Journal of Home Economics

Volume 25, Number (4), 2015

http://homeEcon.menofia.edu.eg

Journal of Home Economics

ISSN 1110-2578

Antimicrobial and Antioxidant Activity of Rosemary and Marjoram

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Abstract

The antioxidant activity, phenolics compounds and pathogenic microorganisms (*Staphylococcus aureus*, *Aspergillus niger* and *Candida albicans*) at different concentrations (0.4 %, 0.8 %, 1.2 % and 1.6 %) of rosemary and marjoram (powder & oil) were determined. The total phenol, total flavonoides, antioxidant activity (TEAC) and radical scavenging (DPPH) were determined using spectrophotometreic method while, identification of phenolics compounds determined using HPLC. Results showed that the rosemary had a higher total phenolic compounds than that of marjoram. The mean values were 5.07 and 0.79 g GAE/100g, respectively while; rosemary had higher total flavonoides. The highest TEAC recorded for rosemary, while, the (DPPH) of rosemary had higher than that of marjoram. The highest phenolics compounds in rosemary recorded as cinnamic acid and vanaillic acid. The values were 1920.93 and 1520.61 mg/kg, respectively. The highest phenolics compounds of marjoram was recorded for rosmarenic acid and methyl rosmarenate, the mean values were 3100.05 and 1510.50 mg/kg, respectively. The maximum value of inhibition percentage of different concentrations of rosemary powder was recorded with *Staph. aureus* while; the lowest was recorder for *E. coli*. The highest inhibition percentage with 0.4% marjoram powder was recorded with *Aspergillus niger*, while the lowest recorded with *E. coli*. The highest value of inhibition percentage of 0.4 % and 0.8 % rosemary oil concentrations was recorded with *Staph. aureus*. The values were 99.98 % and 99.99 %, respectively. The maximum value of inhibition percentage of 0.4 % and 0.8 % marjoram oil concentrations was recorded with *Candida albicans* and *Staph. aureus*. The values were 99.95 % and 99.98 %, respectively. It could be concluded that the highly inhibition percentage was recorded with increasing the rosemary and marjoram oil concentrations by different rates.

Keywords: Rosemary, Marjoram, Antioxidant activity and Pathogenic microorganisms

Introduction

Spices are usually only parts of plants and may be roots, rhizomes, barks, seeds fruits, flower buds, etc. Spices are very aromatic and may contain large percentages of essential oil as well as other powerful 11 nonvolatile flavoring components. Condiments are seasonings which are added to food after it has been served **(Henry *et al.*, 1978)**.

Herbs and spices were recognized by Egyptians over 3000 years ago as a preservative agent. Many types of herbs and spices are used in Egypt mainly as seasonings to improve flavour of food and appetite or as a preservative or for treatment of some disease conditions **(Aboellil, 2007)**.

The growing concern about safety of foods has recently led to the development of natural antimicrobials to control food borne pathogens. Spices are some of the most commonly used natural antimicrobial agents in foods. Addition of spices in foods not only imparts flavor and pungent stimuli but also provides antimicrobial property. Natural antimicrobial compounds in spices were found to possess antimicrobial activity. Although some researchers have studied the antibacterial activity of spices against several species of bacteria, few serotypes of *Salmonella* have been tested, such as *S. typhimurium, S. Enteritidis, S. infantis* and *S. anatum*. Antimicrobial activity of spices may differ between strains within the same species of bacteria. The sensitivity of each type of spices against several serotypes of *Salmonella* has not been reported **(Moore, 2004)**.

Besides their antioxidant activity, many spices display antimicrobial activities. The antiseptic potential of spices resides in the essential oils. Extensive studies have been performed to determine its inhibitory properties, and many food-borne pathogens, both gram-positive and gram-negative bacteria, have been shown to be inhibited by spices. For spices such as nutmeg, black pepper and cinamon were interesting that the pathogenic *Escherichia coli* O157:H7 strain is more susceptible than nonpathogenic *E. coli* (**Takikawa *et al.*, 2002)**.

Rosemary (*Rosmarinus officinalis*, L.) is an aromatic plant and thus a flavoring agent, widely used in foods. Its extracts have been introduced as preservatives in the food industry **(Frankel *et al.*, 1996)**.

Rosemary extract formulations are the only ones commercially available for use as antioxidants in the European Union and the United States, and they are marketed in an oil-soluble form, as a dry powder, and in water-dispersible or water-miscible formulations (**Campo *et al.*, 2000)**.

