander extract), the second factor is the duration of soaking and at two levels (6 and 12) hours, the third factor Varieties of barley in three levels (local black barley, white Rayhan barley, Zanbaqa barley). The aqueous extracts were prepared by taking 50 gm of plant powder and mixing it with 100 ml of distilled water, then left on a heater with continuous stirring at a temperature of 80 ° C for 5 hours, then filtered with a cloth and then filtered with filter paper and 1 tman in a vacuum device, and then lyophilized and disposed of Water in a lyo laser device by lyophilization method, then the raw extracts are placed in sealed opaque bottles and kept in the refrigerator until later used [12]. After obtaining the extract in powder form, the concentrations are prepared with a weight of 2 g of the crude extract and dissolved in 40 ml of distilled water to obtain A concentration of 50%, then the rest of the concentrations are obtained from it[13] [14] [15] The process of soaking the barley seeds was carried out [16], and the barley seeds were scattered in plastic trays at a rate of (3) kg / m2. The experiment was carried out using a complete randomized design (CRD) according to the factorial experiment system [17] with three replications. After (14) days, the following characteristics were studied: (total wet weight (g / 135 cm 2), total dry weight (g / 135 cm 2), thickness of the rootstock (cm), number of roots, total seedling length (cm),, the data were analyzed using the computer according to the SAS program, and the different averages were distinguished by different alphabets.

Diagnostics of active compounds by gas chromatography-mass spectrometer (GC-MS)

The tannins and other active compounds of the aqueous extract of the plants under study were diagnosed in the Food Research and Consumer Protection Laboratories - University of Basra by a gas chromatograph connected to a mass spectrometer type GC MS QP210 Ultra from SHIMADZU of Japanese origin and contains a capillary column type methyl polysiloxane 5% Phenyl, 95% DB-MS 5 and its dimensions 30 meters in length and 0.23 in diameter, with a thickness of 0.25 µm in the static phase is the static phase. Whereas, the mobile phase is high-purity carrying helium gas. The separation process was carried out according to the thermal system of the MS-GC device at a temperature of 40 °C for one minute, then it begins to increase to 150 °C for a minute and at a rate of 5 °C per minute and reaches 280 °C at a rate of 5 °C per minute and the temperature is stable at 280 °C. for a minute,therefore, performing the automatic injection process, by injecting 1 microliter) into the Gas Chromatography / Mass spectroscopy device from the upper layer containing the

fatty acids after the esterification process of the oil of the samples under study, type AOC-AHIMADZU, 20i+5.

Results and Discussion

Total wet weight (g / 135 cm2)

The data in Table (1) show that the coriander extract was significantly superior to the comparison treatment in the total wet weight with an increase of (21.9)%, and this may be due to the coriander containing many active compounds, which made it behave like growth regulators. The long soaking period (12) hours significantly outperformed the short period (6) hours for the same recipe with an increase of (15)%, and this result was identical to what was obtained[5] (Hayawi and Taha, 2021). However, the cultivar Rayhan was significantly superior to the local black cultivar and the Zanbaqa with an increase of (25.25 and 13.5)%, respectively, and that the Zanbaqa cultivar was significantly superior to the local black cultivar with an increase of (10.35)%, and this may be due to the genetic structure of these cultivars.

as for the binary interaction between the factors, the results of the statistical analysis indicate that the interaction between coriander extract and soaking time (12) hours was significantly superior to the total wet yield over all interactions, as the wet weight reached (321.3) g. and the interaction between coriander extract and Rayhan cultivar was significantly superior to the rest of the interactions, as the weight reached (341.4) g. Therefore, the interaction between the long soaking period (12) hours and the cultivar Rayhan achieved the highest total wet weight, and thus significantly outperformed all interactions, reaching (334.2). Hence, the triple interaction between the factors, the data indicate that the interaction between coriander extract and long soaking time (12) hours and Rayhan cultivar caused a significant increase in the total wet weight and thus significantly outperformed all interactions, and the total wet weight reached (387.1) g, while the lowest weight Total wetness was (184.2) g when overlapped between the control treatment, the short soaking period (6) hours, and the local black cultivar.

