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ANTIOXIDATIVE AND ANTIMICROBIAL ACTIVITIES OF NATURAL COMPOUNDS EXTRACTED FROM GARLIC CLOVES

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ABSTRACT

The work to be described here was carried out to separate and identify the phenolic acids of different types of garlic cloves produced in Egypt, as well as studying the possibility of using these compounds as antioxidants by adding them to the sunflower oil at levels of 200, 300 and 400 ppm. The second target of this study is to evaluate the aforementioned compounds microbiologically. The antioxidative effectiveness of phenolic compounds was compared with butylated hydroxy toluene (BHT). The antimicrobial activity of garlic cloves fixed oil was also assayed against some selected microorganisms by disc-diffusion method. HPLC analysis indicated that methanolic extracts of garlic cloves contained large number of phenolic acids, where more than ten phenolic acids were identified. Generally, garlic cloves methanolic extracts contained high levels of gallic, P-hydroxbenzoic, tannic, caffeic and ferulic acids. Moreover, the results of peroxide values (PV,s) indicated, that methanolic extracts from different types of garlic cloves showed stronger antioxidative activity than that of BHT. The antimicrobial effects of garlic cloves fixed oil were compared with phenol (1 and 10%). The diameters of the inhibition zones (mm) were taken as criterion of antimicrobial spectra. However, the data indicated that all samples of garlic cloves oils possess stronger antimicrobial activity than that of 1% phenol. In general, the data showed that, *Bacillus subtilis* was the more sensitive microorganisms to garlic cloves oil at the most applied concentrations, where *Pseudomonas spp.* was the second sensitive one, while fungi strains were the lowest sensitive to the aforementioned material at the most applied concentrations. From the above mentioned results, it could be concluded that garlic cloves, which used as a spice, flavouring agent and in Egyptian salad dishes, have available constituents, which can be used as vital elements and acts as a microbial balancer in the alimentary canal. However, the antioxidant properties of garlic cloves extract and the fixed oil clarify the possibility of using them in the medicinal purposes.

INTRODUCTION

Garlic (*Allium sativum*) is considered one of the most popular vegetable cultivated exclusively for human consumption, which is eaten either raw or cooked. It likes many other strong smelling initiating plants, having a traditional place in folk medicine for many countries (Habashy *et al.*, 2000). In addition, garlic from the nutritional point of view is an important plant widely used for both culinary and medicinal purposes because of its ability to improve the taste of food and its biological activities that include antibiotic, antitumor, cholesterol lowering and antithrombic effects on animal cells (Fujiwara and Natata, 1967). Moreover there are several medical advantages of using garlic and its extracts, since they have been shown to reduce cardiovascular risk factors and carcinogenesis induced by certain chemicals

and viruses. furthermore, total and LDL cholesterol are lowered by up 8%, blood pressure by about 5%, but not HDL cholesterol of serum triglycerides (Steiner *et al.*, 1998).

Polyphenols are secondary plant metabolites occurring widely in plant food (Harbone, 1989). They possess outstanding antioxidant and free radical scavenging properties, suggesting a possible protective role in man (Laughton *et al.*, 1991 and Scott *et al.*, 1993). Polyphenols possess powerful antioxidative properties (Maxwell *et al.*, 1994 and Serafini *et al.*, 1994), and are now considered to be potentially important for the prevention of chronic diseases in man. Garlic cloves represent an excellent source of antioxidant polyphenols (Sun, *et al.*, 1984 and Youn-Soon, *et al.*, 1997). However, antioxidants in foods have recently attracted special interest because they can protect the human body from free radicals, which may cause various diseases and aging (Osawa *et al.*, 1987 and Cutler, 1992).

Several studies were reported dealing with natural antioxidants extracted from plant sources, which some of them have strong activity and are more effective than some of the synthetic antioxidants (Kramer, 1985; Gamel, 1995; Moussa 1996 and Salama, 2000)

No enough attempts have been done to study the antimicrobial and antioxidative activities of oils and phenolic compounds extracted from garlic cloves, therefore, this study was undertaken to isolate and identify the phenolic acids in methanolic extracts of different types of garlic cloves produced in Egypt. The second target of this work is trying to utilize the phenolic extracts and crude oils by using them as natural antioxidants and antimicrobial agents.

