J. Agric. Sci. Mansoura Univ., 32 (9): 7473 - 7487, 2007

SPICE OLEORESINS TO IMPROVE CHEMICAL, MICROBIAL AND ORGANOLEPTIC CHARACTERISTICS OF BEEF SAUSAGE

Helmy, Shahinaz A.; A. S. M. Ammar and A. I. Hegazy
Food Sci. Dept., Fac. of Agric., Cairo University, Giza, Egypt

ABSTRACT

The oleoresins of capsicum, paprika and white pepper were extracted using acetone with a yield of 21.4, 19.2 and 16.3 %, respectively. The volatile components of these oleoresins were fractionated and identified qualitatively using GC/MS. The hydrocarbon compounds were the dominant group presented in all tested oleoresins whereas, tricyclene was the major component. The volatile components of capsicum were similar to those of paprika. The capsaicinoids and alkaloids compounds of the extracted oleoresins were identified using HPLC. Capsaicin and dihydrocapsaicin were the main components in capsicum and paprika which contributed 42.3 and 38.7 % in capsicum and 35.8 and 40.3 % in paprika oleoresins, respectively. The previous compounds presented in small amount in white pepper. The dominant alkaloid presented in white pepper was piperine (56.2 %). On the other hand, capsicum, paprika and white pepper oleoresins were added to beef sausage either individually, or a mixture by 0.55 % of whole sausage weight with the reduction of sodium nitrite from 0.1 to 0.05% and the sausage samples were stored at -18ºC for 90 days. Addition of spice oleoresins didn't exert any changes on total cooking loss compared with the control sample. Concerning thiobarbituric acid (TBA) values, results ascertained that spice oleoresins gave potent oxidative stability to sausage where the average of TBA values of sausage formulated with spice oleoresins was ranged from 0.24 to 0.29 mg malonaldehyde , while it was 0.44 mg malonaldehyde in control sample after storage at -18ºC for 90 days . Also, adoptive ability in reducing the count of total mesophilic aerobic bacteria was noticed in sausage, especially, that formulated with capsicum and paprika oleoresins.

Sensory evaluation of fresh sausage indicated that using of capsicum and paprika oleoresins improved the product color. After frozen storage for 90 days, significant differences were recorded between sausages formulated with spice oleoresins and control one, where sausage formulated with spice oleoresins had higher sensory score.

Keywords*:* Capsicum, Paprika, White pepper, Oleoresins, Volatile components, Capsaicinoids, Beef sausage, Frozen storage.

INTRODUCTION

Beef sausage is produced in Egypt by a traditional method, considered very popular meat product in markets and restaurants (El-Shamei and Shehata, 1993). It is well known that addition of sodium nitrite to meat products results in fixation of meat color and in protection against many kinds of meat spoilage bacteria, besides, giving a pleasant flavor to the cured meat (Noil, *et al*., 1990). Recently, nitrites have been involved in toxicological considerations about its use because they may react with amines present in meats, leading to the formation of nitrosamines compounds responsible for carcinogenic effects (Binstok *et al*., 1996). As a consequence, and because of the public health, the levels of nitrite must be diminished in cured meats to reduce their potential for nitrosamine formation. On the other hand, spices are commonly used in food preparations and concentrates in the form of oleoresins, which are being increasingly used by the food industry (Haque *et al*., 2002). Capsicum species have a long history of cultivation. The oleoresins of capsicum and paprika are widely used in food industries because of their pungency and their ability to impart coloring (Maillard *et al*., 1997). Besides, the ability of capsicum oleoresin to reduce serum cholesterol and triglyceride as reported by Gupta, *et al.,* 2002, in male gerbils at 75 mg/kg body weight /day . Also, Kanki *et al*. (2003) ascertained that paprika at concentrations higher than 5% in the diet (0.67g/rat/day) didn't cause any remarkable adverse effects on the rats. Likewise, lipid oxidation is an important factor limiting both the quality of meat products as well as their consumer acceptability. Sausages are particularly sensitive products due to their high level of fat and high degree of comminution (Sammet, *et al*., 2006). Capsicum, paprika and white pepper exhibited superior antioxidant activity (Palic, *et al*., 1993 and Madsen and Bertelsen, 1995).

the main objective of this study was to study the effect of adding spice oleoresins extracted from capsicum, paprika and white pepper to beef sausage in case of nitrite reduction lipid oxidation, microbial growth and sensorial properties of sausage during frozen storage of sausage at -18ºC for 90 days.