The non-nutrient secondary metabolites of rosemary such as the phenolic diterpenes, carnosol, carnosic acid, methyl carnosate, rosmanol, and epirosmanol, and phenolic acids such as ferulic, rosmarinic, and chlorogenic and caffeic acids, have already been reported to possess diverse biological activities, including antioxidant and antimicrobial activity **(Bozin *et al.*, 2007)**.

Rosemary (*Rosmarinus officinalis*) extracts (RE) have a potent antioxidant activity and are widely used in the food industry. This activity has been associated with the presence of several phenolic diterpenes, such as carnosic acid, carnosol, rosmanol, rosmariquinone and rosmaridiphenol, which terminate free radical chain reactions by hydrogen donation **(Zhang *et al.*, 2010)**.

Marjoram (*Origanum majorana* L.), of Lamiaceae family was known to the ancient Egyptians, Greeks and Romans. The Greeks felt it as a symbol of happiness and that if grown on the grave, the deceased would be eternally happy **(Tainter and Grenis, 1993).**

Marjoram is also known to possess various therapeutic properties including antioxidant activity. The antioxidant activity of marjoram was found to be much higher than that of a –tocopherol and comparable with BHT at all concentrations tested **(Abdel-Massih and Abraham, 2014)**.

The marjoram (*Origanum majorana* L.) species plays a primary role among culinary herbs in world trade the increasingly growing popularity of oregano is a result of scientific research recent findings report the antimicrobial , fungicidal and antioxidant properties of marjoram **(Cristiani *et al.*, 2007).**

Among several essential oils that may be useful as antimicrobial agents, marjoram (*Origanum majorana* L.) essential oil belonging to the family Lamiaceae possesses antimicrobial properties against food borne bacteria and mycotoxigenic fungi and therefore, it may have the greatest potential for use in industrial applications **Busatta *et al.*, 2008)**.

Several species and herbs exert antibacterial influences due to their essential oil fractions. Some scientists revealed the antimicrobial activity of essential oils from oregano, thyme, sage, rosemary, clove, coriander, garlic, and onion against both bacteria and molds. The composition, structure, as well as functional groups of the oils play an important role in determining their antimicrobial activity **(Omidbeygi *et al.*, 2007)**.

Mohamed *et al.*, (2011) examined the ethanol and water marjoram (*Origanum marjorana*, L.) extract for its antimicrobial activities and its possible food applications. Results clearly indicated that the *Origanum marjorana*, L. showed strong exhibited antimicrobial activity against gram positive bacteria and gram negative. Thereupon,

Material And Methods

Materials:

Source Of Herbs:

Commercially dried ground spices herbs and its oils such as {Rosemary (*Rosmarinus officinalis*) and Marjoram (*Origanum majorana*)} using different concentrations (0, 0.4, 0.8, 1.2 and 1.6 g /L) in liquid media. And mixture of them as powder and its oils were obtained from herbalist in 2015 from Menoufia Governorate.

Microbiological cultures:

Bacterial, fungal and yeasts cultures used in this study involved: *Escherichia coli* (DSM 30083), *Staphylococcus aureus* (DSM 1104), *Bacillus cereus* (DSM 315), *Salmonela sp.* (DSM 347) were obtained from Microbiological Resource Center "MIRCIN", Faculty of Agriculture, Ain Shams University, Cairo, Egypt. And mold (*Aspergillus niger*) & yeast (*Candida albicans*) were obtained from Department of Microbiology, Faculty of Science, Ain Shams University, Cairo, Egypt.

Methods:

Microbiological Methods:

Ten grams of each sample were homogenized with 90 ml. of distilled water so as to give 0.1 dilutions. Then different dilutions ($1:10^{-1}$ to $1:10^{-6}$) were prepared to be used for microorganisms tests.

Staphylococcus aureus determined on Paird parker agar base media **(ICMSF, 1996)**, while Molds and yeast, enumerated in potato dextrose agar **(ICMSF, 1996)**, Coliform bacterial (Oxoid) enumerated on Endo agar media **(WHO, 1988)**, *salmonella sp*. & *Shigella* SS agar modified Oxoid according to **Bryan, (1991)** and *Bacillus cereus* determined on *Bacillus cereus* selective agar medium with supplement SR99 **(Roberts, 1991)**.

