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THE ANTIOXIDANT ACTIVITY AND CHEMICAL PROPERTIES OF THREE ESSENTIAL OILS THAT ARE GROWN IN EGYPT

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ABSTRACT: Numerous essential oils are widely recognized for their capacity to act as antioxidants. The three essential oils of clove, thyme, and marjoram were assessed for their physical (soluble in 80% ethanol, specific gravity, refractive index, and optical rotation) and chemical (acid number, saponification number, and ester number) qualities in the current study. The gas chromatography/ mass spectrum (GC/MS) method was utilized to ascertain the compositions of the essential oils, and the DPPH (2,2-diphenyl-1 picrylhydrazyl) free radical scavenging and reduction power tests were used to assess the antioxidant activity of the oils. The solubility of the oils of clove, thyme, and marjoram in 80% ethylene was found to be 1:1.5, 1:1.5, and 1:1.7, respectively, while specific gravity intensity was 1.08, 0.97 and 0.97 respectively, refractive index was 1.53, 1.53 and 1.50, respectively and optical rotation was -1.9, +5.47 and +6.01 respectively. On the other hand, chemical properties of clove, thyme and marjoram oils showed that; saponification number was 198.17, 195.32and 199.21(mg KOH/g oil), respectively, while acid number was 11.39, 11.83 and 12.03 (mg KOH/g oil), respectively, and ester number was 186.78, 183.49and 187.18 (mg KOH/g oil) respectively. Major identified components were benzene-methanol 50.74 % for clove essential oil, o-cymene 42.0% for thyme essential oil and 3-cyclohexen-1-o1 23.32% for marjoram essential oil. The three essential oils clove, thyme and marjoram showed an IC_{50} of 17.74%, 15.67% and 14.63% respectively for in the DPPH assay.

Key words: Antioxidant activity, Essential oils, Physical and chemical properties of oils.

INTRODUCTION

Large amounts of antibiotics used for human therapy, as well as for farm animals and even for fish in aquaculture, resulted in the selection of pathogenic bacteria resistant to multiple drugs. Multi drug resistance in bacteria may be generated by one of two mechanisms. First, these bacteria may accumulate multiple genes, each coding for resistance to a single drug, within a single cell. This accumulation occurs typically on resistance (R) plasmids. Second, multidrug resistance may also occur by the increased expression of genes that code for multidrug efflux pumps, extruding a wide range of drugs (Hiroshi, 2009). Medicinal and aromatic Plants are nature's gift to humans, enabling them to live healthy, disease-free lives. Because of their potential to combat a variety of ailments with no negative side effects and economic viability, scientists have been looking into the medicinal qualities of plants in recent years, both domestically and internationally. Numerous bioactive substances found in a wide range of plants have been shown to have a variety of biological effects, such as being anti-inflammatory, anti-carcinogenic, and antioxidant. (Ganga *et al.*, 2011**)**. Many studies have indicated the vital role that plants, and their effective components play in improving public health in general, especially improving blood lipid profile indicators (Abozid, and Farid, 2013; Abozid and Ahmed, 2013; Abozid *et al*., 2014; Farid *et al.*, 2015; Ashoush *et al.*, 2017; El-Shennawy, and Abozid, 2017).

There is mounting evidence that oxidative stress causes numerous metabolic alterations in people, which in turn cause significant illnesses. Basic biomolecules including deoxyribonucleic

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acid (DNA), proteins, and lipids can be damaged by oxidative stress, which can have cytotoxic and genotoxic effects. Oxidative stress results from the production of free radicals, also known as reactive oxygen species (ROS), during metabolism and other activities that exceed a biological system's antioxidant capacity. Cardiovascular disorders, neurode generation, cancer, and the aging process are all impacted by oxidative stress. (Praveen *et al.,* 2007). The antibacterial qualities of extracts from aromatic medicinal plants—more especially, essential oils—have attracted a lot of attention lately. Essential oils are complex, volatile chemicals with a distinctive smell that are spontaneously generated as secondary metabolites by aromatic plants. They are abundant in substances that have biological activity (Bishop and Thornton 1997). Therefore, phytochemicals class of physiologically active substances—are abundant in plants. It has been discovered that phytoconstituents scavenge free radicals to function as antioxidants. Many of these constituents also possess antibacterial activity and the ability to treat illnesses linked to free radicals. (Molan *et al.,* 2012). With over 500,000 plants in the globe that have not yet been investigated for medical purposes, and with ongoing and upcoming research on medicinal activities showing promise for illness treatment, the future of medicinal herbs looks bright. Therefore, the purpose of this research is to evaluate the chemical compositions, physico-chemical properties, and investigate the antioxidant activity of clove, thyme, and marjoram essential oils in vitro.