MATERIALS AND METHODS

Materials

Spices

Capsicum fruits (*Capsicum annuum* L. var. annuum, family Solanaceae) and white pepper fruits (*Piper nigrum*, family Piperaceae) were obtained from Agricultural Experimental Station, Faculty of Agric., Cairo University, Giza, Egypt. The fruits were air dried, milled and kept until used.

Ground paprika (*Capsicum annuum* L. var. SZ-178) was obtained from the Paprika Research Developing Co. (Kalocsa, Hungary).

Acetone

HPLC grade acetone used for oleoresins extraction was purchased from Sigma Chemical Co., Poole, London, England.

Fresh beef

Ten kilograms of fresh beef (beef trim and plate) were obtained from Faculty of Agric., Cairo University, Giza, Egypt.

Methods

Extraction of oleoresins

Two hundred grams of each type of spices were extracted (using a maceration technique, in which the ground spices mixed with 2 L of freshly redistilled acetone), continuous shaking was applying for 24hrs., then the resultant extracts were filtrated and concentrated at 55ºC in rotary evaporator under vacuum . Likewise, drying was made with N_2 in a 55ºC water bath to obtain oleoresins as described by Dapkevicius *et al.* (1998).

The volatile flavor components

The volatile fractions of oleoresins were obtained using 'head space method' as described by Guadayol *et al.* (1997), in which aliquots of 5 gm of the oleoresins were kept into 10 ml sealed tubes. Then the tubes were heated for 1 hr in a water bath at 60ºC. The volatile fractions were then removed with chromatographic syringes for quantification and identification by GC/MS using a Hewlett- Packard Gas Chromatography- Mass Spectroscopy Model 6890 series equipped with selective detector.

Analysis of capsaicinoids compounds of oleoresins

The capsaicinoid fraction of oleoresins was analyzed and quantitatively determined by HPLC according to the method of Maillard *et al.*(1997).

Processing and storage of beef sausage

The beef was cut into cubes and minced with a meat grinder (model WD114, Germany). The minced beef was divided into five parts and the ingredients (Table 1) mixed for each part (thus, the number of formulations was five including control). Spice mixture (25 coriander, 8 cubeb, 15 cumin, 25 black pepper, 10 clove, 10 cardamom and 7 % cinnamon) was added. Each sausage formula was prepared by mixing the minced beef with the ingredients for 8 min, using a laboratory Hobbart Kneading machine. Based on preliminary test, 0.55% spice mixture was substituted with either capsicum, paprika or white pepper oleoresins, individually, or with 0.55% from all oleoresins. The quantity of sodium nitrite was reduced from 0.1 to 0.05% in all sausage samples formulated with spice oleoresins. Then, the obtained emulsions were stuffed in previously cleaned natural mutton casings using a sausage filling machine to produce a linked uniform size (8cm length). Finally, sausage samples were packed in low density polyethylene bags in 250 gm aliquot each, and stored at -18ºC for 90 days wherein, periodically withdrawn for analysis to correspond to the shelf life of sausage found on the market.

Table 1. Sausage ingredients for preparing 100 gm.