Determination Of Active Compounds:

Determination Of Total Phenolic Content:

Total phenolics in the selected extract samples were determined according to Mazza's method **(Mazza *et al*., 1999)**, with some modifications as described by **Radovanović and Radovanović, (2010)**. Briefly, 0.25 ml of the diluted sample was mixed with 0.25 ml of 0.1% Hcl in 95% ethanol and 4.55 ml of 2% Hcl, approximately 15 min. before reading the absorbance at 280 nm with a UV/ VIS spectrophotometer (Agilent 8453 spectrophotometer). The absorbance at 280 nm, *A*, was used to estimate total phenolics (gallic acid was used as standard).

Determination Of Total Flavonoids:

An aliquot (250µl) of each extract or standard solution was mixed with 1.25 ml of doubly distilled H_2O and 75µl of 5%$NaNO_2$

solution. After 6 min, 150 µl of 10% $AlCl_3$ was added then, H_2O solution was added. After 5 min, 0.5 ml of 1M NaoH solution was added and then the total volume was made up to 2.5 ml with water. The absorbance against blank was determined at 510 nm. Catechin was utilized for constructing the standard curve **(Liu *et al.*, 2009)**.

Determination Of Free Radical-Scavenging (DPPH):

The DPPH radical-scavenging activity was determined using the method proposed by **Yen and Chen (1995)**. DPPH (100 lM) was dissolved in pure ethanol (96%). The radical stock solution was prepared fresh daily. The DPPH solution (1 ml) was added to 1 ml of polyphenol extracts with 3 ml of ethanol. The mixture was shaken vigorously and allowed to stand at room temperature in the dark for 10 min. The decrease in absorbance of the resulting solution was monitored at 517 nm at 10 min. The results were corrected for dilution and expressed in lM trolox per 100 g dry weight (dw). All determinations were performed in triplicate.

Determination Of Trolox Equivalent Antioxidant Capacity (TEAC):

The $ABTS^+$ radical cation was produced by the method of **Miller *et al.*, (1993**). A solution of ABTS (10 mg) and potassium peroxodisulfate (2.9 mg) was diluted with 0.01 M pH 7.4 sodium phosphate buffer (10 ml). The mixture was protected from light and stored at room temperature for 12–16 h. Formation of ABTS+ was checked by its absorbance at 734 nm. The ABTS+ solution was diluted with water to an absorbance of 0.80 (±0.05) at 734 nm. For the assays, briefly, samples (0.02 ml) were mixed with ABTS.+ solution (1 ml). Reduction of absorbance was measured at 734 nm after 5 min. Trolox was used as the standard for the comparison of antioxidant activity expressed as Trolox equivalent antioxidant capacity (TEAC) by plotting the Trolox calibration curve (from 10 to 300 mg/L) and expressed as milligrams of Trolox equivalents per gram of dried extract. The equation for the Trolox calibration curve was $Y = -0.0022\ X + 0.7473$ (where X = concentration of Trolox equivalents expressed as milligrams of Trolox per gram of dried extract; Y = measured absorbance), and the correlation coefficient was R2 = 0.9995.

Identification Of Phenolic Compounds:

HPLC analysis of extracts was performed using an Agilent 1200 chromatograph equipped with a PDA model G1315B, a Bin pump odel G1312A, an auto-sampler model G1313A and a RR Zorbax Eclipse Plus C18 column (1.8 µm, 150 mm ×4.6 mm). The mobile phase A was 0.2 % formic acid in water and the mobile phase B was acetonitrile. Elution was performed at 0.95 ml min-1 with the following gradient program of solvent B: 0–20 min, 5–16 %; 20–28 min, 16–40 %; 28–32 min, 40–70 %; 32–36 min, 70–99 %; 36– 45 min, 99 % and 45–46, min. 99–95

%.30. The injection volume was 10 µL. Wavelengths of 280 nm (for flavan-3-ols and benzoic acid derivatives) and 360 nm (for flavonols and cinnamic acid derivatives) were selected for detection. Quantification of the compounds was realized using calibration curves obtained by HPLC of pure standards: gallic acid, caffeic acid, (+)-catechin, (-)-epicatechin, and ellagic acid. Rutin was used as an internal standard. Some compounds were quantified as equivalents of the most similar chemical structures: gallic acid for gallic acid glucoside, gentisic acid glucoside, protocatechuic acid, p-hydroxybenzoic acid and methyl gallate; caftaric acid as caffeic acid; (+)- -catechin for proanthocyanidin dimers and trimers and their monogallates; (–)-epicatechin for epicatechin gallate; ellagic acid for ellagic acid pentoside. The HPLC method was used according to **Radovanović *et al.*, (2010)** with some modification (elution gradient and flow rate).