MATERIALS AND METHODS

1- Materials

The Ministry of Agriculture, Giza, Egypt's horticulture department (medicinal and aromatic plants section) provided the marjoram (*Origanum marjoram*) and thyme (*Thymus vulgaris*) leaves, while the Cairo Food Flavor Essence Company provided the clove (*Eugenia caryophyllus*) flower buds.

Table 1: Sources of essential oils from the medicinal and aromatic plants under investigation, together with their Latin names, family names, and botanical parts:

Plant	Latin names	Scientific name	Familyname	Plant part	الاسم العربى
Thyme	*Thymus valgarius,l*	Thyme	*Labiata*	Leaves	الزعتر
Clove	*Eugenia caryophyllus*	Syzygium	*Myrataceae.*	Flower buds	القرنفل
Marjoram	*Origanum marjorama*	Marjoram	*Labiata*	Leaves	البردقوش

2- Method

2.1. Essential oils extraction

Essential oils extraction was carried out by water distillation using special apparatus with general features as devised by Golmohammadi *et al*., (2018), the percentage of the essential oil was calculated and expressed as volume/weigh.

2.2. Physical properties of essential oils

2.2.1. Determination of solubility in 80% ethanol

By titrating a known volume (1 ml) of essential oil with ethanol 80 % to the point of homogeneity, the solubility in 80 % ethanol was ascertained and is expressed as volume /volume (Yadav, 2022).

2.2.2 Specific gravity determination (SG)

Using a pycnometer with a one milliliter capacity, the oil's specific gravity was ascertained, following (Guenther 1960).

2.2.3. Refractive index determination (RI)

According to A.O.A.C. (1975), the Abbe refractometer model 60 was used to calculate the refractive index.

2.2.4. Optical rotation measuring

Using a sodium lamp at room temperature, a polarimeter was used to measure the oils' optical rotation. The following formula (td=/dL) was used to determine the oils' specific optical rotation, as stated by Guenther (1960).

Where: L is the polarimeter tube's length in decimeters; t is the observed optical rotation; and d is the oil's specific gravity measured at 20 degrees Celsius.

2.3. Chemical properties

2.3.1. Acid number determination

The procedure outlined in (A.O.A.C 1975) was used to calculate the acid number. An indicator, phenolphthalein, was used to titrate an oil sample with a known weight of 1g that had been dissolved in 10 ml of neutral ethanol by ethanolic potassium hydroxide (0.1 N).

$$\text{Acid number} = \frac{V \times N \times 56.1}{W} \quad \frac{V \times N \times 56.1}{W}$$

Where:

V: KOH solution volume in milliliters.

N: the KOH solution's normalcy.

W is the oil's weight in grams.

2.3.2. Determination of saponification number:

The following method, which was basically identical to the conventional process previously reported by Gunther (1961), was used to calculate the saponification number. It involved accurately weighing 1.5 grams of oil in a 150 ml flask and using phenolphthalein as an indicator. Ethanolic potassium hydroxide (approximately 0.5 N) in a predetermined volume (10 ml or 20 ml) was used to treat the oil. Using an air-cooled condenser, the mixture was heated in a water bath for one hour at 100 c. After this time, the indicator was used to back titrate the excess potassium hydroxide using hydrochloric acid (0.15 N). Ethanolic potassium hydroxide in the same quantity was used for the blank determination. The number of saponification was computed using the following equation:

$$\text{Saponification number} = \frac{56.1(\text{blank titr.} - \text{titr.of sample})\ N \text{ of HCL}}{\text{Weight of sample oil in grams}} \quad \frac{56.1(\text{blank titr.} - \text{titr.of sample})\ N \text{ of HCL}}{\text{Weight of sample oil in grams}}$$

2.3.3. The ester number calculating:

According to Gunther (1961), the ester number is the difference between the saponification number and acid number.