Ingredients	Formulations				
	Control*	1	2	3	4
Ground beef	63.0	63.0	63.0	63.0	63.0
Minced buffalo fat	17.0	17.0	17.0	17.0	17.0
Chilled water	12.5	12.5	12.5	12.5	12.5
Starch	2.5	2.5	2.5	2.5	2.5
Salt	1.8	1.8	1.8	1.8	1.8
Onion & garlic paste	1.3	1.3	1.3	1.3	1.3
Spice mixture#	1.5	1.0	1.0	1.0	1.0
Sodium` nitrite	0.1	0.05	0.05	0.05	0.05
Tri sodium pyrophosphate	0.3	0.3	0.3	0.3	0.3
Capsicum oleoresin (1)	-	0.55	-	-	-
Paprika oleoresin (2)	-	-	0.55		
White pepper oleoresin (3)	-	-	-	0.55	-
Oleoresins mixture(4)**	-	-	-	-	0.55

***Control sausage without oleoresins.**
**** Oleoresins mixture (capsicum, paprika and white pepper).**
#Spice mixture (25 % coriander, 8% cubeb, 15% cumin, 25% black pepper, 10% clove, 10% cardamom and 7% Cinnamon).

Analytical methods

Moisture, crude protein, crude fat contents and pH were determined by the method described in A.O.A.C. (1995).

Total cooking loss

Total cooking loss of all sausage samples was determined after boiling in water for 15 min then the cooked sausage was drained. Cooking loss was calculated using the following equation:

$$\text{Cooking loss} = \frac{\text{uncooked sample weight} - \text{cooked sample weight}}{\text{Uncooked sample weight}} \times 100$$

Assessment of lipid oxidation

Detection of lipid oxidative changes in sausage was carried out after preparation and during frozen storage by determining thiobarbituric acid (TBA) values as described by Ke *et al.,* (1984). TBA values were expressed as milligrams malonaldehyde per kg sample.

Microbial analysis

Bacterial counts were determined by pour plate method every 15 days during storage according to the method described by Andres, *et al*. (2006). The initial dilution was made by aseptically blending 10gm of sample with 90 ml peptone solution (1gm/1L water). Appropriate serial dilutions were plated duplicate with plate count agar (Oxoid) for total mesophilic aerobic count (incubated at 30ºC for 2 days) and total psychrotrophic aerobic count (incubated at 4ºC for 7 days) with violet red bile agar (Merck, Germany). Data were expressed as colony forming unit CFU/g sample.

Sensory evaluation

Cooked sausage samples were left to warm at room temperature before being subjected to sensory evaluation as described by Garcia *et al*.(2002) using ten panelists from staff members of the department of Food Science & Technology, Faculty of Agriculture, Cairo University. The test was carried out using hedonic scales in which the panelists evaluate different attributes i.e., color, texture, odor, taste and overall acceptability. (0=very unpleasant and 10= very pleasant). The collected results were statistically analyzed using Least Significant Difference (LSD) test according to the method of Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Oleoresin extraction

Acetone was selected to extract the oleoresins because of its high efficiency in extracting oleoresins with high intensity as well as high color value and flavor as mentioned by Borges *et al*. (1997). Furthermore, acetone had good affinity for pungent compounds (capsaicinoids) as reported by Amaya-Guerra, *et al*. (1997). The yield of oleoresins obtained from capsicum, paprika and white pepper was 21.4, 19.2 and 16.3 %, respectively. These results are approximately in line with those obtained by Borges *et al*. (1997) and Boelens and Boelens (2000).

The volatile flavor components of the oleoresins

The volatile components of capsicum, paprika and white pepper oleoresins were fractionated and identified by qualitatively GC/MS and the results are presented in Table 2.

Table 2. The volatile flavor components of capsicum, paprika and white pepper oleoresins estimated by GC/MS.