Statistical Analysis:

The data were analyzed using a Completely Randomized Factorial Design **(SAS, 1988)** when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ($P \leq 0.05$) were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.

Results And Discussion

Data presented in Table (1) show the phytochemicals characteristics (total phenolic compounds and total flavonoides) of rosemary and marjoram. It is clear to notice that the rosemary had a higher total phenolic compound than that of marjoram. The mean values were 5.07 and 0.79 g GAE/100g, respectively. On the other hand, rosemary had higher total flavonoides than that of marjoram. The mean values were 19.23 and 8.14mg, respectively. These results are in agreement with **Jiao *et al.*, (2005)**, they found that the amount of phenolic compounds in the ethanol extract (14.20 g of GAE/100 g of extract) was the highest. For the SFE, the total phenolic content ranged from 7.45 to 13.51g of GAE/100 g of extract, with an overall mean of 10.06 g of GAE/100 g of extract.

Data given in Table (2) show the trolox antioxidant capacity (TEAC) and free radical scavenging (DPPH) of rosemary and marjoram. The obtained results showed that the highest trolox antioxidant capacity (TEAC) was recorded for rosemary, while the lowest one was recorded for marjoram. The mean values were 37.8 and 6.31 m mol trolox/100g DW, respectively, while, the free radical scavenging (DPPH) of rosemary had higher than that of marjoram. The mean values were 513 and 179.6 m moltrolox/100g DW. These results are in agreement with **Rodriguez-Rojo, *et al.*, (2012)** they reported that the rosemary alcoholic

extract had higher antioxidant activity (DPPH) than the oregano alcoholic extract, despite the lower total phenolic content.

The phenolic compounds of rosemary fractionation by HPLC analysis (mg/kg on dry weight basis) is shown in Table (3). It is evident that the highest phenolics compound in rosemary was recorded for cinnamic acid and vanaillic acid. The values were 1920.93 and 1520.61 mg/kg, respectively. While, the lowest one was recorded for P.OH-Benzoic acid and synergic acid, the values were 30.67 and 100.98 mg/kg, respectively. These results are in agreement with **Faixova and Faxi, (2008)**, they reported that the extraction of phenolic compounds by HLPC demonstrated that, the cinnamic acid was the most abundant phenolic compound in rosemary leaves (192.929 mg/100g) followed by vanaillic acid (152.607 mg/100g). On the other hand, the coumarine, synergic acid and P.(OH)-Benzoic acid were also detected in small amounts.

The obtained results in Table (4) showed the phenolic compounds of marjoram fractionation by HPLC analysis (mg/kg on dry weight basis). It is clear that the highest phenolics a compound of marjoram was recorded for rosmarenic acid and methyl rosmarenate, the mean values were 3100.05 and 1510.50 mg/kg, respectively. While, the lowest one was recorded for ferulic acid and caffeic acid, the values were 120.92 and 160.85 mg/kg, respectively. On the other hand, cinnamic acid and naringin did not detected. These results are in agreement with **Wojdylo *et al.*, (2007),** they mentioned that caffeic acid, rosmarenic acid and methyl rosmarenate were found to represent more than 90% of phenolic compounds extracted from marjoram leaves.

The inhibitory effect of different concentrations of rosemary as powder on some pathogenic microorganisms in liquid media is shown in table (5). It is clear to mention that the highest value of inhibition percentage of different concentrations of rosemary powder (0.4 %, 0.8 %, 1.2 % and 1.6 %) was recorded with *Staphylococcus aureus*. The values were 99.70 %, 99.90 %, 99.98 % and 99.99 %, respectively, While, the lowest inhibition percentage was recorder for *E. coli*. The values were 60.0 %, 68.0 %, 99.10 % and 99.30 % with the same mentioned rosemary concentrations, respectively. It could be concluded that the value of inhibition percentage of tested microorganisms increasing with the increase of rosemary powder concentrations by different rats. These results are in agreement with those found by **Yu *et al.*, (2007)**. They found that the antimicrobial activity of rosemary essential oil against *Pseudomonas aeruginosa* and *Aspergillus niger* was less than against the other bacteria and *Candida albicans.*