Table (1): Effect of coriander extract, duration of soaking, varieties and the interaction between them on the Total wet weight (g / 135 cm2) of barley culture

Transactions		Barley varieties			Extract * Soak	The effect of soaking time	ex-tract effect
Extract	**Soak time (hour)**	**black local**	**Rayhan**	**Zanbaqa**			
Comparison	**6**	184.2 e	250.1c d	255.1bcd	229.8 c		
	12	253.7 bcd	281.3 bcd	241.2 d	258.7 b		
Coriander	**6**	240.4 d	295.7 b	287.3 bc	274.5 b		
	12	290.8 bc	387.1 a	285.9 bc	321.3 a		
Abstract * Varieties	Comparison	218.9 d	265.7 bc	248.2 c			244.3 b
	coriander	265.6 bc	341.4 a	286.6 b			297.9 a
Soak * Varieties	**6**	212.3 c	272.9 b	271.2 b		252.17 b	the 5% probability level.
	12	272.2 b	334.2 a	263.6 b		290.00 a	
barley effect		242.3 c	303.5 a	267.4 b			

Total dry weight (gm / 135 cm^2)

The results of the statistical analysis presented in Table (2) indicate that the coriander extract achieved a significant increase of (48)% compared to the comparison treatment in the total dry weight. In turn, it is positively reflected on the wet and dry weight [18] (Abdul-Hussein, 2016), and that the long soaking period (12) hours did not reach the level of morality compared to the short soaking period (6) hours. The cultivar Rayhan was significantly superior to the local variety and the cultivar Zanbaqa in the same trait. Therefore, the interaction between coriander extract and the short soaking period (6) hours was significantly superior to the rest of the interactions in total dry weight, which reached (60.9) g. The interaction between coriander extract and basil cultivar was significantly superior to the rest of the interactions, and the total dry weight reached (74.7) g, in the record of interaction between the control treatment and the black local cultivar, the lowest dry weight was (34.9) g. The interaction between the long soaking period (12) hours and the variety Rayhan achieved the highest total dry weight, and thus significantly superior to the rest of the interactions, as the weight reached (63.3) g, while the lowest weight was (35.4) g, when the interaction between soaking for (6) hours and the local black variety,as for the results of the triple interaction between the factors, the data indicate that the interaction between coriander extract and the long soaking period (12) hours and the Rayhan variety achieved the highest total dry weight, reaching (77.7) g, and thus significantly superior to all interactions, while the interaction between the comparison treatment and the duration of Soaking the short (6) hours and the local black variety in achieving the lowest total dry weight and reached (30.6) g.

Table (2): Effect of coriander extract, duration of soaking, varieties and the interaction between them on the total dry weight of barley culture

Transactions		Barley varieties			Extract * Soak	The effect of soaking time	extract effect
Extract	Soak time (hour)	black local	Rayhan	Zanbaqa			
Comparison	**6**	30.6 g	41.6 e	42.4 e	38.25 d		
	12	39.2 ef	48.9 cd	38.0 f	42.05 c		
Coriander	**6**	40.2 ef	71.6 b	70.7 b	60.9 a		
	12	50.2 c	77.7 a	45.9 d	57.97 b		
Abstract * Varieties	Comparison	34,9 e	45.2 c	40.2 d			40.15 b
	coriander	45.2 c	74.7 a	58.3 b			59.43 a
Soak * Varieties	**6**	35.4 e	56.6 b	56.6 b		49.57 a	the 5% probability level.
	12	44.7 c	63.3 a	41.9 d		50.01 a	
barley effect		40.1 c	59.9 a	49.3 b			

Root Total Thickness (cm)

The results of the statistical analysis presented in Table (3) show that the coriander extract and the short and long soaking times had no significant effect on the thickness of the rootstock. As for Rayhan cultivar, it was significantly superior to the local black cultivar and Zanbaqa cultivar with an increase of (16.39 and 52.29)% for the two cultivars, respectively. The reason for this may be due to the difference in the genetic structure of these cultivars in terms of the number of rows of barley kernels. As for the binary interaction between the factors, the results indicate that the interaction between the extract and the soaking did not have any significant effect, and the binary interaction between the extract and the cultivars was clear through the interaction between the cultivar Rahan and the two comparison treatments and coriander extract, which did not differ between them significantly,the interaction between the control treatment and the lily variety achieved the lowest thickness of the root system, and the interaction between the long soaking period (12) hours and the Rayhan variety achieved the largest thickness of the roots, reaching (8.3) cm, while the lowest thickness was (4.91) cm when the overlap between the short soaking period (6) hours and Zanbaqa variety. As for the triple interaction between the factors, the data in the same table indicate that the basil variety was not significantly affected by the difference in the duration of soaking. The control treatments and coriander extract, and the highest thickness of the roots was achieved when the triple interaction between the control treatment and soaking for (12) hours and the basil cultivar, which reached (8.80) cm. While the triple interaction between the comparison treatment, the duration of (6) hours, and the Zanbaqa cultivar gave the lowest thickness of the root total, which amounted to (4.03) cm.