MATERIALS AND METHODS

Materials :

Five entries of exotic garlic were obtained from Asian Vegetable Research and Development Center (AVRDC) in Taiwan besides the dominate variety that cultivated in Egypt (Balady) the aforementioned samples (seds 40, VFG-180 "3-1", G98-6-1, Strain 133 and Balady) were evaluated in the Experimental farm of the Faculty of Agriculture, Kafr El-Sheikh during the two successive seasons of 2001/2001 and 2001/2002. The used samples were ranked as the following order.

Garlic sample No. 1 named Balady
Garlic sample No. 2 named seeds 40
Garlic sample No. 3 named VFG 180 (3-1)
Garlic sample No. 4 named G 98-6-1
Garlic sample No. 5 named strain 133

Synthetic antioxidants and oils :

Butylatedhydroxy toluene (BHT) was provided from Tokyo Kasei Kogyo Co. (Tokyo, Japan). Sunflower oil free of added antioxidants was obtained from Tanta Company for Oils and Soaps, Tanta, Egypt.

Methods :

Preparation of garlic cloves :

Garlic cloves were manual peeled, then dried in an air oven under vacuum. The dried garlic cloves were ground in a hammer mill to pass through 100 mash screen sieve, the obtained powder was packaged in polyethylene bags and stored at 4°C until used.

Garlic cloves oils extraction :

Garlic cloves oils were extracted with n-hexan in a soxhlet apparatus. The solvent was evaporated in a rotatory evaporator under vacuum. The oily residue was considered as the total lipid and expressed as percentage of dry weight (Holme and Hazel, 1983).

Extraction of phenolic compounds from garlic powder :

Phenolic compounds of garlic powders were extracted following the method of Rodriguez de Sotillo *et al.* (1994) using methanol 95% under cooling temperature (4°C) as follows : Five grams of garlic powder were homogenized for 4 min (in a dualrange Osterizer blender) with 29 ml of cold methanol. The resulting slurry was centrifuged (Hettich, Mikro Rapid/K type 1306) at 3000 xg for 10 min at 5°C. The supernatant liquid was filtered through Whatman No. 4, filter paper and the filtrate was collected for quantitative analysis.

Quantitative determination of total polyphenolic compounds :

A suitable aliquot of methanolic extracts of each sample of garlic cloves under investigation containing not more than 0.5 ml of acetone was diluted with distilled water to about 7 ml. in 10 ml graduated test tube. The samples were well mixed and 0.5 ml of Folin-Denis reagent was added. The test tubes were thoroughly shaken again for 4 min. About 1 ml of saturated sodium carbonate solution was added and the mixture was made up to 10 ml with good mixing. After one hour of absorption (Spectrophotometer JENWAY 6100) determined in 1 cm cells at 725 nm using a blank (water and reagents only). Calibration required for the evaluation was carried out using standard chlorogenic acid solution in the concentration ranged from 10 to 100 µg (Swain and Hillis, 1959).

HPLC determination of phenolic compounds presented in methanolic extracts of garlic cloves :

Phenolic compounds of methanolic extracts recovered from garlic cloves were determined in the food Research center, Giza, Egypt using HPLC according to the method described by Andersen and Pedersen (1983).

Antioxidative activity of garlic cloves methanolic extracts :

The antioxidative activities of methanolic extracts recovered from garlic cloves were assayed at concentrations of 200, 300and 400 ppm to sunflower oil (free of added antioxidants) and were bottled in amber glass bottles. The treated oils were stored at room temperature for 90 days. Comparative samples of sunflower oil free of added garlic cloves methanolic extracts (control) and samples of sunflower oil containing 200, 300 and 400 ppm of butylated hydroxy toluene (BHT) were prepared under the same conditions. The degree of oxidation was evaluated at different times using proxide values (PV's) (Leonard *et al.*, 1987).

Estimation of antimicrobial activity of garlic cloves fixed oil by disc-diffusion method :

The disc-diffusion method was used for detecting the antimicrobial activity of garlic cloves fixed oil against some selected microorganisms, such as *Bacillus subtilis, Pseudomonas spp., Aspergallis niger* and *Candida guilerimondii* FTI 20037. All the previous bacteria and fungi were kindly provided by the microbiology department, Faculty of Agriculture- Tanta University. Yeast strain was obtained from Dept. of chemical Engineering, university of Vigo, Las Lagoas, Ourense, Spain. These microorganisms were checked for purity and identify. The cultures were stored in a refrigerator at 5°C and reactivated monthly on the suitable medium for each microorganisms as described by Conner and Beuchat (1984).