The results in table (6) show the inhibitory effect of different concentrations of marjoram as powder on some pathogenic

microorganisms enumerated in liquid media. It is clear to notice that the highest inhibition percentage with 0.4% marjoram powder was recorded with *Aspergillus niger*, while the lowest recorded with *E. coli*. The values of inhibition percentage were 99.25% and 47.0%, respectively. In case of 0.8%, 1.2% and 1.6% marjoram powder, data indicated that the highest value of inhibition percentage was recorded with *Aspergillus niger*. The values of inhibition percentage were 99.4 %, 99.80 % and 99.99 %, respectively. The lowest inhibition percentage was recorded with *Candida albicans, E. coli* and *Staphylococcus aureus*. The values were 95 %, 99.5 % and 99.5 % with 0.8, 1.2 and 1.6% marjoram powder concentrations, respectively. These results are in agreement with those found by **Bonjar, (2004)**, who reported that with the increasing of marjoram ethanol extract concentration, the diameter of clear zone for all tested pathogens had significant also increased. The current results showed that MIC for *E. coli* was between 8 and 10 mm.

Data presented in table (7) show the inhibitory effect of different concentrations of rosemary oil on some pathogenic microorganisms enumerated in liquid media. The obtained results indicated that the highest value of inhibition percentage of 0.4 % and 0.8 % rosemary oil concentrations was recorded with *Staphylococcus aureus*. The values were 99.98 % and 99.99 %, respectively. While, the lowest inhibition percentage was recorder for *Candida albicans,* the values were 99.70 % and 99.80 % with the same mentioned rosemary oil concentrations, respectively. In case of 1.2 % and 1.6 % rosemary oil concentrations, it could be indicated that the highest value of inhibition percentage was recorded with *E. coli*. The values were 99.99 %, 99.999 %, respectively. On the other hand, the lowest inhibition percentage was recorder with *Candida albicans.* The values were 99.85 % and 99.98 % with the same mentioned rosemary oil concentrations, respectively. These results are in agreement with **Cressy *et al.*, (2003)**, they reported that there have been some reports on the essential oils activity of clove and rosemary that inhibited the growth of bacteria and fungi. The antimicrobial properties of clove essential oil was tested and showed inhibitory activity to *Listeria monocytogenes, Campylobacter jejuni, Salmonella enteritidis, Bacillus cereus, Escherichia coli* and *Staphylococcus aureus*.

The inhibitory effect of different concentrations of marjoram oil on some pathogenic microorganisms enumerated in liquid media is shown in table (8). The obtained results indicated that the maximum value of inhibition percentage of 0.4 % and 0.8 % marjoram oil concentrations was recorded with *Candida albicans* and *Staphylococcus aureus*. The values were 99.95 % and 99.98 %, respectively. While, the lowest inhibition percentage was recorder with *Bacillus cereus,* the values were 96.50 % and 97.00 % at the same mentioned marjoram oil

concentrations, respectively. In case of 1.2 % and 1.6 % marjoram oil concentrations, it could be indicated that the maximum value of inhibition percentage was recorded with *Staphylococcus aureus* and *Candida albicans*. The values were 99.998 %, 99.999 %, respectively. On the other hand, the lowest inhibition percentage was recorder with *Bacillus cereus.* The values were 99.40 % and 99.85 % with the same mentioned marjoram oil concentrations, respectively. Finally, it could be concluded that the highly inhibition percentage was recorded with increasing the marjoram oil concentrations by different rates. These results are in agreement with those found by **(Burt, 2004)**.

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Table (1): Phytochemicals characteristics of the of rosemary and marjoram

Phytochemicals characteristics	Rosemary M±SD	Marjoram M±SD
TPC (g of GAE / 100 g of DW)	5.07 ±0.036[a]	0.97 ±0.02[b]
TF(mg/ 100 g of DW)	19.23± 0.20[a]	8.14 ± 0.52[b]

TPC= Total phenolics compounds TF= Total flavonoids

Mean under the same raw bearing different superscript letters are different significantly (P≤0.05)

Table (2): Trolox antioxidant capacity (TEAC), total phenolics content and free radical-scavenging (DPPH) of rosemary and marjoram