Table (3): Effect of coriander extract, duration of soaking, varieties and the interaction between them on the thickness of the rootstock of barley culture

Transactions		Barley varieties			Extract * Soak	The effect of soaking time	extract effect
Extract	**Soak time (hour)**	**black local**	**Rayhan**	**Zanbaqa**			
Comparison	**6**	6.60 bc	7.63 ab	4.03 d	6.08 a		
	12	6.90 abc	8.80 a	5.66 bcd	7.12 a		
coriander	**6**	6.80 abc	7.56 ab	5.80 bcd	6.72 a		
	12	7.03 abc	7.80 ab	5.40 cd	6.74 a		
Abstract * Varieties	Comparison	6.75 bc	8.21 a	4.85 d			6.60 a
	Coriander	6.91 abc	7.68 ab	5.60 cd			6.73 a
Soak * Varieties	**6**	6.70 bc	7.60 ab	4.91 d		6.40 a	the 5% probability level.
	12	6.96 ab	8.30 a	5.53 cd		6.93 a	
barley effect		6.83 b	7.95 a	5.22 c			

Number of Roots

The results of the statistical analysis presented in Table (4) indicate that the coriander extract has no significant effect compared to the comparison treatment on the number of roots. Thus, the difference in the soaking period did not reach the significant level between the two periods, while the Rayhan variety achieved an increase in the number of roots. The number of roots reached (5.79) significantly superior to the local black and Zanbaqa cultivars. The interaction between coriander extract and soaking time had no significant effect on this trait, while barley basil within the control treatment and coriander extract achieved the highest number of roots,the lowest number of roots was achieved when the comparison treatment and the lily variety overlap, as the number of roots reached (5.20) roots. Henceforth, the interaction between the two soaking times and the cultivar Rayhan caused the highest number of roots, as well as the interaction between the long (12) hour period and the Zanbaqa cultivar. As for the triple interaction between the factors, the results of the statistical analysis indicate that the interaction between the comparison treatment and the duration of soaking (12) hours and the basil variety achieved the highest number of roots as it reached (5.86) roots, and the interaction between the comparison treatment and the duration of (6) hours and the Zanbaqa variety recorded the lowest number of roots. It reached (4.66) roots.

Table (4): effect of coriander extract, duration of soaking, varieties and the interaction between them on the number of roots of barley culture

Transactions		Barley varieties			Extract * Soak	The effect of soaking time	extract effect
Extract	Soak time (hour)	black local	Rayhan	Zanbaqa			
Comparison	**6**	5.4 abc	5.66 ab	4.66 c	5.24 a		
	12	4.93 bc	5.86 a	5.73 ab	5.51 a		
Coriander	**6**	5.13 abc	5.83 a	5.23 abc	5.40 a		
	12	4.90 c	5.80 a	5.50 abc	5.40 a		
Abstract * Varieties	Comparison	5.16 b	5.76 a	5.20 b			5.37 a
	Coriander	5.01 b	5.81 a	5.36 ab			5.40 a
Soak * Varieties	**6**	5.26 ab	5.75 a	4.95 b		5.32 a	the 5% probability level.
	12	4.91 b	5.83 a	5.61 a		5.45 a	
Barley effect		5.09 b	5.79 a	5.28 b			

Total gesture length (cm)

The data of the statistical analysis presented in Table (5) shows that the coriander extract was significantly superior to the comparison treatment in the average length of the gesture, and the reason for this may be due to the presence of many active compounds in the coriander extract, which caused this increase in length, and this result was identical to the results obtained[16]. The long soaking period (12) hours was significantly superior to the short period (6) hours in the same character, and the reason for this may be attributed to the fact that the length of the soaking period may increase the transformation of soluble nutrients into easily absorbable materials, which reflected on the gesture growth rate [6]. The Zanbaqa variety was significantly superior to the local black and Rayhan cultivars in this trait. The results of the binary interaction show that the interaction between coriander extract and the long soaking period (12) hours was significantly superior in the average length of the seedling to the rest of the interactions, as the average length was (26.16) cm, and the interaction between the long soaking period (12) hours and the basil variety, as well as the interaction between The duration of soaking and Zanbaqa cultivar was significantly superior to the rest of the interactions, and the interaction between coriander extract and basil cultivar over the rest of the interactions. The results of the triple interaction between the factors indicate that the interaction between coriander extract and the long soaking period (12) hours and Rayhan cultivar was significantly superior to the rest of the interactions in the average length of the seedling, as the length

of the seedling reached (27.16) cm. As for the lowest length, it was achieved when the comparison treatment, the short soaking period (6) hours, and the local black variety, which reached (20.66) cm, were overlapped.

