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Preservation Properties of Natural Spices in Local Markets

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Abstract: *The study was conducted to evaluated prolong shelf-life effect of seventeen flavoring spices in Sudan local market, however, spices were different chemically in (protein, fat, ash, and moisture %). There were significantly different in pH value within the spices types and all in acidity rang (4.07 – 6.10) for cloves and ginger respectively. The microbial growth was assessed by total viable bacterial count for each one and there were significantly different. Antimicrobial activity of spices extract has been evaluated agnist staphylococcus aureus, and Escherichia coli. Among spies extract in three concentration of each one garlic, Fenugreek, and piper showed excellent antimicrobial activity agnist staphylococcus aureus. The fenugreek extract, however, showed excellent antimicrobial activity for Escherichia coli also. Antioxidant capacities of 17 spices extracts available in local market were determined using 2,2- diphenyl - 1- picrylhdrazil (DPPH). Percentage radical scavenging activity by samples was determined in comparison with a di methyl sulpho oxide (DMSO) treated control group. Cloves, cinnamon, thymes, piper, and ginger has been excellent antioxidant result respectively.*

I. Introduction

Spices can be defined as vegetable products used for flavoring, seasoning and imparting aroma in food (FAO,2005) . Herbs and spices have been associated with many different religions of the world herbs were most notably associated with the Romans and Greeks. Spices and herbs come from the following parts of aromatic plants: fruits fennel, fenugreek, mustard), rhizomes, roots (ginger, turmeric), leaves (bay, marjoram, parsley, sage, thyme), barks (cinnamon and cassia), floral parts (saffron, cloves) , or bulbs (onion, garlic),stems (coriander, cinnamon). Flavor is the primary purpose of spices and herbs, however some have been shown to have antimicrobial properties (Tajkarimi, Ibrahim &Cliver, 2010; Tiwari et al., 2009). Similarly, many spices and extracts contain compounds that have been shown to have antioxidant activity (Sasse, Colindres & Berwer, 2009). Spices active compounds have been included in class of naturally occurring food preservatives and have their inclusion in foods allowed by food production regulator offices (Brull and Coote, 1999). Spices and herbs have been added to food since ancient times, and used for many centuries by various cultures to enhance flavor and aroma of our foods as our ancestors have recognized the usage of spices in food preservation and in treatment of clinical ailments and there are several reports on development of antibiotic resistance in diverse bacterial pathogens (Gold and Moellering, 1996)., not only as flavoring agents, but also as folk medicine and food preservatives (Beuchat (1994)& Cutler (1995)). Furthermore, certain spices and herbs prolong the storage life of foods by preventing rancidity through their antioxidants activity or through bacteriostatic or bactericidal activity, also to food-borne pathogenic bacteria (Shelef *et al*., 1980). Much research has indicated that lipid oxidation and microbial growth in meat products can be controlled or minimized by using either synthetic or natural food additives (Gray *et al.*, 1996; Lee *et al.* 1997; Mielnik *et al*., 2003). Natural agents possessing antioxidant and antimicrobial properties have the advantage of being readily accepted by consumers, as they are considered natural (Sallama *et al*., 2004). Some spices and herbs used today are valued for their antimicrobial activities and medicinal effects in addition to their flavor and fragrance qualities. The extracts of many plant species have become popular in recent years and the attempts to characterize their bioactive principles have gained momentum for varied pharmaceutical and food processing applications (Shan *et al.*, 2007). Spices are used widely in the food industry as flavors and fragrances. Besides, they also exhibit useful antimicrobial properties (Pruthi1976; Roller, 2003) and were used in food industry for shelf-life extension and wholesomeness. Therefore, there has been increasing interest to replace synthetic preservatives with natural, effective and nontoxic compounds. Those are, in the first place, extracts and essential oils (EOs) of spices and herbs (Smid and Gorris (1999)). As natural food stuffs, spices and herbs appeal to all who question safety of synthetic food additives and demand high-quality products that at the same time are safe and stable (Brul and Coote (1999), used and considered indispensable in many types of meat products for its colouring, flavouring, antioxidative and antimicrobial properties (Honikel, 2008). The key technological measures needed during storage is the preservation of the meat from microbial spoilage and contamination/proliferation of pathogenic microorganisms (Jang and Lee, 2005; Brightwel *et al*., 2009; Pennacchia *et al*., 2011). The using about 30 types of spices in meat products, but it is only in recent years that modern science has started paying much attention to