Ester number = Saponification number - Acid number

2.4. Chemical composition

2.4.1. GC-Ms analysis

Using gas chromatography-mass spectrometry instrument stands at the Laboratory of Medicinal and Aromatic Plants, National Research Center, the GC-Ms analysis of the essential oil samples was performed in the second season with the following specifications. The instrument used is a THERMO Scientific Corp., USA, TRACE GC Ultra Gas Chromatograph, connected to an ISQ Single Quadrupole Mass Spectrometer THERMO mass spectrometer detector. A TG-WAX MS column (30 m x 0.25 mm i.d., 0.25 µm film thickness) was fitted to the GC-MS system. Helium was used as a carrier gas for the analyses with the following temperature program and a flow rate of 1.0 mL/min at a split ratio of 1:10: 40 C for one minute; 4.0 C/min rise to 150 C, held for six minutes; 4.0 C/min rise to 200 C, kept for one minute. 200 C was maintained for the injector and 200 C for the detector, respectively. Injections of 0.2 µL of the mixes were always made using diluted samples (1:10 hexane, v/v). Using a spectral range of m/z 40-450, mass spectra were produced by electron ionization (EI) at 70 eV. Most of the compounds were identified by means of two distinct analytical techniques: (a) mass spectra (genuine chemicals and Wiley spectral library collection) and (b) KI, Ko vats indices in reference to alkanes (C9-C22), Wallace *et al.*, (2017). When identification was based solely on mass spectral data, it was deemed uncertain.

2.5. Antioxidant activity

2.5.1. Determination of reducing power

Reducing power ability, the samples were determined using the method of Adesegun *et al.*,(2008) by mixing 2.5 mL of oil samples of various concentrations of essential oils with 2.5 mL of potassium ferricyanide and incubate at 50^{o}C for 20 min (trichloroacetic acid 2.5mL, 10%) was added and centrifuged (1000Xg,10min) the supernatant (2.5mL) was mixed with equal volume of distilled water and ferric chloride (0.5ml,.1%) the absorbance was measured at 700nm against a reagent blank.

2.5.2. DPPH radical scavenging activity

DPPH radical scavenging assay the antioxidant activity of EOS was measured on basis of the scavenging activity of the stable 1, 1dipheny1-2-picrylhyorazyl (DPPH) free radical according to the recorded by Baratta *et al.*, (1998), with slight modifications 1 ml of 0.1 Mm DPPH solution of various concentrations (25, 50, 75, 100µg/ml), corresponding blank sample were repaired and 1ml ascorbic acid (25-100µg/ml) was used as reference. Standard mixture of 1ml methanol and 1ml DPPH solution was used as a control the reactions carried out in triplicate and the decrease in absorbance was measured at 517nm after 30 minutes in dark using UV-Vis spectrophotometer in the inhibition %was calculated using the following formula:

Inhibition %=Ac-As/Ac×100.

Ac is the absorbance of control.

As is the absorbance of sample.

RESULTS AND DISCUSSION

1. Physico-chemical properties of essential oils:

It well known that the determination of physicochemical properties of essential oils is very important to evaluate their values and application. Therefore, the physicochemical properties of clove, thyme and marjoram essential oils were determined, and the results are shown in Table (2).