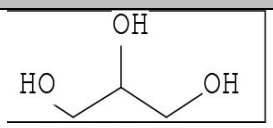
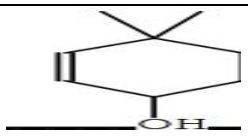
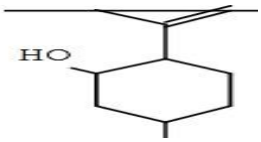
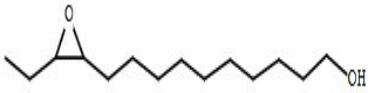
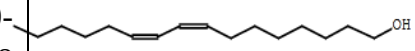
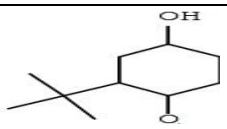
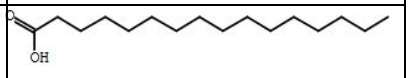
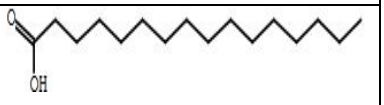
Table (5): effect of coriander extract, duration of soaking, varieties and the interaction between them on the total seedling length in barley culture

Transactions		Barley varieties			Extract * Soak	The effect of soaking time	extract effect
Extract	Soak time (hour)	black local	Rayhan	Zanbaqa			
Comparison	**6**	20.66 g	23.40 def	24.33 bcde	22.80 c		
	12	21.66 g	24.00 cdef	26.56 ab	24.07 b		
Coriander	**6**	22.06 efg	24.00 cdef	26.33 abc	24.13 b		
	12	25.33 abcd	27.16 a	26.00 abc	26.16 a		
Abstract * Varieties	Comparison	21.16 c	23.70 b	25.45 a			23.43 b
	Coriander	23.70 b	25.58 a	26.16 a			25.15 a
Soak * Varieties	**6**	21.36 c	23.70 b	25.33 a		23.46 b	
	12	23.50 b	25.58 a	26.28 a		25.12 a	
Barley effect		22.43 c	24.64 b	25.80 a		the 5% probability level.	

Diagnostics of active compounds by gas chromatography-mass spectrometer (GC-MS)

Using GSMS technology assists to diagnose some phenolic compounds and fatty acids present in the aqueous extract of cumin and coriander seeds, as the graphs showed the diagnosis and presence of 8 phenols and 2 fatty acids in a plant. A comparison was made between the retention time for each active compound with the standard detention time, as shown in Table (6) and Figure (1).

Table (6): Identification of the active compounds separated from coriander seeds by GC-MS device

peak	R time	Area	Area%	Name	Type
3	7.169	1825697	**8.34**	Glycerin	
5	16.075	144822	**0.66**	4,4-Dimethyl-cyclohex-2-en-1-ol (phenol)	
6	16.267	175912	**0.80**	Cyclohexanol, 5-methyl-2-(1-methylethenyl)-(phenol)	
7	16.600	123451	**0.56**	cisZ-11,12-Epoxytetradecan-1-o (phenol)	
8	17.258	111691	0.51	Z,Z-8,10-Hexadecadien-1-o	
10	18.218	80214	0.37	3,trsns-(1,1-dimethylethyl)-4,trans-methoxycyclohexanol (phenol)	
11	18.783	166899	**0.76**	E-11,13-Tetradecadien-1-ol (phenol)	
12	19.042	2830530	**12.94**	n-Hexadecanoic acid (Fatty acid)	
13	20.933	10782828	**49.28**	Z-10-Pentadecen-1-ol	
14	21.100	1914656	**8.75**	n-Hexadecanoic acid(Fatty acid)	

The results of the current study were close to the study[18], as the diagnostic results of coriander extract when analyzed using GC-MS technology showed the presence

of several pharmacologically active compounds, including linalool, which has strong insecticide activity against Sitophilus zamias and Triboliumcastaneum.

The researcher [19] confirmed the presence of several effective compounds, including phenols, fatty acids and tannins in the coriander plant. They were able to identify 40 compounds using GCMS technology, including Cyclohexadecane, and this was confirmed by the current study.