the exploitation of desirable properties of spices. As technologies improved, processing and storage conditions reduced bacterial growth and meat processors were able to lessen the amount of salt added to products. This allowed greater diversity of flavors and subtle use of spices because salt did not overpower the other flavors (Aberle et al., 2001). The objective of this study to evaluate the antimicrobial activity and antioxidants content, beside chemical composition of spices in Sudan local market.

II. Materials And Method

Preparation of samples:

Seventeen types of spices were purchased from Khartoum local market. The samples were minced to homogenous mass in a grinder, and then used for analyses immediately.

Chemical composition

The Chemical compositions of samples were measured according to standard methods of AOAC (1980). Crude protein was determined using a Foss Tecator Kjeltec 2300 Nitrogen/Protein Analyzer. Fat was determined by Soxhlet extraction of the dry sample, using petroleum ether. Ash content was determined by ashing samples in a muffle furnace at 500 °C for 24 h. The ultimate pH of Spices samples determined by sing pH meter. The pH meter was calibrated with buffers 4 and 7.

Preparation Spice extracts

Extraction was carried out according to method describe by (Sukhdev et. al. (2008). 50 g of each plant sample was grounded using mortar and Pestle and extracted by soaking in 80 % ethanol for about seventy two hours with daily filtration and evaporation. Solvent was evaporated under reduced pressure to dryness using rotary evaporator apparatus and the extracts were combined together. Extracts allowed to air till complete dryness and the yield percentages were calculated as followed:

Weight of extract / weight of sample × 100

Measurements of antioxidant content:

The free radical scavenging activity of the fractions was measured in vitro by 2,2-diphenyl-1-picrylhydrazyl (DPPH) was determined according to the method of (Shimada et. al. (1992). with some modification. The test samples were to react with (DPPH) for half an hour at 37°C. The concentration of DPPH was kept as (300µ M). The test samples were dissolved in di methyl sulphoxide (DMSO) while DPPH was prepared in ethanol. After incubation, decrease in absorbance was measured at 517nm using multiplate reader spectrophotometer. Percentage radical scavenging activity by samples was determined in comparison with a DMSO treated control group. All tests and analysis were run in triplicate.

Antimicrobial activity of plant extract

The extracts were reconstituted to concentration of 4%, 20%, and 30% in dimethyl sulphoxide (DMSO). Antimicrobial activity was assessed by the agar – well diffusion method (performance… 2006). The inoculums size of each tested bacterium was adjusted to a suspension of 10^6 cells. The inoculums suspension was spread over a Mueller Hinton Agar (MHA) plat, to achieve confluent growth, and allowed to dry. 10 mm diameter wells were bored in the agar using a sterile cork borer and the agar dices were removed. A 100 µl aliquot of the reconstituted extract was placed into a well with pipette and the plate was held for one hr at room temperature for diffusion of extract into the agar. Subsequently , the plate was incubated for 18 hr at 37 C °. After incubation, the diameters of the zones of inhibition were measured to the nearest mm.

Statistical analysis

All determinations were carried out at least in triplicates. One way ANOVA was used to find statistical difference between the means of the values reported. The means were separated by using new Duncan multiple range technique with SPSS package (version 20).