Thyme had the lowest dextro rotation (+5.47) and clove essential oil stood out for its levo-rotation (-1.9) in terms of optical rotation. Dextro rotation (+6.01) was the defining characteristic of marjoram essential oil. Clove essential oil had a greater specific gravity (1.0787) than marjoram and thyme, which had specific gravities of (0.9711) and (0.9734), respectively. The refractive index likewise revealed the same pattern, with thyme recording 1.5349. Marjoram and clove recorded 1.4952 and 1.5344, respectively. It was discovered that the solubility of marjoram essential oil in 80%ethanol was 1:1.7 vol/vol, but the ratio for both thyme and clove essential oils was 1:1.5 vol/vol. The investigation's essential oils had acid numbers of 11.39 for clove, 11.83, and 12.03 for thyme, marjoram, and thyme, respectively. The greater results suggested that there were significant levels of organic acids present. Regarding ester, table (2)'s data revealed that thyme essential oil had the lowest ester value of 183.49, while marjoram essential oil had the highest value of 187.18. Clove essential oil came in second with a value of 186.78. These results correspond with the information provided by Masada (1980), Farag *et al.*, (1986), and El-Baroty (1988) and Soliman (1990).

Table 2: The physico-chemical properties of clove, thyme, and marjoram essential oils

Property	Clove essential oil	Thyme essential oil	Marjoram essential oil
Optical rotation	-1.9	+5.47	+6.01
Specific gravity	1.0787	0.9711	0.9734
Refractive index	1.5344	1.5349	1.4952
Solubility in 80%Et	1:1.5	1:1.5	1:1.7
Acid number	11.39	11.83	12.03
Saponification number	198.17	195.32	199.21
Ester number	186.78	183.49	187.18

2. Chemical composition of essential oils

The chemical composition of clove, thyme, and marjoram flower buds was examined using their essential oils. For this, the gas-liquid chromatography–mass spectrometry approach was used.

2.1. Chemical composition of clove essential oils

The information regarding the chemical composition of clove essential oil was displayed in Table (3). Based on the data, it is evident that the primary constituents included in clove essential oil were benzene methanol (50.74%), phenol (48.40%), benzaldehyde (0.15%), tetradecane (0.08%), and naphthalene (0.03%). 0.02% eugenol. The eugenol content of clove essential oil is highest in flowers (87-96%), followed by β-caryophyllene in leaves (11-19%) and eugenoleacctate in clove leaves (8-21%). These results are consistent with those reported by Choi *et al.* (2014) regarding the composition of clove essential oil.

Table 3: Chemical composition of clove essential oil:

Components	Retention time	Area%
Benzene-methanol	7.38	50.74 %
Phenol	19.52	48.40 %
Benzaldehyde	5.51	0.15 %
Tetradecane	2.27	0.08 %
Naphthalene	25.63	0.03 %
Eugenol	19.90	0.02 %

2.2. Thyme essential oil chemical composition

Table 4 presents the elements of thyme essential oil. The results indicates that thyme essential includes mostly o-cymene (42.0%)., f-terpinene (17.43%), thymol (10.79%), a-linalool (3.15%), 2-thujene (3.13%),1R-a-pinene (2.60%), a-pinene (2.60%), cyclohexene (2.58%), eucalyptol (2.20%), camphene (2.03%), caryophyllene (1.85%), 3-cyclohexen-1-o1, (1.48%), benzene, (1.16%), endo-borneol (1.07%), benzene, (0.75%), (+)-2-bornanone (0.71%), a-pinene (0.64%), carvone (050%),1-octen-3.01(0.49%), 2-thujene (044%), Cyclohexanone 1-menthone (040%), cyclohexonol (036%), caryophylleneoxide (0.34%), bornylacetate (0.29%),a-terpineol (0.20%), 1-menthone (019%), cyclohexene, (018%), thymol(0.15%), naphthalene, (0.14%), comparable outcomes were attained by El Baroty (1988), Farag *et al.,* (1989), Zani *et al.*,(1991), Perracci *et al.,* (1994), Bhaskara and Reddy (1998), in which they mentioned that o-cymene and F-terpinene were the major substances for thyme essential oil. These results are not far from what was found in previous studies, y-terpinene; thymol and cymene are the primary ingredients of thyme essential oil in numerous earlier investigations (Ballester-Costs *et al.,* 2013; De Lisi *et al.,* 2011; Imelouane *et al.*,2009; Kowalski and Wawrzykowski, (2009).