Garlic cloves oil was diluted in 70% ethanol to give solution of 1%, 50% and 100% (v/v). Appropriate amounts of media were poured into sterile plates (100 mm diameter), left to solidify, at room temperature. The organisms were grown on the surface of the previous media. A sterile disc, 6 mm diameter of Whitman No. 1 filter paper was dipped in the appropriate oil solution blotted, then placed on the surface of inoculated plates.

The inhibitory effect of the 70% ethanol and 1% of phenol solution (w/v) were also tested by placing disc saturated with only 70% ethanol or placing discs saturated with phenol solution on each inoculated plate.

The plates of bacteria were incubated at 30°C for 48 hours, whereas the plates of fungi and yeast were incubated at 25°C for 48 hours. The results were recorded by measuring the zone of inhibition (mm) around the discs. All tests conducted in triplicates with four discs per plate. The bacteria were cultured on Nutrient agar, while fungi and yeast inoculated on Sabourand-dextrose agar as recommended by Difico (1974). Both types of organisms were inoculated on the surface of the agar plates.

Media used :

Nutrient agar medium :

Nutrient agar medium was used to detect the total count of bacteria, activation, and antibacterial study.

The medium consists of : (Meat extract, 3.0 gm; Peptone, 5.0 gm; Sodium chloride, 5.0 gm; Agar, 15.0 gm; Distilled water, 1.0 liter; PH, 6.8) as reported by Difco (1974).

Sabouround's medium :

Sabouround's medium was used to study the effect of garlic cloves oil on the growth of fungi and yeast, it consists of : (Glucose, 40.0 gm; Peptone, 10.0 gm; Agar, 20.0 m; Distilled water, 1.0 liter, PH, 5.6±0.2) as outlined in Difco (1974).

RESULTS AND DISCUSSION

Isolation and identification of phenolic acids of fresh garlic cloves extracts :

Total polyphenols in all methanolic garlic cloves extracts were colourimetrically determined and the results are presented in Table (1). Samples 3 and 4 garlic cloves recorded the highest levels of polyphenols, (220.80 and 195.13mg/100 g, respectively), where the lowest content was found in garlic cloves of sample 5.

The composition of polyphenolic compounds extracted from the five garlic cloves samples are determined using HPLC and the results are listed in Table (1) and Figure (1). The methanolic extracts of garlic cloves contained large numbers of phenolic acids. More than ten of them were identified using external standards. Generally, the given data indicated that, garlic cloves methanolic extracts contained high levels of gallic, p-hydroxybenzoic, tannic, caffeic and ferulic acids. Moreover garlic cloves of sample No. 3 contained the highest numbers of phenolic acids followed by samples 4 and 2, while garlic cloves of samples No. 1 and 5 contained the lowest numbers of phenolic acids.

Table (1) Separation and identification of *phenolic acids presented in garlic cloves extracts.

Garlic samples / Phenolic acids	Balady (1)		Seds 40 (2)		VFG 180 (3-1) (3)		G98-6-1 (4)		Strain 133 (5)	
	R.T	%	R.T	%	R.T	%	R.T	%	R.T	%
Tannic acid	-	-	3.29	14.40	3.44	38.75	3.42	44.37	3.45	14.91
Gallic acid	3.55	49.40	3.37	29.80	3.87	7.87	3.88	10.73	3.63	31.87
Ferulic acid	4.92	13.44	-	-	4.30	9.09	4.62	8.45	3.93	14.27
Chlorogenic acid	-	-	-	-	5.23	8.31	5.32	8.32	4.77	9.22
P-hydroxy benzoic acid	5.40	19.99	5.35	34.58	5.40	11.08	5.47	13.31	5.59	18.52
P-amino benzoic acid	8.00	4.21	-	-	6.20	8.57	6.43	8.22	-	-
Caffeic acid	8.91	5.56	8.76	3.84	8.16	9.10	8.72	6.21	8.18	11.19
Ellergic acid	-	-	9.15	3.78	-	-	-	-	-	-
Catchin	11.73	5.24	10.13	4.10	10.21	2.25	-	-	-	-
Cinamic acid	-	-	11.59	6.92	11.67	1.95	11.71	0.38	-	-
Unk.	-	-	-	-	12.35	1.04	-	-	-	-
Unk.	-	-	-	-	13.13	1.99	-	-	13.03	0.01
Unk.	16.04	2.16	16.17	2.58	-	-	-	-	-	-
Total poly phenols (mg/ 100 g)	189.70		193.68		220.80		195.13		185.10	