III. Results And Discussion

The Result of this study for chemical composition of 17 types of spices in Sudanese local markers in table (1) The moisture content (%) were significantly different ($p>0.05$) among spices samples. the sample of Nutmeg (9.37 %) had a higher value compared with the other samples and lower value for Thyme (2.50 %), the samples of Ginger, Garlic and Black pepper obtained (6.33 %, 5.50%, 6.47%) respectively agreement with Gloria A. Otunola.,*et al* **(**2010). Which ranged the moisture content of spices Ginger, Garlic, and Pepper Black (6.37%, 4.55%, 5.70%) respectively. The sample of Cloves (6.45%). were not similar with result of (C.U. Ogunka-Nnoka .,*et al 2008)* Cloves (12.1%). Referred the differences between the sources of spices. The Ash content (%) were significantly different ($p>0.05$) among spices samples. the sample of Fennel (13.20%) had a

higher value compared with the other samples and lower value for Nutmeg (2.20%).The samples of Ginger, Garlic and Pepper Black(6.30%, 4.08%, 4.35) respectively agreement (Gloria A. Otunola.,*et al* 2010). The protein content (%) were significantly different (p>0.05) among spices samples. the sample of Fenugreek (26.5%) had a higher value compared with the other samples and lower value for Cinnamon (1.75 %) The samples of Ginger, Garlic, onion and Pepper Black, and Fenugreek (8.58%, 7.35%, 10.45%, 12.50%, 28.45%) respectively, Nwinuk.,*et al* 2005 and Vani Pasricha.,*et al 2014* Which mentioned the protein content of spices Ginger and Garlic onion and Pepper Black (7%, 5.25%, 10.25%, 7.62%, 26%) respectively. The Fat content (%) were significantly different (p>0.05) among spices samples. the sample of Sesames (56.47%) had a higher value compared with the other samples and lower value for Cinnamon (0.623%),and there were not similar with result of the samples for Ginger, Garlic, and Pepper Black (5.35%, 0.72%, 12.70%) (Gloria A. Otunola., *et al* 2010).the reason it might be of referred to the different between the spices sources.

Table(1) Chemical compositions of Spices.

Samples	moisture	Ash	Fat	Protein
Ginger	6.33±1.375	5.75±0.250	2.37±0.125	7 ± 1.750
Fenugreek	4.95±1.450	4.00±0.000	3.70±0.300	26 ± 0.000
Fennel	4.50±0.000	13.20±0.800	1.37±0.375	18.2 ± 0.250
Cardamom	6.35±0.350	9.00± 1.500	2.22±1.025	7 ± 1.750
Mustard	4.00±0.500	5.75 ±0.250	1.37±.125	1.75 ± 0.00
Cloves	6.45±0.450	7.0±0.000	1.62±0.125	5.25 ± 1.750
Cumin	4.85±1.350	8.37±0.375	21.75±0.750	26.5 ± 1.500
Sesames	2.87±0.875	3.75 ±0.25	56.47±1.225	22.62±0.125
Anise	5.45±0.450	7.25±0.250	1.67±0.750	16.6±2.625
Thyme	2.50±0.000	14.50±0.500	2.87±0.375	17.5 ± 0.0
Garlic	5.50±0.500	3.50 ±0.00	3.62±0.625	5.25 ± 0.0
Onion	8.50±2.000	4.70±0.200	1.62±0.125	10.25 ± 0.2
Cinnamon	8.85±0.150	3.37±0.125	.623±0.125	1.75 ± 0.00
Nutmeg	9.37±0.125	2.20±0.000	5.00±0.500	3.05 ± 0.45
piper cubeba	5.60±1.1	4.82±0.325	0 .75±0.00	7.87 ± 0.87
Pepper Black	6.47±1.475	4.22±0.225	1.37±0.375	7.62 ± 0.62
Coriandor	6.47±0.975	8.27±0.125	2.12±0.625	4.37 ± 0.87
Sig	*	*	*	*

Values were mean ± SD of 3 replicates. Test values along the same row carrying different superscripts for each parameter are significantly different ($p < 0.05$).