Components	Capsicum	Paprika	White pepper
Hydrocarbons			
Tricyclene	20.95	14.94	12.46
Butane	9.17	8.55	-
α- Thujene	1.87	1.01	-
Sabinene	6.85	3.00	1.61
β- Thujene	2.65	2.00	-
d- Limonene	5.98	3.22	3.02
α- Terpinene	3.09	2.99	-
α- Pinene	1.77	-	2.26
β- Pinene	2.34	-	2.29
γ- Caryophyllene	5.59	5.88	-
β- Caryophyllene	1.12	-	1.37
Terpenolene	0.35	0.72	0.6
Camphene	-	-	1.25
Delta-4-carene	-	-	2.30
α-Humulene	-	0.92	2.99
3- butyl pyridine	1.14	8.04	1.58
Vinyl amine	1.31	1.22	-
Junipene	-	-	5.51
α-Phyllandrene	-	-	2.57
β- Phyllandrene	-	-	3.26
α-Fenchene	1.77	-	4.81
α-Copaene	-	-	4.62
Delta-cadinene	-	-	3.11
Cyclo-Fenchene	-	-	1.96
Myrcene	-	-	1.37
Total	**65.95**	**52.49**	**58.94**
Alcohols			
1,8-cineole	1.59	2.99	4.51
Butanol	1.63	0.82	-
9-Octadecanol	1.18	-	-
Isobutanol	1.27	0.94	-
Terpinen-4-ol	-	-	0.44
Total	**5.67**	**4.75**	**4.95**
Esters			
Phenyl butanoate	2.71	1.36	1.46
α-terpenyl butyrate	1.05	1.03	-
α-terpenyl butanoate	-	-	0.47
Dihydro carvyl acetate	-	0.85	-
Dimethyl acetate	-	2.47	-
Trans sabinene hydrate	-	-	1.14
Total	**3.76**	**5.71**	**3.07**
Aldehydes and Ketones			
Phenyl hydrazone	10.05	-	-
Ethanone	-	0.62	2.45
Benzaldehyde	-	0.88	-
Total	**10.05**	**1.50**	**2.45**
Lactones			
Muskolactone	1.06	0.55	-
Total	**1.06**	**0.55**	**-**
Total identified	**86.49**	**65.00**	**69.41**
Total unidentified	**13.51**	**35.00**	**30.59**

It could be noticed that 23, 22 and 25 components were identified from capsicum, paprika and white pepper, respectively. The identified components represented 86.49, 65.00 and 69.41 % from all components, respectively. The hydrocarbon compounds group was the dominant group of all tested oleoresins where, it constitutes 65.95, 52.49 and 58.94 %, respectively. Tricyclene was the dominant component in all tested oleoresins, whereas butane was just identified in both capsicum and paprika oleoresins. While junipene, delta-4-carene, α- and β- phyllandrene, camphene, α-copaene, Delta- cadinene, cyclo fenchene and myrcene, were fractionated only from white pepper oleoresins. Although, γ- caryophyllene was found in high percentage in capsicum and paprika oleoresins (5.59 and 5.88 %, respectively), it wasn't found in white pepper oleoresin. These results agree with those obtained by Mazza, *et al*., (1993) and Guadayol, *et al*., (1997). Aldehyde and ketone group was the second group for capsicum (10.05 %) while, ester group was the second one for paprika (5.71 %), and alcohol group was the second one for white pepper (4.95 %). The results of volatile components of white pepper are in line of those obtained by Jennings and Wrolstad (1961).

Capsaicinoids and alkaloid components of the oleoresins

The capsaicinoids of capsicum, paprika and white pepper oleoresins were fractionated, identified and quantitatively determined and the results are shown in Table 3. It could be noticed that the oleoresins of capsicum and paprika contained six capsaicinoid compounds representing 97.7 and 97.1%, of the total fractions, respectively. The main components were capsaicin and its isomer dihydrocapsaicin which contributed 42.3 and 38.7% in capsicum and 35.8 and 40.3 in paprika oleoresins, respectively. Meanwhile, nonanoyl vanillylamide and octanoyl vanillylamide recorded 5.8 and 5.4 %, respectively, for capsicum and 8.4 and 8.0 %, respectively, for paprika oleoresins. Other capsaicinoids were relatively found in low concentrations such as homodihydrocapsaicin and nordihydrocapsaicin. These results agree well with those obtained by Maillard *et al.* (1997) and Kirschbaum-Titze, *et al*.(2002). Regarding the capsaicinoid and alkaloid components presented in white pepper oleoresin, data in Table 3 indicated that nine components were identified accounted 94.1%. Six capsaicinoid components were identified constituted about 27.3%, while three alkaloid components were identified representing 66.8%. Capsaicin was the major capsaicinoid compound (18.3%), while homodihydrocapsaicin, dihydrocapsaicin and nordihydrocapsaicin were presented in low amounts. Such results agree with that recorded by Wood *et al*., 1988. With regard to alkaloid components, data showed that piperine was the major compound which contributed 56.2 %, while piperanine recorded 7.1% and piperylin, 3.5%.