2.3. Marjoram essential oil chemical composition

Table 5 presents the elements of marjoram essential oil. The research indicates that marjoram essential oil mostly contains 3-cyclohexen-1-o1, (23.32%), cyclohexonol, (16.32%), f-terpinene (13.23%), a- phellandrene (7.40%), cyclohexanol, (4.07%), a-terpineol (3.85%), Cyclohexonol, (3.08%), linalylacetate (2.77%),caryophyllen (2.59%), a- phellandrene (2.30%), d-limonene (1.92%),a-pinene (1.62%), 2- cyclohexen-1-o1, (1.58%),m-cynene (1.48%),

cyclohexan, (1.28%), 2-cyclohexen-1-o1, (0.88%), a-pinene (0.76%), a-phellandrene (0.70%), a-phellandrene (0.46%), a-pinene (0.41%), 2-cyclohexen-1-o1,(0.33%), 3-cyclohexen-1-o-o1 (0.25%), humulene (0.10%), acetic acid, (0.08%), caryophyllene. oxide (0. 6%), (-)-spathulenol (0.05%), isoborneol (0.05%), cyclohexen (0.04%). Comparable outcomes were attained by El Baroty, (1988), Farag *et al.,* (1989); Zani *et al.,* (1991), Perracci *et al.,* (1994); Bhaskara and Reddy, (1998). These results are largely consistent with many previous studies that were conducted on the marjoram essential oil (Komaitis *et al.,* 1992 and Sarer *et al.,* 1982). Although there are some differences that maybe due to the different plant variety, planting season, and harvest stage.

Table 4: Chemical composition of thyme essential oil:

Component	Retention time	Area%
o-cymene	6.99	42.0
y-terpinene	8.03	17.43
Thymol	17.73	10.79
a-linalool	9.60	3.15
2-thujene	4.23	3.13
1R-a-pinene	4.42	2.60
a-pinene	5.80	2.60
Cyclohexene	6.66	2.58
Eucalyptol	7.18	2.20
Camophene	4.84	2.03
Caryophyllene	22.54	1.85
3-Cyclohexen-1-o1	12.81	1.46
Benzene,	14.84	1.16
Endo-Borneol	12.56	1.07
Benzene	15.21	0.75
(+)-2-Bornanone	11.59	0.71
a-pinene	5.54	0.64
Carvone	15.77	0.50
1-octen-3.01	5.69	0.49
2-thujene	6.37	0.44
Cyclohexanon1-menthone	11.91	0.40
cyclohexonol	12.79	0.36
Caryophylleneoxide	29.08	0.34
Bornylacetate	17.06	0.29
a-terpineol	13.58	0.20
1-Menthone	12.27	0.19
Cyclohexene	8.97	0.18
Thymol	18.18	0.15
Naphthalene	26.54	0.14

Table 5: Chemical composition of marjoram essential oil:

Component	Retention time	Area%
3-cyclohexen-1-o1	12.92	23.32%
Cyclohexonol	9.73	16.32%
F-terpinene	8.05	13.23%
Cyclohexen	6.68	8.98%
a- phellandrene	5.40	7.40%
cyclohexanol	8.56	4.07%
a- terpineol	13.57	3.85%
Cyclohexonol	8.97	3.08%
Linalylacetate	15.56	2.77%
Caryophyllen	22.47	2.59%
a- phellandrene	7.14	2.30%
D-limonene	7.07	1.92%
a-pinene	5.81	1.62%
2-cyclohexen-1-o1,	10.60	1.58%
m-cynene	6.99	1..48%
Cyclohexan	25.61	1.28%
2-cyclohexen-1-o1	11.35	0.88%
a-pinene	4.42	0.76%
a- phellandrene	4.23	0.70%
a- phellandrene	6.37	0.46%
a -pinene	5.55	0.41%
2-cyclohexen-1-o1	14.11	0.33%
3-cyclohexen-1-o-o1	17.57	0.25%
Humulene	23.98	0.10%
Acetic acid	17.08	0.08%
Caryophyllene. Oxide	29.10	0.06%
(-)-spathulenol	28.97	0.05%
Isoborneol	12.59	0.05%
Cyclohexen	6.29	0.04%