The Antioxidant activity (%) were significantly different (p>0.05) among spices samples. The sample of Cloves (92%) had a higher value compared with the other samples and lower value for Cumin (0.3%). The samples Thyme (29.5%) (Aneta Wojdyło.,*et al 2007)* , cardamom (24.2%) ginger (23.5%), fennel (30.3%) and cumin (37.4%) (Iris hinneburg., *et al 2006)* this values were not agreement with the samples cardamom (22 %), ginger (77%), fennel (44%) and cumin (0.3%). It might be to the different of solvent extract. The pH values were significantly different (p>0.05) among spices samples. The sample of ginger (6.1%) had a higher one compared with the other spices and lower value for Cloves (4.07%). Samson.K.Baby and Girish,T.Eon 2006 Which ranged the pH value of spices Clove, Fennel, Black pepper, Garlic, ginger, Corainder, Cumin, Cinnamon, Nutmeg (4.07 %, 5.47%, 6.04%, 5.98%,6.1 % 5.71%, 5.98%, 4.81%, 5.79%) respectively. The extraction Yield (%) were different among spices samples. Onion extract yield (59.24%) had a higher content compared with the other spices and lower value for Cumin (3.43%). The extract yield of cardamom, ginger, Fennel and Cumin (88%, 30.2%, 21.6%, and 24.2%) respectively mentioned by Iris Hinneburg ., *et al 2006).* This values were not agreement with the this study which obtained for cardamom, ginger, Fennel and Cumin (7.44%, 8.24%, 15.23%, and 3.43%) respectively. Different it may be for the different solvent extract.

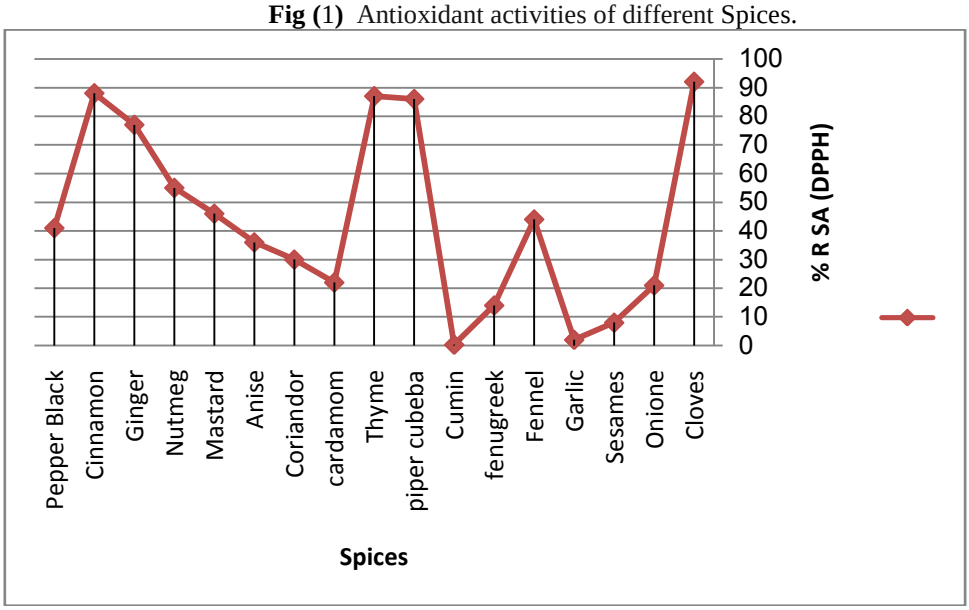
Table (2) Antioxidant capacity, pH value, Yield%, and Extract Wight of 50gm of spices.

samples	w.extarct	Yield%	pH	% RSA±SD (DPPH)
Ginger	4.11±.082	8.24±.00	6.1±0.11	77±0.01
fenugreek	4.53±.09	9.07±.001	5.86±0.02	14±0.03
Fennel	7.61±.152	15.23±.0005	5.47±0.00	44±0.02
cardamom	3.72±.074	7.44±.0005	5.29±0.01	22±0.09
Mustard	3.75±.075	7.51±.000	5.87±0.02	46±0.03
Cloves	10.88±.21	21.76±.0005	4.07±0.04	92±0.01
Cumin	1.71±.034	3.43±.0005	5.98±0.06	0.3±0.03
Sesames	2.10±.042	4.21±.000	6.07±0.04	8±0.03
Anise	5.34±.106	10.67±.000	5.58±0.02	36±0.05
Thyme	19.31±.386	38.62±.0005	5.21±0.03	87±0.01
Garlic	6.26±.125	12.52±.000	5.98±0.00	2±0.02
Onion	29.62±.59	59.24±.001	5.06±0.03	21±0.07