*** Phenolic acids were determined using HPLC.**

Gallic acid was found to be the main phenolic acid detected in garlic cloves extract of sample 1, representing about 49.40% of the total phenolic compounds, followed by P-hydroxybenzoic acid (19.99%) and ferulic acids (13.44%). On the other hand P-hydroxy benzoic acid was the main phenolic acid in the methanolic extracts of garlic cloves for sample No. 2, representing about 34.58% followed by gallic acid (29.80%) and tannic acid (14.40%).

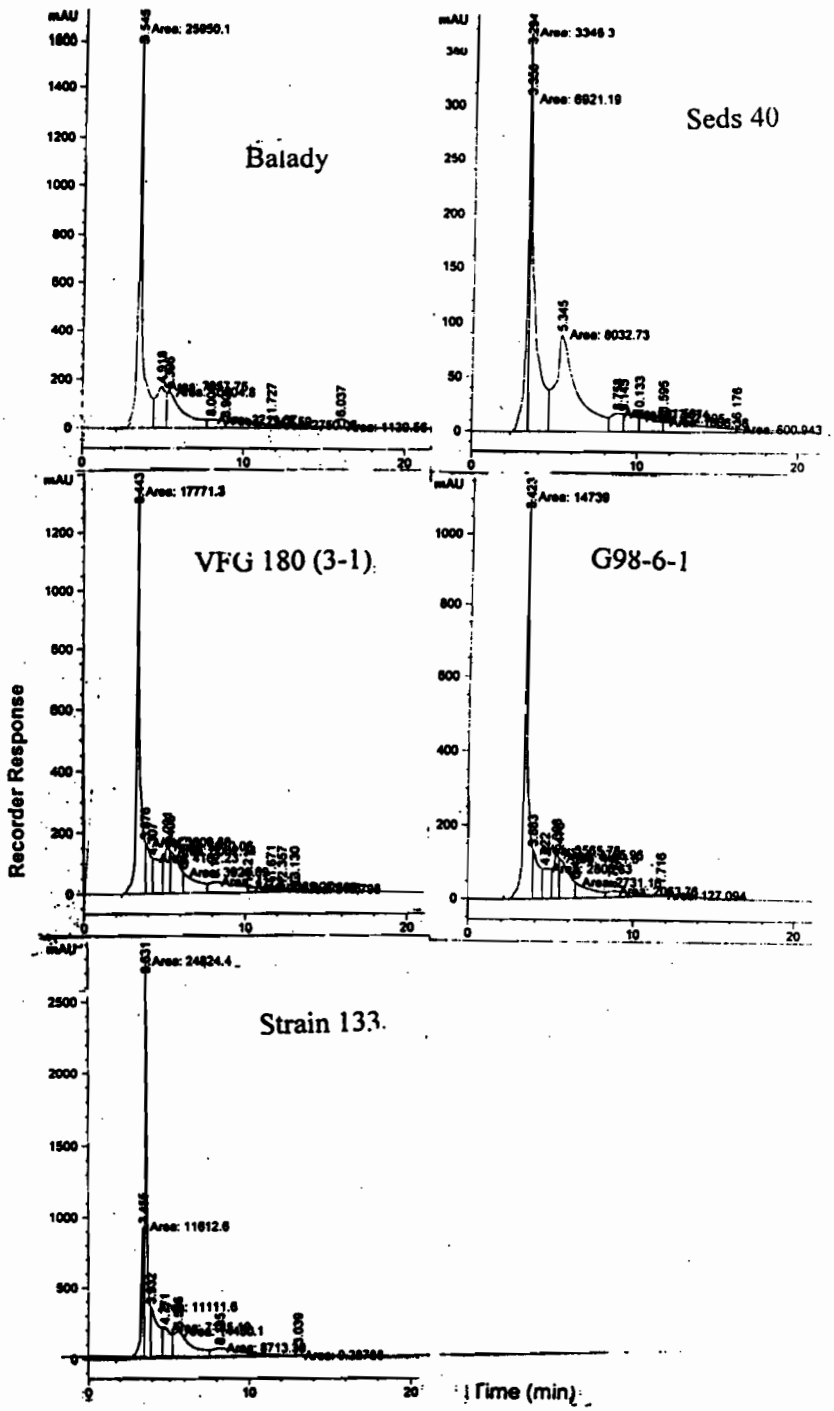

Fig. (1): HPLC chromatograms of the phenolic compounds extracted from garlic cloves samples produced in Egypt.