Components	TEAC (mmol of trolox/100 g of DW) M±SD	DPPH mmol of trolox/100 g of DW M±SD
Rosemary	37.80 ± 0.021[a]	513.0 ± 5.99[a]
Marjoram	6.31 ± 0.005[b]	179.6 ± 2.04[b]

TEAC = Total equivalent antioxidant capacities DPPH = 1, 2-diphenyl picrylhydrazyl

Mean under the same raw bearing different superscript letters are different significantly (P≤0.05)

Table (3): Phenolic compounds of rosemary fractionation by HPLC analysis (mg/kg on dry weight basis)

Phenolic compounds	Dried rosemary (mg/kg DW)
Catechol	530.99
Caffeic acid	680.74
Synergic acid	100.98
Cinnamic acid	1920.93
Ferulic acid	760.88
Coumarin	290.99
P.OH-Benzoic acid	30.67
Vanaillic acid	1520.61
Pyrogallol	430.39
Protocatchuic acid	460.34

Table (4): Phenolic compounds of marjoram fractionation by HPLC analysis (mg/kg on dry weight basis)

Phenolic compounds	Dried marjoram (mg/kg DW)
Gallic acid	290.50
Chlorogenic acid	250.31
Caffeic acid	160.85
p-Coumaric acid	380.50
Ferulic acid	120.92
Cinnamic acid	-----
Apigenin	950.67
Rosmarenic acid	1510.50
Methyl rosmarenate	3100.05
Naringnin	-----

Table (5): Inhibitory effect of different concentrations of rosemary powder on some pathogenic microorganisms enumerated in liquid media:

Rosemary concentrations / Tested organisms	Control	0.4%	0.8%	1.2%	1.6%
Escherichia coli	1.0×10^6	4.0×10^5	3.2×10^5	9.0×10^3	6.6×10^3
Salmonella sp.	1.0×10^6	1.8×10^4	1.5×10^4	2.5×10^3	1.3×10^3
Bacillus cereus	1.0×10^6	3.5×10^4	2.2×10^4	1.8×10^3	1.2×10^3
Staphylococcus aureus	1.0×10^6	3.3×10^3	1.4×10^3	1.9×10^2	1.1×10^2
Aspergillus niger	1.0×10^6	1.5×10^4	1.0×10^4	5.0×10^2	4.0×10^2
Candida albicans	1.0×10^6	3.6×10^5	3.0×10^5	8.5×10^3	1.2×10^2

Table (6): Inhibitory effect of different concentrations of marjoram powder on some pathogenic microorganisms enumerated in liquid media

Marjoram concentrations / Tested organisms	Control	0.4%	0.8%	1.2%	1.6%
Escherichia coli	1.0×10^6	5.3×10^5	2.0×10^4	1.8×10^3	1.5×10^3
Salmonella sp.	1.0×10^6	3.0×10^4	2.5×10^4	3.1×10^3	1.0×10^3
Bacillus cereus	1.0×10^6	2.0×10^4	1.0×10^4	2.4×10^3	5.0×10^3
Staphylococcus aureus	1.0×10^6	1.0×10^4	7.5×10^3	2.5×10^3	3.0×10^2
Aspergillus niger	1.0×10^6	7.5×10^3	6.0×10^3	5.2×10^3	1.0×10^2
Candida albicans	1.0×10^6	6.0×10^4	5.0×10^4	3.5×10^3	2.5×10^3

Table (7): Inhibitory effect of different concentrations of rosemary oil on some pathogenic microorganisms enumerated in liquid media

Rosemary Concentrations / Tested organisms	Control	0.4%	0.8%	1.2%	1.6%
Escherichia coli	1.0×10^6	2.0×10^2	1.7×10^2	6.0×10^1	2.0×10^1
Salmonella sp.	1.0×10^6	1.0×10^3	6.5×10^2	2.5×10^2	1.7×10^2
Bacillus cerueus	1.0×10^6	3.0×10^2	2.0×10^2	1.0×10^2	7.5×10^1
Staphylococcus aureus	1.0×10^6	2.0×10^2	1.5×10^2	1.0×10^2	0.8×10^2
Aspergillus niger	1.0×10^6	1.0×10^3	5.0×10^2	2.5×10^2	1.2×10^2
Candida albicans	1.0×10^6	3.0×10^3	2.0×10^3	1.5×10^3	1.3×10^2

Table (8): Inhibitory effect of different concentrations of marjoram oil on some pathogenic microorganisms enumerated in liquid media