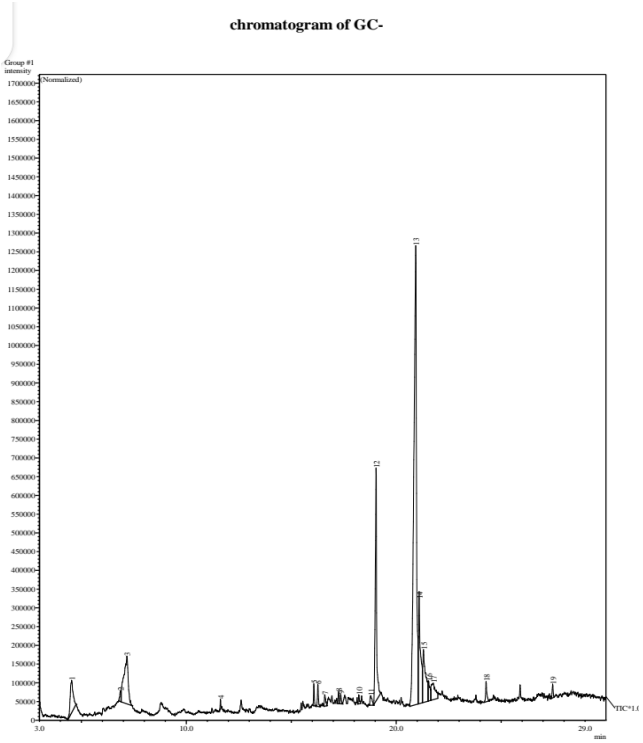


Figure (1): The schematic diagram of the active compounds of coriander, diagnosed by gas chromatography-mass spectrometry (GC-MS).

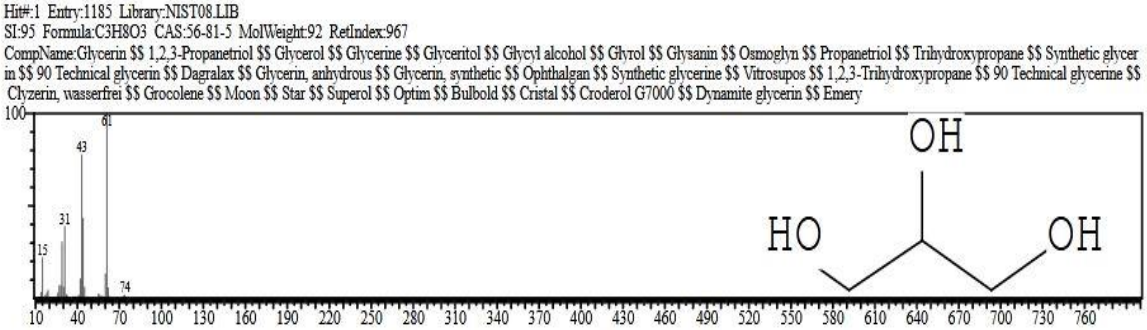


Figure (2): The compound (glycerin) diagnosed by GCM technique

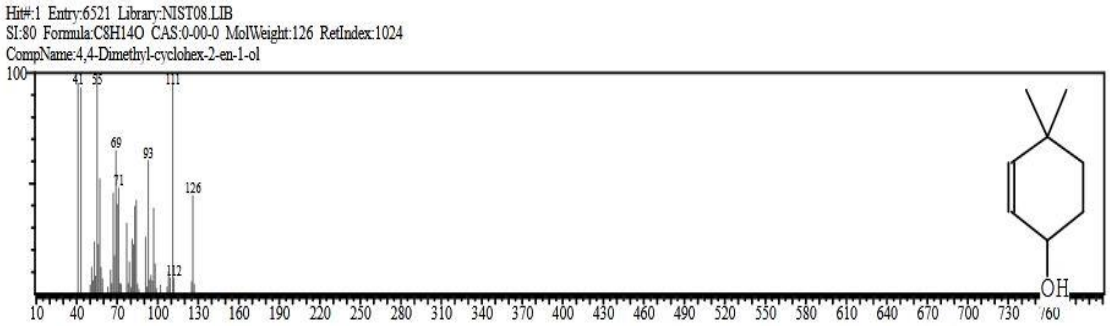


Figure (3): The compound (4,4-Dimethyl-cyclohex-2-en-1-ol (phenol)) diagnosed by GCMS technique.

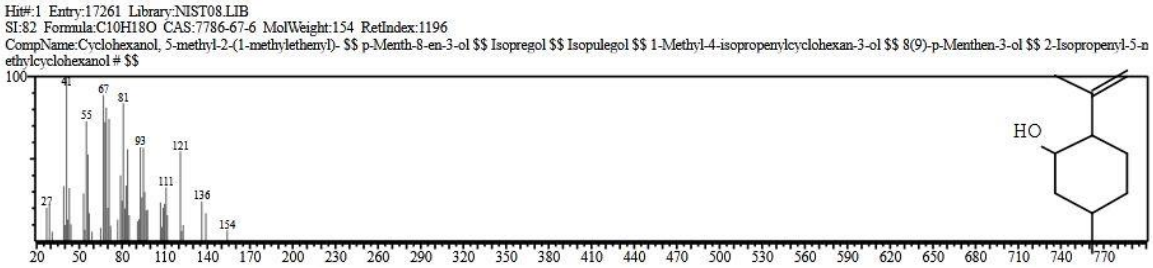


Figure (4): The compound (Cyclohexanol, 5-methyl-2-(1-methylenethenyl)-(phenol)) diagnosed by GCMS technique