Concerning the pungency of the isolated oleoresins, Belitz and Grosch (1999) signified that both capsaicin and dihydrocapsaicin are considered the principle pungent of the most capsicum species and their pungencies are about two fold higher than the other components. Meanwhile, piperine and pipranine have lower role.

Table 3. Capsaicinoid and alkaloid composition of capsicum, paprika and white pepper oleoresins estimated by HPLC.

Capsaicinoid and alkaloid components	%		
	Capsicum	Paprika	White pepper
Octanoyl vanillylamide	5.4	8.0	3.1
Unknown	1.2	-	1.2
Capsaicin	42.3	35.8	18.3
Unknown	0.6	1.7	-
Nor dihydrocapsaicin	1.4	0.6	0.5
Nonanoyl vanillylamide	5.8	8.4	1.8
Unknown	0.5	0.6	2.1
Piperylin	-	-	3.5
Dihydrocapsaicin	38.7	40.3	1.5
Homo dihydrocapsaicin	4.1	4.0	2.1
Piperine	-	-	56.2
Piperanine	-	-	7.1
Unknown	-	0.4	0.8
Unknown	-	0.2	1.8
Total identified	**97.7**	**97.1**	**94.1**
Total unidentified	**2.3**	**2.9**	**5.9**

Chemical composition of stored sausage formulated with spice Oleoresins

Moisture, crude protein and fat contents were determined after direct processing and during frozen storage at -18º C for 90 days and the results are presented in Table (4).

Table 4. Chemical composition of sausage formulated with spice oleoresins during frozen storage at -18ºC for 90 days (wet wt. bases).

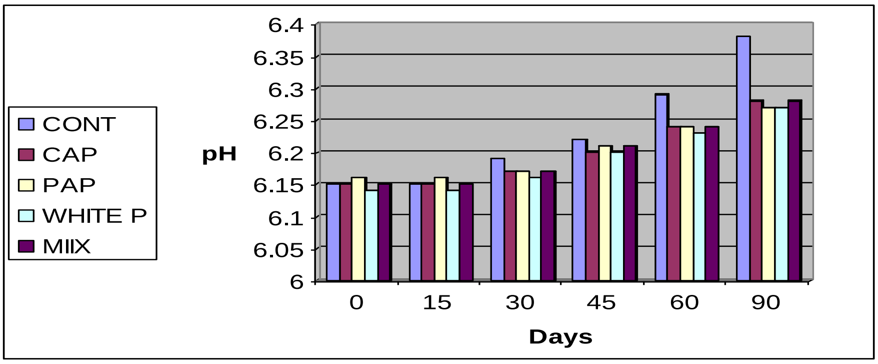
Formulae & Storage time (days)	Chemical composition (%)		
	Moisture	Crude Protein	Fat
Control*			
0	60.88	11.94	23.40
30	59.41	11.81	23.63
60	58.69	11.60	24.34
90	58.21	11.31	24.71
Formula 1			
0	60.20	11.92	23.90
30	59.88	11.78	24.09
60	59.04	11.61	24.11
90	58.33	11.27	24.92
Formula 2			
0	60.31	11.95	23.90
30	59.82	11.70	24.19
60	59.04	11.62	25.22
90	58.54	11.28	25.75
Formula 3			
0	60.32	11.90	23.89
30	59.89	11.82	24.20
60	59.10	11.58	25.61
90	58.61	11.34	25.91
Formula 4			
0	60.34	11.94	23.95
30	59.81	11.85	24.30
60	59.07	11.54	25.28
90	58.69	11.32	25.81