In addition, the phenolic compounds found in methanolic extract of garlic cloves for sample (3) were ranked as follows : tannic acid (38.75%), p-hydroxy benzoic acid (11.08%) caffeic acid (9.10%), ferulic acid (9.09%), p-amino benzoic acid (8.57) and chlorogenic acid (8.31%). Apparent also from the same Table that, tannic acid (44.37%) was the main phenolic acids in methanolic extracts of garlic cloves in sample 4 followed by p-hydroxy benzoic acid (13.31%), gallic acid (10.73%). Ferulic acid (8.45%), chlorogenic acid (8.32%), p- amino benzoic acid (8.22%) and caffeic acid (6.21%). Gallic acid was the main compound in methanolic extracts of garlic cloves for sample No. 5, representing 31.87% of the total phenolic compounds where the levels of the other detected compounds were as follows: P-hydroxy benzoic acid (18.52%), tannic acid (14.91%), ferulic acid (14.27%), caffeic acid (11.19%) and chlorogenic acid (9.22%).

Plant tissues are the main biological systems that synthesize α-tocopherol, ascorbic acid and carotenoids, in addition they are also rich in a wide variety of phenolic compounds (Namiki, 1990). Common foods of plant origin contain a variety of phenolic acids in amounts ranging from traces to several grams per kilogram of fresh weight (Macheix *et al.*, 1990 and Pratt and Hudson, 1990). Flavonoids and other plant phenolics were reported to have multiple biological effects such as antioxidant activity (Bors and Saran, 1987 and Kanner *et al.*, 1994). The presence of phenolic hydroxyl-groups increases the antioxidative activity of phenolic acids, while methoxylation of hydroxyl groups causes a decrease in activity (Marinova and Yanishlieva, 1992).

Use of garlic cloves methanolic extracts as natural antioxidant for keeping sunflower oil during storage :

Antioxidative activities of garlic cloves methanolic extracts were assayed against sunflower oil, which contained high percentage of polyunsaturated fatty acids (88.70%) (Malti *et al.*, 1988). The addition of garlic cloves methanolic extracts at various concentrations did not affect the colour or the appearance of sunflower oil.

Changes in peroxide values of sunflower oil treated with garlic cloves methanolic extracts and synthetic antioxidants (BHT):

However, measuring the peroxide value is considered a suitable potent method to characterize oxidative changes in sunflower oil stored at room temperature for 90 days. The development of rancidity was estimated and compared with those of untreated sunflower oil (control sample). Peroxide values (PV,s) were estimated after 0, 10, 20, 30, 40, 50, 60, 70, 80 and 90 days to monitor the stability of sunflower oil during storage at room temperature in amber glass bottles. The results in Figure (2) clarified that, PV of control sample (sunflower oil without antioxidants) was increased rapidly to reach 29.10 meq./kg after 90 days of storage at room temperature, while the value found in the oil treated with 200 ppm of garlic cloves extracted (sample 3) was 12.70 meq./kg after storage under the aforementioned conditions. The highest antioxidative activity was found in case of garlic cloves extracts of sample No. 3 and 4. From the results shown in Fig. (2) it should be noted that, garlic cloves methanolic extracts at 200 ppm possessed appreciable antioxidant activity greater than synthetic antioxidant (BHT).