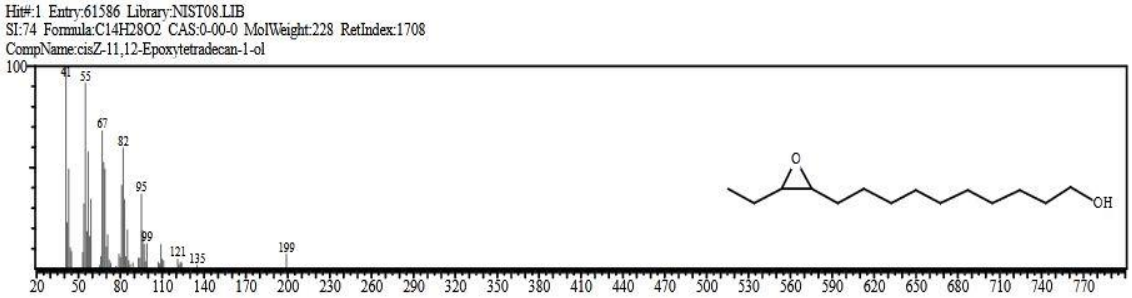


Figure (5): The cisZ-11,12-Epoxytetradecan-1-o (phenol) compound diagnosed by GCMS technique

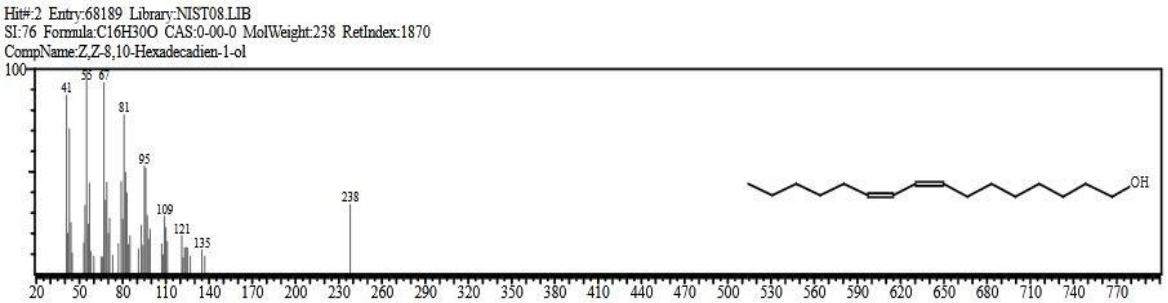


Figure (6): The compound (Z,Z-8,10-Hexadecadien-1-o) diagnosed by GCMS technique

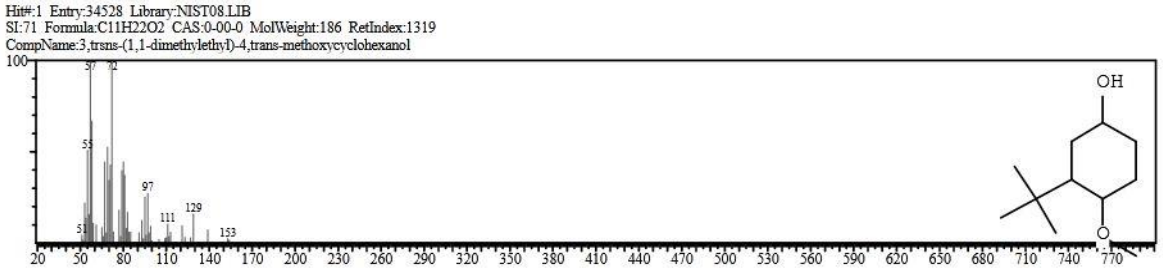


Figure (7): The compound (,trsns-(1,1-dimethylethyl) -4, trans-methoxycyclohexanol (phenol)) diagnosed by GCMS technique

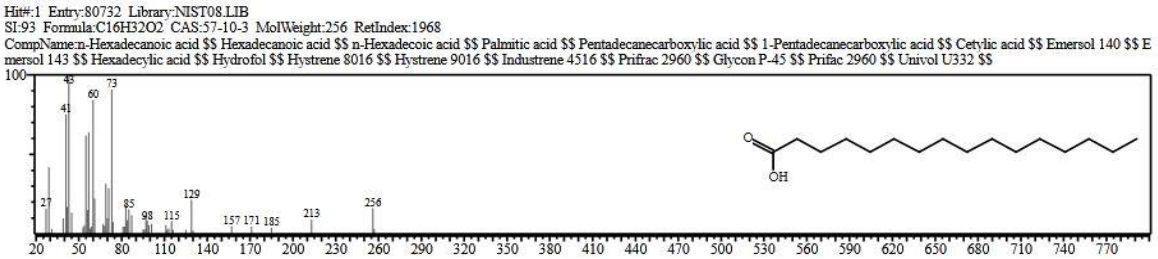


Figure (8): The compound (E-11,13-Tetradecadien-1-ol (phenol)) diagnosed by GCMS technique