3. Antioxidant activity of marjoram, thyme, and cloves essential oils

It is commonly recognized that the ability of essential oils to both absorb free radicals and donate electrons or hydrogen atoms is what gives them their antioxidant properties. One test used to demonstrate the components of essential oils' capacity to behave as hydrogen atom donors is the DPPH analysis. The DPPH method's basic idea is that an antioxidant agent reduces the alcoholic DPPH solution by causing the non-radical form DPPH–H to develop (Oyaizu, 1986). The DPPH method has been extensively employed to evaluate the effectiveness of various antioxidant compounds in scavenging free radicals (Ozcelik *et al.*, 2003).

To enhance their sensory qualities and prolong their shelf life, numerous herbs, such as thyme, marjoram, and clove, as well as their extracts, have been added to a range of foods (Burt, 2004). Since natural plant preservatives are generated from compounds with antioxidant and antibacterial capabilities, using them to extend the shelf life of food goods has become a promising technological advancement in recent years. Essential oils have the potential to serve as a natural antioxidant source and a potential substitute for artificial antioxidants in food products, helping to stop oxidative deterioration. The majority of these phytochemicals from the aforementioned medicinal plants ought to be incorporated into a daily diet soon, and side effects from antibiotics and conventional medications that may affect human health must be avoided (Roychoudhury and Bhowmik, 2020).

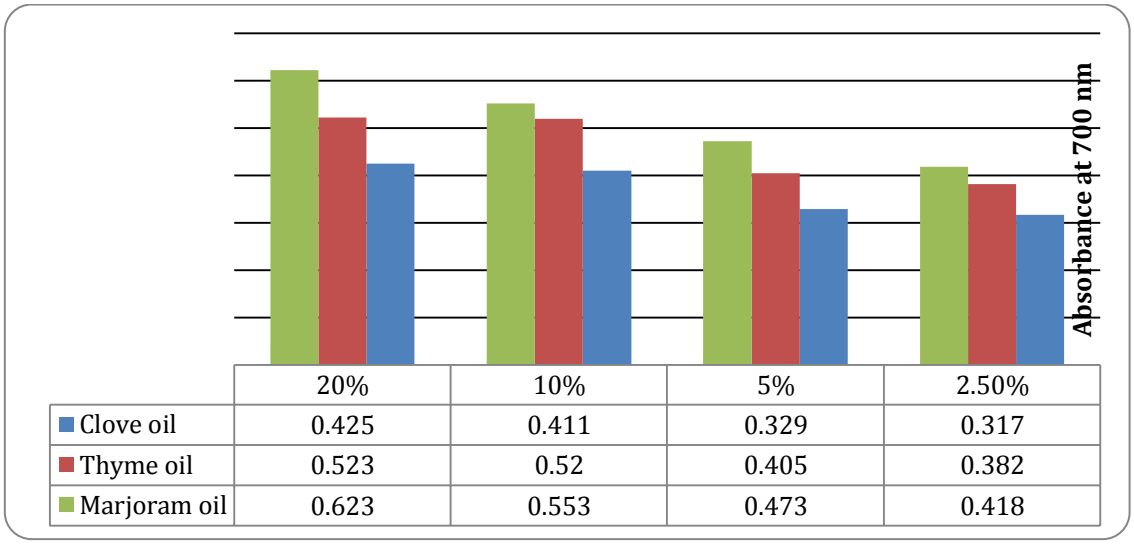
3.1. Reducing power assay for clove, thyme and marjoram essential oils

Fe (III) reduction is frequently employed as a measure of electron-donating activity, a crucial process in the antioxidant action of phenols (Nabavi *et al.*, 2009). Reductants, often known as antioxidants, would cause Fe+3 to be reduced to Fe+2 in this assay by giving up an electron. The production of Perl's Prussian blue at 700 nm can then be used to measure the amount of Fe+2 complex. An increase in reductive ability is indicated by an increase in absorbance at 700 nm. The dose-response curves for the reducing abilities of the essential oils of marjoram, thyme, and clove are displayed in Table (6) and are further illustrated in Figures 1.