***Control sausage without oleoresins.**

It could be concluded that, the moisture as well as protein content were similar in all sausage samples after processing, however, fat content of sausage samples formulated with spice oleoresins was higher than that of control sample. Such result due to the nature of oleoresins which considered oil soluble portion. During frozen storage for 90 days, a very little decrease in moisture and protein contents was recorded in all sausage samples. The decrement in protein content probably attributed to the denaturation of protein associated with freezing and also the reaction of myosin protein with malonaldehyde which is a product of polyunsaturated fatty acids oxidation (Sebranek *et al*., 1979). However, the decrement in moisture content may be due to the evaporation of moisture during frozen storage. On the contrary, an increase in fat content was noticed in all sausage samples during storage. The increment in fat content may be due to the losses in moisture and protein content (Sebranek *et al*., 1979).

pH values

Results of pH values of processed sausage samples during storage are illustrated in Fig. (1). Results indicated that pH values of all sausage samples were stable up to 15 days of storage, then a slight increase in the pH values was noticed in sausage samples. The increment in pH was higher in control sausage during storage where pH reached 6.38, while the increment in pH values of sausages formulated with spice oleoresins were comparatively low. Such increment in pH values during storage, especially, in control one could be explained by the presence of some strains of bacteria able to degrade the protein and forming different levels of ammonia and basic compounds (El-Adawy *et al*., 1996).



Cont= control, Cap= capsicum, Pap= paprika, White p= white pepper, Mix= mixture.

Fig 1. pH values of sausage formulated with oleoresins during frozen storage at -18º C for 90 days.

Total cooking loss

Results in Fig. 2 showed the total cooking loss of sausage samples after processing as well as during frozen storage at -18º C. It could be noticed that the total cooking loss was nearly the same for processed control sausage and sausage formulated with spice oleoresins at zero time storage. Then, the cooking losses progressively increased as a period of frozen storage increased up to 90 days in all sausage samples including, control one.

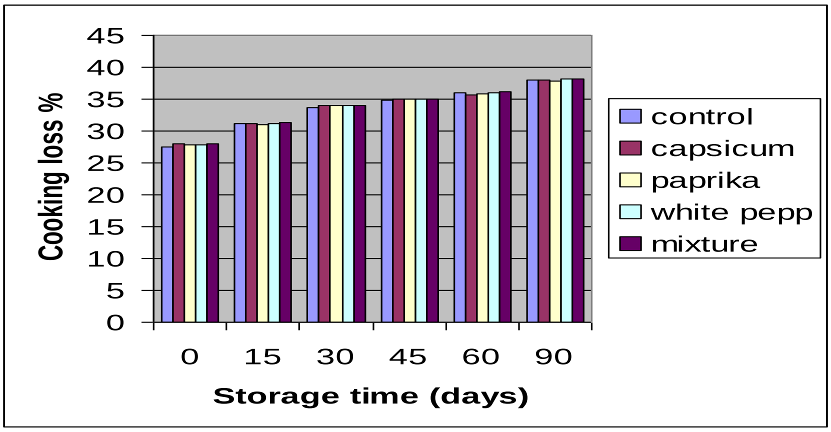


Fig 2. Total cooking loss (%) of sausage samples formulated with oleoresins during frozen storage at -18º C for 90 days.

Thiobarbituric acid values

Thiobarbituric acid (TBA) values have been widely used for measuring oxidative rancidity in fat containing food, especially, meat and fish. Thiobarbituric acid values of sausage samples were determined and the results are presented in Fig. (3).

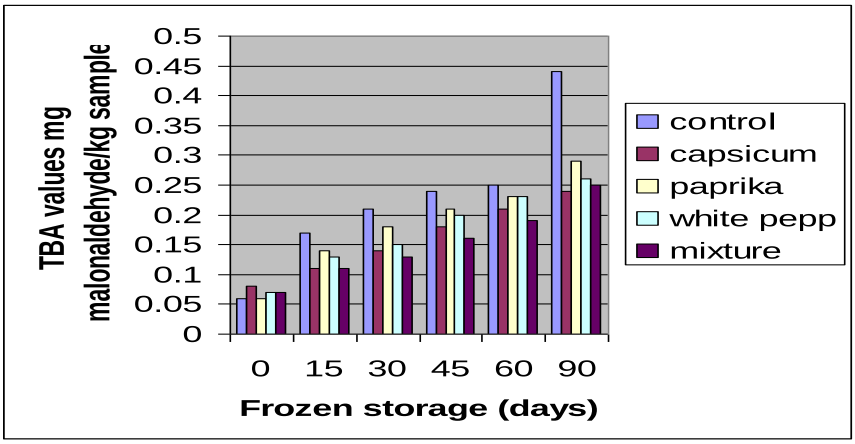


Fig 3. TBA values of sausage formulated with oleoresins during frozen at -18º C for 90 days.