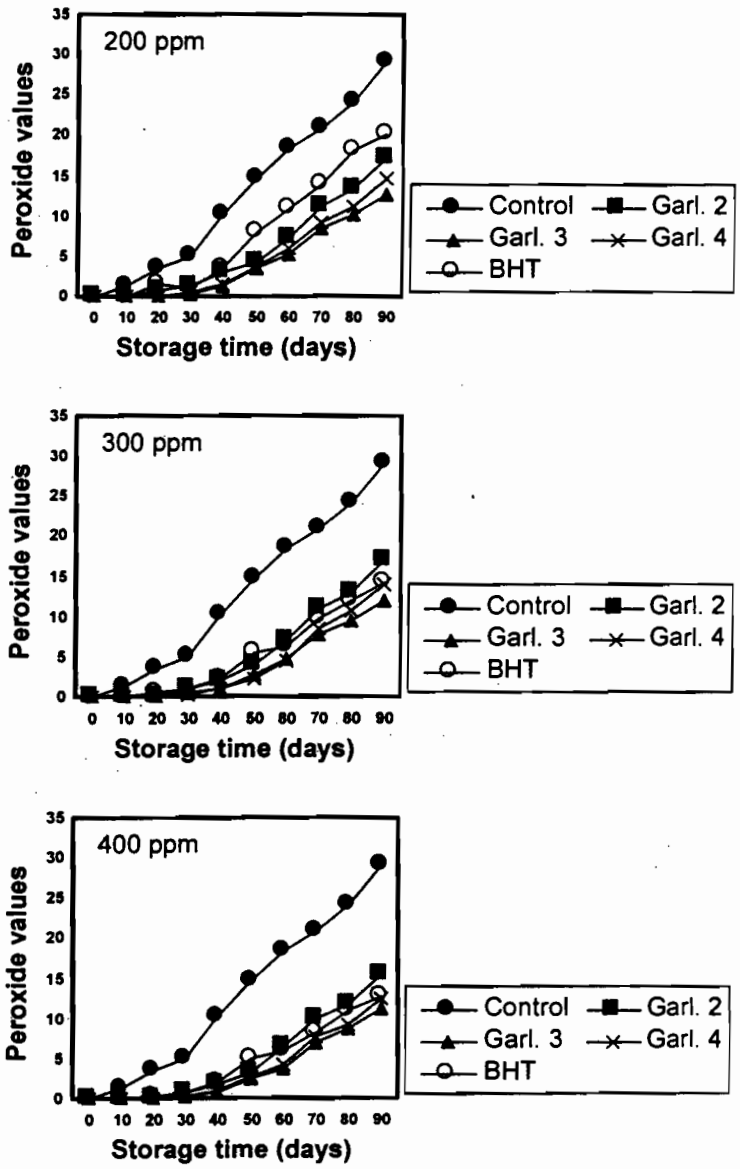

Fig. (2): Effect of adding garlic cloves phenolic extracts and BHT (200, 300 and 400 ppm) to sunflower oil on its peroxide values during storage in amber glass bottles at room temperature for 90 days.

Apparent also from the same figure that, increasing the levels added from 200 to 300 and 400 ppm helped to decrease PV's formed and retarding oxidative rancidity in sunflower oil. The oil treated with 400 ppm of garlic cloves extracts, especially sample 3 showed the best natural antioxidants in decreasing PV (11.10 meq/kg) followed by, those treated with the same level of garlic cloves extracts since the value of sample No. 4 was (12.50 meq./kg oil). The extent of activity of garlic cloves extracts was stronger than that of commercially antioxidants (BHT). However the lowest antioxidative activity was found in the sunflower oil treated with garlic cloves extract from sample 2.

The recorded results are in agreement with those reported by Farag *et al.*, (1989), who found that some spice essential oils and their constituents were possess an antioxidant effect and this phenomenon was increased by increasing their concentration.

Sources of natural antioxidants are primarily plant phenolics that may occur in all parts of the plants, especially, in the seeds and leaves (Pratt and Hudson, 1990).

Antioxidative activity of the phenolic acids was decreased with following order: ferulic acids > syringic acid > P-hydroxybenzoic acid > p-coumaric acid > protocatechuic acid > caffeic acid (Gadow *et al.*, 1997). It was reported also that, benzoic acid derivatives were more effective as antioxidants than their cinnamic analogues (Vanillic acid > ferulic, p-hydroxy benzoic acid > p-coumaric acid, protocatechuic acid > caffeic acid). Generally, results illustrated in Fig. (2) are in agreement with those reported by (Rabe *et al.*, 1994; Ferreira *et al.*, 1995 and Salama, 2000), they reported that, phenolic acids are widely distributed in nature, especially plant leaves extracts and have been shown to possess antioxidative properties. It was concluded from the given results that, methanol extract from garlic cloves at various concentrations exhibited antioxidative activity in comparison with control one and showed features of an autocatalytic chain reaction in all cases.The inhibitory effect of antioxidative compounds has been attributed to their donation of electrons or hydrogen atoms from hydroxyl groups to the oil containing free radicals and to the formation of stable free radicals, which do not initiate nor propagate further oxidation of the oils. Recently, these compounds attracted special interest because they can protect the human body from free radical, which may cause various diseases including carcinogenesis (Osawa *et al.*, 1987 and Cutlar, 1992).