It was discovered that when essential oil concentrations rose, so did the oils' lowering abilities. Marjoram essential oil had the highest activity of all the oils tested, (0.623) at the highest concentration (20%), followed by thyme essential oil (0.523) and clove essential oil (0.425) at the same concentration. Research has demonstrated that a compound's ability to reduce power may be a key marker of its possible antioxidant activity (Adesegun *et al.*, 2008). This theory was supported by the current investigation, which found that oils from lavender, eucalyptus, clove, mint, and rosemary, which had higher phenolic content, had higher antioxidant components and activity.

Table 6: Reducing power assay for tested plant oils.

Essential oil concentration	Absorbance at 700 nm		
	Clove essential oil	Thyme essential oil	Marjoram essential oil
2.5%	0.317	0.382	0.418
5%	0.329	0.405	0.473
10%	0.411	0.520	0.553
20%	0.425	0.523	0.623



	20%	10%	5%	2.50%
Clove oil	0.425	0.411	0.329	0.317
Thyme oil	0.523	0.52	0.405	0.382
Marjoram oil	0.623	0.553	0.473	0.418

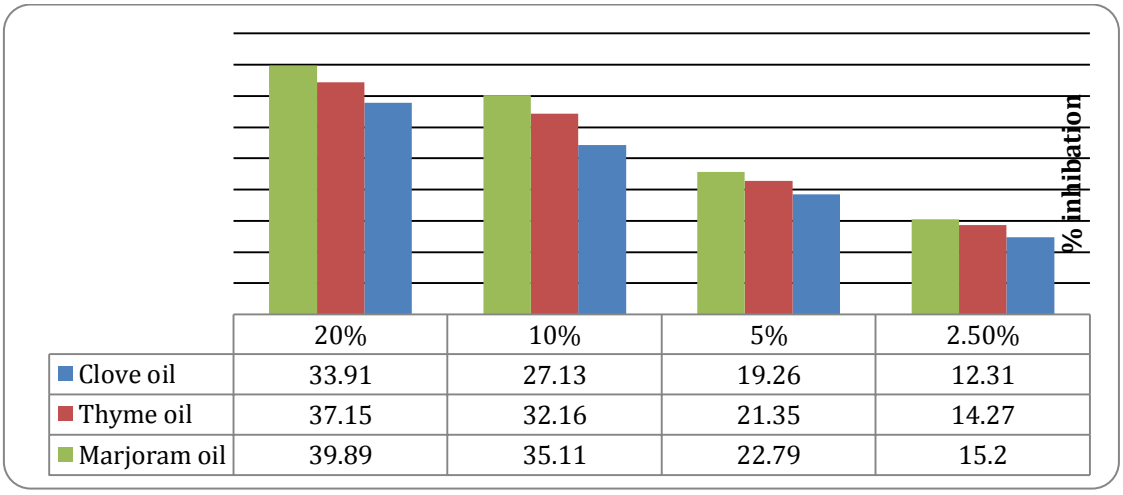
Fig. 1: Reducing power activity of different tested essential oils.

Previous studies (Jirovetz *et al.*, 2006 and Wei and Shibamoto, 2010) have indicated that clove essential oil is one of the strongest antioxidants, even surpassing some synthetic antioxidants like BHT. Eugenol, the primary component of clove essential oil, is known to have antioxidant activity, which may account for some of its potent properties (Ruberto and Baratta, 2000).

3.2. DPPH radical scavenging activity

When DPPH is reduced by hydrogen or electron donation, it transforms from violet to yellow, indicating that it is a stable free radical with a nitrogen core. The ability to carry out this reaction makes certain substances antioxidants and consequently radical scavengers. Because of their superior structural chemistry, phenolic compounds have been reported and shown to be potent hydrogen donors to the DPPH radical (Von *et al.*, 1997). In fact, the free radical scavenging method (DPPH) demonstrated the reduction of DPPH solutions in the presence of a hydrogen donating antioxidant (Rice-Evans *et al.*, 1997).