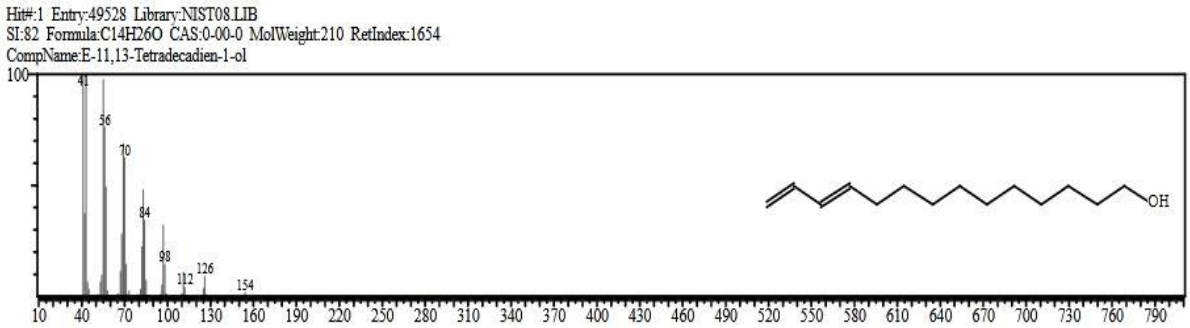


Figure (9): The compound (n-Hexadecanoic acid (Fatty acid)) diagnosed by GCMS technique

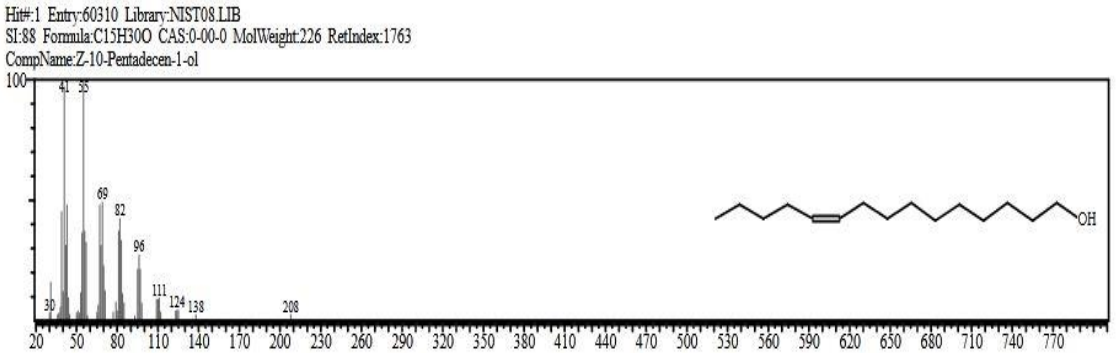


Figure (10): The compound (Z-10-Pentadecen-1-ol) diagnosed with GCMS technique

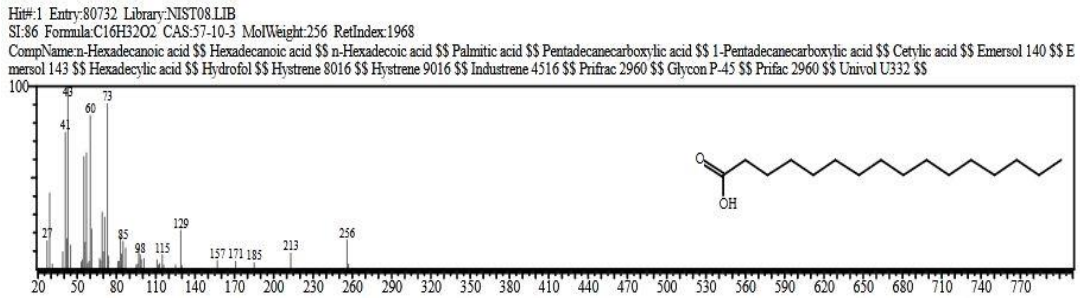


Figure (11): The compound (n-Hexadecanoic acid (Fatty acid)) diagnosed by GCMS technique

References

1) Hayawi , J.A., M.A.W.Taha and A. Sh. Hamad(2021) . The use of Trifloralin Herbicide , cultivation distances and cultivation method to control the weeds accompanying the local barley crop (Hordeum vulgare L.). IOP Conf. Series: Earth and Environmental Science 735

2) Waqas, M.B. (2006). Role of some agronomic traits for grain yield production in wheat (Triticum aestivum L.) genotypes under drought conditions. Revista Cintetifica UDO Agricola, 6:11-19.