In conclusion the obtained data suggested using methanol extracts from garlic cloves play an active rule for minimizing/preventing lipid oxidation. Concerning the fact that garlic cloves extracts and garlic cloves oil were used as natural food ingredient without any known toxic effects, they may be considered promising sources of natural antimicrobial and antioxidants for food use.

Antimicrobial activity of garlic (*Allium sativum*, L.) cloves fixed oil :

The antimicrobial properties of garlic cloves oil were studied using some selected microorganisms such as *Bacillus subtilis, Pseudomonas* spp., *Aspergallis niger* and *Candida guilerimondii.* Five types of garlic cloves oil namely Balady (1), Seds 40 (2), VFG 180 (3), G98 (4) and strain 133 (5) were

used in this study at concentrations of 1, 50 and 100%. The antimicrobial effects of garlic cloves oil and ethanol 70% (as a diluents), were compared with phenol (1 and 10%). The diameters of the inhibition zones were taken as criterion of antimicrobial spectra (total inhibition zones, mm) and the obtained results are given in Table (2). The data indicated that, there is no inhibitory affect of garlic cloves oil at concentration of 1% against all microorganisms except *Bacillus subtilis*.

Garlic oil for sample No. 4 had the highest inhibition effect against *Bacillus* in comparing with those of samples 3 and 2, at the same concentration (1%). Simultaneously, garlic cloves oil had not effect at all microorganisms at concentration less than 50%.

Generally, the results in Table (2) revealed that with increasing the garlic cloves oil concentrations the inhibition zones (mm) were increased from 0 to 29.75 mm. These results proved that, at all concentration, garlic cloves oil of sample 3 possess the highest inhibition zones against the four microorganisms among all of the other garlic oil samples. Comparing with phenol 1%, the results in Table (2) indicated that, all samples of garlic cloves oils possess stronger antimicrobial activity than that of phenol 1%. The inhibitory effect of garlic cloves oil samples at the used concentrations against *Pseudomonas* spp., was greater than that of phenol 1%. In addition, it was clear also from the same data that, garlic cloves oil at concentration of 100% had inhibition effect against *Bacillus subtilis*, higher than that of phenol 1%, since the inhibition zone was two time greater than the phenol one.

Table (2): Diameters of the inhibition zones (mm) produced by garlic cloves fixed oil against some selected microbial culture.

Microorganisms / Treatments	Diameters of inhibition zones (mm)				Total inhibition zones (mm)
	Bacillus subtilis	*Pseudomonas* spp.	*Aspergalli sniger*	*Candida Gullerimondii*	
Ethanol 70%	0.00	0.00	0.00	0.00	0.00
Phenol 1%	14.00	11.25	0.00	0.00	25.25
Garlic sample (1) 1%	0.00	0.00	0.00	0.00	0.00
Garlic sample (1) 50%	22.00	15.00	0.00	9.25	46.25
Garlic sample (1) 100%	29.75	15.75	12.00	9.00	66.50
Garlic sample (2) 1%	8.00	0.00	0.00	0.00	8.00
Garlic sample (2) 50%	20.25	12.75	10.50	10.75	54.25
Garlic sample (2) 100%	24.50	15.25	12.25	14.00	66.00
Garlic sample (3) 1%	10.00	0.00	0.00	0.00	10.00
Garlic sample (3) 50%	24.50	14.75	13.75	15.00	68.00
Garlic sample (3) 100%	29.50	19.25	19.50	16.00	84.25
Garlic sample (4) 1%	12.25	0.00	0.00	0.00	12.25
Garlic sample (4) 50%	23.50	14.25	12.25	12.50	63.50
Garlic sample (4) 100%	28.00	18.50	15.50	13.00	76.00
Garlic sample (5) 1%	0.00	0.00	0.00	0.00	0.00
Garlic sample (5) 50%	18.50	10.50	5.75	6.25	41.00
Garlic sample (5) 100%	25.25	11.75	8.50	8.50	54.00

In general, the data showed that *Bacillus subtilis* was the major sensitive microorganisms to garlic cloves oil at the most applied concentrations. On the other hand, *Pseudomonas* spp. was the second

sensitive one to garlic cloves oil, while Fungi strains were the least sensitive microorganisms to the extracted oil at the most applied concentrations.