Cinnamon	4.26±.127	8.57±.000	4.81±0.08	88±0.04
Nutmeg	8.11±.162	16.23±.0005	5.79±0.09	55±0.01
piper cubeba	3.77±.075	7.57±.000	4.94±0.03	86±0.03
Pepper Black	3.74±.075	7.49±.010	6.04±0.02	41 ±0.06
Coriander	2.97±.059	5.95±.001	5.71±0.03	30±0.02
Sig	*	*	*	

The means ±SD values for Antioxidant capacity , The pH , The Yield and the Wight of spice Extract from 50g of Spices.

Fig (1) Antioxidant activities of different Spices.



The results of the antimicrobial activity of samples the microorganism were record in Table (3) the samples at all concentrations, that is,(4%, 20%, 30%) were significantly different (p>0.05) among spices samples. The samples of Fenugreek, Garlic and Cumin had a highest percentage of antimicrobial, wereas Cloves, Fennel and Cinnamon had lower percentage of antibacterial. The samples of garlic (9%, 12%, 14%) respectively Zone of inhibition in S.aurues (M. Melvin Joe ., *et al* 2009) were similar with result of garlic (7.5% 11% 12%) respectively Zone of inhibition in S.aurues. And The samples of Pepper Black (20%) Zone of inhibition in E.coli (H.G.Shete and M.P.Chitanand 2014) were similar with result of Pepper Black (11%)

Table (3) sensitivity test of *S. aureus* and *E. coli* in three concentration and Total Viable count of Spices.

	Zone of inhibition in mm in *E. coli*			**Zone of inhibition in mm in** *S. aureus*			
Samples	Con (4%)	Con (20%)	Con (30%)	Con (4%)	Con (20%)	Con (30%)	Total count
Ginger	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	5±0.62	15.33±3.51
Fenugreek	3.5±0.62	9±0.62	12.5±0.62	4±0.62	4.5±0.62	7.5±0.62	.33±0.57
Fennel	0±0.62	0±0.62	2.5±0.62	0±0.62	0±0.62	0±0.62	16.33±0.57
Cardamom	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	13.33±1.52
Mustard	0±0.62	0±0.62	10. 5±0.6	0±0.62	0±0.62	5.5±0.62	12.33±0.57
Cloves	0±0.62	4.5±0.62	9±0.62	0±0.62	2.5±0.62	5.5±0.62	.33±0.57
Cumin	0±0.62	0±0.62	13±0.62	0±0.62	0±0.62	4.5±0.62	12.33±2.51
Sesames	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	2.33±0.57
Anise	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	17.00±5.00
Thyme	0±0.62	0±0.62	3±0.62	0±0.62	0±0.62	9±0.62	19.33±0.57
Garlic	0±0.62	0±0.62	0±0.62	7.5±0.62	11±0.62	12±0.62	1.00±1.00
Onion	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	9.00±0.00
Cinnamon	0±0.62	2.5±0.62	7.5±0.62	0±0.62	0±0.62	0±0.62	12.33±0.57
Nutmeg	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	37.33±2.51
piper cubeba	0±0.62	0±0.62	0±0.62	3±0.62	5±0.62	6±0.62	26.33±0.57
Pepper Black	8±0.62	11±0.62	11±0.62	0±0.62	0±0.62	0±0.62	21.00±3.00
Coriandor	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	0±0.62	7.00±1.00

The means ±SE values for of 3 replicates. Test values along the same row carrying different superscripts for each parameter are significantly different ($p < 0.05$).

IV. Conclusion

Spices had excellent preservative proprieties especial cloves, Fenugreek, Garlic, and Ginger in food processing without side effect, but must be treated carefully for the flavor and food taste. Some mixing of selected spices should be replacement the chemical preservation in food industry. However, spices had good power to enhanced or prolong the food shelf-life which had a higher antibacterial and antioxidant contents.

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