3) Krishnaveni. M and Santhosh K.J (2019) FT-IR, GC-MS/MS Analysis of Essential Oil from Coriandrum sativum Seeds, Antibacterial Assay Advanced Biomedical Research., 7 (5) September 124-129

4) Al-Janabi, M, Ali A. and Haider H, Ahmed A. (2017). Effect of cultivation periods, seed quantities and nitrogen fertilizer on the quality of green fodder for cultivar barley (Hordeum vulgare L) Tikrit University Journal of Agricultural Sciences. Volume (17) Issue (2).

5) Hayawi , J.A and A. Sh. Hamad (2020). Effect of trifloralin herbicide in emergence, growth and production of seeds for wild radish (Raphanus raphanistrum L.) weed in different types of soil . Plant Archives Vol. (20) Supplement (1) . pp. 1700 – 1704.

6) Khaled, S Mustafa, Abbas H. Abdullah and Hawass H. Habar (2013). Plant growth stimulants (environmentally friendly). Al-Nahrain University Journal. 16 (4): 19-35.

7) Jamali, M. (2013). Investigate the effect of drought stress and different amount of chemical fertilizers on some physiological characteristics of coriander (Coriandrumsativum L.) International Journal of Allied Sciences IJFAS Journal. 2(20):872 – 879.

8) Abdel A. Mohammed (2015). Medicinal and aromatic plants. practical part . Directorate of Books and Publications - Tishreen University Publications - Faculty of Agriculture. Syrian Arab Republic .

9) Eidi, M., Eidi, A., Saeidi, A., Molanaei, S., Sadeghipour, A., Bahar, M., Bahar, K. (2009). Effect of coriander seed(Coriandrum sativum L.) ethanol extract on insulin release from pancreatic beta cells in streptozotocin-induced diabetic rats. Phytother Res., 23: 404-406.

10) Mohamed, M., M. Ibrahim , and H.Wahab (2018) . Flavoring compounds of essential oil isolated from agriculture waste of coriander (Coriandrumsativum L.) Plant . Journal of Materials and Environmental Science. 9(1): 77 – 82 .

11) Bhalsing S. R. and V. L Maheshwari J.Sci & Ind Res (2005) .57: 703 – 708 .

12) Hayawi , J.A. and M.A.W.Taha (2021) . Study of the effect of Soaking Periods and seed rate per unit area on some characteristics of barley culture (Hordeum vulgare L.) . Natural Volatiles and Essential Oils , 8 (6) : pp. 2200 – 2205.

13) Sultan,F., Al-Farha,A. and Shaaban, I (2020 a) Separation and identification of some fatty acids and phenolic compounds from PortulacaoleraceaL. and study their biological effect on two types of pathogenic bacteria Asian Journal of Agriculture and Biology. 2020;8(3):1-1.

14) Sultan ,F.I., Khorsheed,A.CH. and Khalel , A.(2020 b) Separation of four fatty acids and two phenolic compounds from Camellia sinensisusing chromatographic techniques and evaluation of their antibacterial activity ,EurAsian Journal of BioSciences,14, 2123-2129

15) Sultan ,F.I., (2020) Phytochemical Analysis And Anti Bacterial Activates Of Frankincense Of Bswellia Serrata Plant Archives Volume 20 No. 2,

16) Al Rawii .I, Reda (2008). Allelopathic interaction of wild oats and Saad with two cultivars of barley (Hordeum vulgare L), Journal of Education and Science - Volume (21) Issue (2).

17) Abdel H, Taif M, R, Zaid A, R, Lafta A, .Jaber, H, Razak. K. and Mustafa M. (2016). Effect of extracts of some medicinal plants on germination and seedling strength of alfalfa crop, Karbala Journal of Agricultural Sciences, (Volume III - Issue IV).

18) Satyal1, P and Setzer1, W.N (2020) Chemical Compositions of Commercial Essential Oils From Coriandrumsativum Fruits and Aerial Parts, Natural Product Communications journal , Volume 15(7): 1–12

19) Sunil ,K. S., Suma,A. Ashika, B. D., Roy , CH.L., Naresh, S .and Sathy amurthy,B.(2018) GCMS And Ftir Analysis on the methanolic extract of coriander Sativum leaves . European Journal of Pharmaceutical and Medical Research ejpmr, 2018,5(8), 454-460