The total inhibition zones (mm) of each applied concentration of garlic cloves oils were taken as a criterion of antimicrobial spectrum. However, it was found that 1% concentration of garlic cloves oil was less effective than that of 1% phenol, whereas other higher concentrations (50 and 100%) of garlic cloves oil showed higher antimicrobial effect than that of 1% phenol.

Youn *et al.*, (1997) found that, *Escherichia coli* was the most sensitive to garlic antibacterial action. The possibility of eliminating *E. coli* by using garlic extract in foods like kimchi of which garlic is one of the regular ingredients is suggested.

From the above mentioned results, it should be concluded that garlic cloves which used as a spice, flavouring agent and in Egyptian salad dishes, have available constituents, which consider as important source for vital elements and act as a microbial balancer in the alimentary canal. Moreover, the antioxidant properties of garlic cloves extract and oil make it possible to use them in medicinal purposes.

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النشاط المضاد للأكسدة والميكروبات لبعض المركبات الطبيعية المستخلصة من فصوص الثوم

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تم فى هذا البحث استخلاص وفصل الأحماض الفينولية من فصوص عدة أنواع مختلفة من الثوم المنتجة فى مصر وذلك باستخدام كحول الميثانول واستخدامها كمضادات أكسدة طبيعية لحماية زيت عباد الشمس من عمليات الأكسدة ومقارنتها بمضادات الأكسدة الصناعية مثل بيوتلاتيدهيدروكسى تولوين (BHT) بعد إضافة كل منها لزيت عباد الشمس بتركيزات ٢٠٠ و ٣٠٠ و ٤٠٠ جزء فى المليون كما درست التأثيرات المضادة للميكروبات للزيت الثابت المستخلص من فصوص خمسة أنواع مختلفة من الثوم المصرى على بعض السلالات الميكروبية وذلك باستخدام طريقة الدسك Disc-diffusion .

أثبتت نتائج التحليل الكروموتوجرافى السائل عالى الكفاءة (HPLC) أن مستخلص الميثانول لأصناف الثوم المستخدمة فى هذا البحث تحتوى على عدد كبير من الإحماض الفينولية حيث تم التعرف على عشرة أنواع مختلفة من هذه الأحماض.

وبصفة عامة احتوت مستخلصات الميثانول لفصوص الثوم على كميات كبيرة من أحماض الجاليك والباراهيدروكسى بنزوك والتانييك والكافيك والفريوليك.

كما اثبتت نتائج تقدير رقم البيروكسيد أن مستخلصات الميثانول لفصوص الثوم ذات نشاط قوى كمضادات للأكسدة لزيت عباد الشمس حيث كانت أقوى فى نشاطها من مضادات الأكسدة الصناعية.

أما بالنسبة للنشاط المضاد للميكروبات للزيت الثابت المستخلص من فصوص الثوم فقد تم اختباره على عدة سلالات ميكروبية وقورن بالتأثير المضاد للفينول عند تركيزات ١%، حيث تم قياس معدلات التثبيط لهذه الميكروبات بالمليمترات، واثبتت الدراسة أن زيت الثوم ذات نشاط قوى جدا كمضاد للميكروبات بالمقارنة بالفينول عند تركيز ١%. وبصفة عامة فإن جنس *Bacillus subtilis* كانت أكثر الميكروبات المختبرة حساسية لهذا الزيت عند كل تركيزاته يليها فى التثبيط الـ *Pseudomonas spp.* ، بينما كانت سلالات الخمائر اقلها حساسية لهذا الزيت.

من النتائج السابقة المتحصل عليها يمكن التركيز على أن الثوم الذى يستخدم فى مصر ضمن التوابل المحسنة للطعم والرائحة أو المستخدمه مع أطباق السلاطه يمكن أن تستخدم لكثير من الأغراض الطبية حيث يعتبر مصدر هام لكثير من المركبات الحيوية المضادة للميكروبات خاصة المرضية منها فى الجهاز الهضمى، هذا بالإضافة الى الصفات المضادة للأكسدة لمستخلصات فصوص الثوم.