The data in Table 7 and Figure 2 indicates that, among the three essential oils—marjoram, thyme, and clove—at three concentrations (2.5%, 5%, 10%, and 20%), the essential oils with the highest percentage of inhibition of the free radical DPPH (I%)—marjoram essential oil showed the highest percentage (15.2, 22.79, 35.11, and 39.89, respectively) with an IC 50 of 14.63%, followed by thyme essential oil (14.27, 21.35, 32.16, and 37.15, respectively) with an IC 50 of 15.67%, and clove essential oil displayed the lowest percentage (12.31, 19.26, 27.13, and 33.91, respectively) with an IC 50 of 17.74%.



	20%	10%	5%	2.50%
Clove oil	33.91	27.13	19.26	12.31
Thyme oil	37.15	32.16	21.35	14.27
Marjoram oil	39.89	35.11	22.79	15.2

Fig. 2: Clove, thyme, and marjoram essential oils' capacity to scavenge the DPPH radical at various concentrations.

Table 7: DPPH radical scavenging activity for clove, thyme and marjoram essential oils.

Essential oils	% Inhibition of DPPH				IC 50
	2.5%	5%	10%	20%	
Clove	12.31	19.26	27.13	33.91	17.74%
Thyme	14.72	21.35	32.16	37.15	15.67%
Marjoram	15.20	22.79	35.11	39.89	14.63%

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النشاط المضاد للأكسدة والخواص الكيميائية لثلاثة زيوت عطرية نامية في مصر

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الملخص العربي

تشتهر أعداد كبيرة من الزيوت العطرية بخصائصها المضادة للأكسدة. في هذه الدراسة، تم تقييم ثلاثة زيوت عطرية (زيت القرنفل والزعتر والبردقوش) من حيث خواصها الفيزيائية (الذوبان في ٨٠% إيثانول، و معامل الإنكسار، والكثافة النوعية، والدوران الضوئي) وكذلك الخواص الكيميائية (رقم الحامض، ورقم التصبن ورقم الإستر). تم تفريدمكونات الزيوت العطرية بواسطة GC-MS جهاز الكروماتوجرافى الغازى وتم تقييم نشاطها المضاد للأكسدة من خلال تحديد القدرة المخفضة على الجذور الحرة DPPH (٢،٢-ثنائي فينيل -١ بيكريل هيدرازيل). أظهرت الخواص الفيزيائية لزيوت القرنفل والزعتر والبردقوش ما يلي: كانت الذوبان في ٨٠%ايثانول ١:١.٥و١:١.٥ و١:١.٧ على التوالي، في حين كانت الكثافة النوعية ١.٠٨ و٠.٩٧ و٠.٩٧ على التوالي، وكان معامل الانكسار ١.٥٣ و١.٥٣ و١.٥٠ على التوالي وكان الدوران الضوئي -١.٩ و+٥.٤٧. و+٦.٠١ على التوالي. ومن ناحية أخرى أظهرت الخواص الكيميائية لزيوت القرنفل والزعتر والبردقوش أن؛ رقم التصبن كان ١٩٨.١٧، ١٩٥.٣٢ و١٩٩.٢١ (مجم KOH/جم زيت)، على التوالي، بينما كان رقم الحامض ١١.٣٩، ١١.٨٣ و١٢.٠٣ (مجم KOH/جم زيت)، على التوالي، وكان رقم الإستر ١٨٦.٧٨، ١٨٣.٤٩ و١٨٧.١٨ (مجم KOH/ جم زيت) على التوالي. المكونات الرئيسية التي تم تحديدها هي الأوجينول ١٩.٩٠% لزيت القرنفل العطري، النفثالين ٢٦.٥٤% لزيت الزعتر العطري وأكسيد الكاريوفيلين ٢٩.١٠% لزيت البردقوش العطري. أظهرت الزيوت العطرية الثلاثة، القرنفل والزعتر والمردقوش، IC٥٠ بنسبة ١٧.٧٤% و١٥,٦٧% و١٤,٦٣% على التوالي في اختبار DPPH.

الكلمات المفتاحية: النشاط المضاد للأكسدة، الزيوت العطرية، الخواص الفيزيائية والكيميائية للزيوت.