Marjoram concentrations / Tested organisms	Control	0.4%	0.8%	1.2%	1.6%
Escherichia coli	1.0×10^6	3.0×10^4	1.8×10^3	1.3×10^3	8.8×10^2
Salmonella sp.	1.0×10^6	2.3×10^4	1.4×10^4	1.5×10^3	7.5×10^2
Bacillus cereus	1.0×10^6	3.5×10^4	3.0×10^4	6.0×10^3	1.5×10^3
Staphylococcus aureus	1.0×10^6	5.0×10^2	2.0×10^2	1.2×10^2	0.8×10^2
Aspergillus niger	1.0×10^6	5.0×10^2	4.0×10^2	2.3×10^2	1.8×10^2
Candida albicans	1.0×10^6	4.8×10^2	4.3×10^2	3.6×10^2	3.5×10^1

Journal of Home Economics, Volume 25, Number (4), 2015

الـتأثير المضاد للميكروبات ولمضادات الأكسدة لأكليل الجبل والبردقوش

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الملخص العربى

تم فى هذا البحث *تقدير* النشاط المضاد للأكسدة، المركبات الفينولية والميكروبات المرضية (أستافيلوكوكاس أورياس, السالمونيلا, الايشيريشيا كولاى وباسيلس سيريس وأسبرجلس نيجر وكانديدا ألبيكانز) لكلا من إكليل الجبل والبردقوش مسحوق وزيت (بتركيزات مختلفة (٠.٤٪، ٠.٨٪، ١.٢٪ و ١.٦٪) على التوالى. حيث تم تقدير الفينولات الكلية، والفلافونيدات ومضادات الأكسدة باستخدام طريقة الأسبكتروفوتوميتر, فى حين تم التعرف على المركبات الفينولية باستخدام جهاز الكروماتوجرافى الغازى عالى الأداء. وأظهرت النتائج أن أكليل الجبل محتواه مرتفع من الفينولات الكلية بالمقارنة بالبردقوش حيث كانت متوسط القيم ٥.٠٧ و ٠.٧٩ جرام مكافىء حامض جاليك / ١٠٠ جم على التوالي. كذلك كان إكليل الجبل مرتفع فى الفلافونيدات الكلية. سجلت نشاط مضادات الأكسدة لإكليل الجبل قيم مرتفعة في حين أن (DPPH) لاكليل الجبل كان أعلى من المردقوش .أعلى قيم للمركبات الفينولية لاكليل الجبل سجلت لحمض السينامك وحمض الفانيليك حيث كانت القيم ١٩٢٠.٩٣ و ١٥٢٠.٦١ ملجم / كجم على التوالي، بينما كانت أعلى قيم للمركبات الفينولية للبردقوش سجلت للحمض الروزمانيك وروزمانيلات الميثيل حيث كان متوسط القيم ٣١٠٠.٠٥ و ١٥١٠.٥٠ ملجم / كجم على التوالي .وسجلت قيم الحد الأقصى للتثبيط كان مع تركيزات مختلفة من مسحوق إكليل الجبل مع أستافيلوكوكاس أورياس ؛ بينما أدنى مستوى سجل لميكروب الايشيريشيا كولاي . وسجلت أعلى نسبة تثبيط مع مسحوق البردقوش ٠.٤٪ مع فطر أسبرجلس نيجر ، في حين أن أدنى قيم للتثبيط سجلت مع الايشيريشيا كولاي .وسجلت أعلى قيمة نسبة تثبيط عند تركيز ٠.٤٪ و ٠.٨٪ من زيت إكليل الجبل مع أستافيلوكوكاس أورياس وكانت القيم ٩٩.٩٨٪ و ٩٩.٩٩٪ على التوالي .وسجلت قيمة الحد الأقصى لنسبة التثبيط ٠.٤٪ و ٠.٨٪ على تركيزات مع زيت البردقوش مع الكانديدا ألبيكانز و أستافيلوكوكاس أورياس وكانت القيم ٩٩.٩٥٪ و ٩٩.٩٨٪ على التوالي .يمكن أن نشير إلى أن نسبة التثبيط للميكروبات المرضية بنسب مختلفة تزداد بزيادة تركيزات زيت اكليل الجبل والبردقوش.

الكلمات الدالة: أكليل الجبل , البردقوش, مضادات الأكسدة, المركبات الفينولية , الميكروبات المرضية