It could be observed that the TBA values were slightly higher in fresh sausage formulated with capsicum and white pepper after processing compared with that of control and paprika ones, may be due to the high content of aldehydes and ketones in these oleoresins (as presented in Table 2). During frozen storage at -18º C, an increase in TBA values were noticed in all sausage formulas during 90 days, but less increase was observed in sausage formulated with all oleoresins (0.24-0.29 mg malonaldehyde) compared with that of control one. These results could be attributed to the antioxidant activity of these oleoresins, especially, capsicum and white pepper which considered combined sources of the major antioxidant agents as mentioned by Zamora *et al*.(1990). Also, these results are in good line with those obtained by Palic *et al*.(1993). The same authors found that paprika and white pepper had high antioxidant activity on pork /beef sausage. Furthermore, Madsen and Bertelsen (1995) signified a strong antioxidant activity of paprika, while they revealed that white pepper gave a moderate antioxidant activity on lard.

Microbial analysis

Total mesophilic aerobic and psychrotrophic aerobic counts in sausage samples during frozen storage were determined and the obtained results are illustrated in Fig. 4 and 5. From these results, it could be noticed that a very little decrease in total mesophilic counts was recorded in control sausage during storage. Meanwhile, a high decrement in these bacteria was noticed in sausage samples especially, samples formulated with the oleoresins mixture and capsicum followed by paprika and white pepper. The adoptive ability in reducing the bacterial count, especially for capsicum and paprika may be due to the presence of capsaicin and dihydrocapsaicin in high percentages comparing with that of white pepper as reported by Lawson and Giant (1989). Therefore, this elucidates the less activity of white pepper oleoresin on bacteria (Belitz and Grosch, 1999). Also, the activity of these oleoresins in reducing the bacterial count could be attributed to the presence of hydrocarbon compounds such as β-thujene, limonene, α-pinene, terpinolene, 1,8-cineole and sabinene (Table, 2) as reported by Farrell (1990) and Gustafson *et al.* (1998). Concerning the total psychrotrophic aerobic count, data presented in Fig 5 showed a gradual increase in total psychrotrophic counts in control sausage during storage. Meanwhile, a very slight increase in psychrotrophic count could be seen in sausage formulated with white pepper oleoresin.

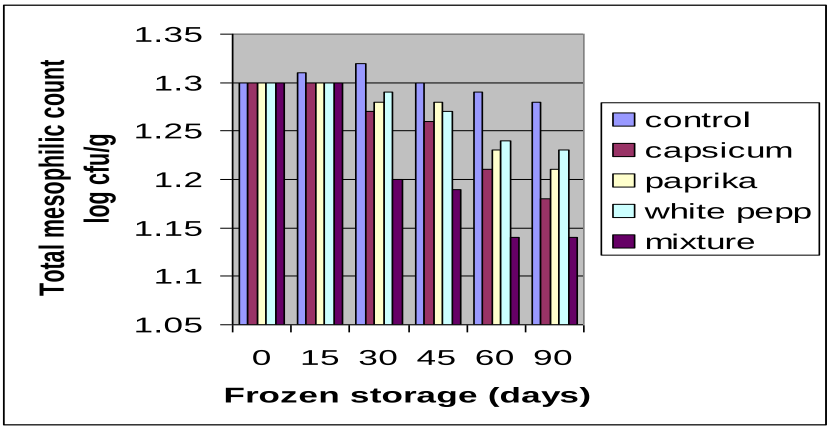


Fig. 4. Effect of oleoresins on total mesophilic aerobic count in sausage during frozen storage at -18º C for 90 days.

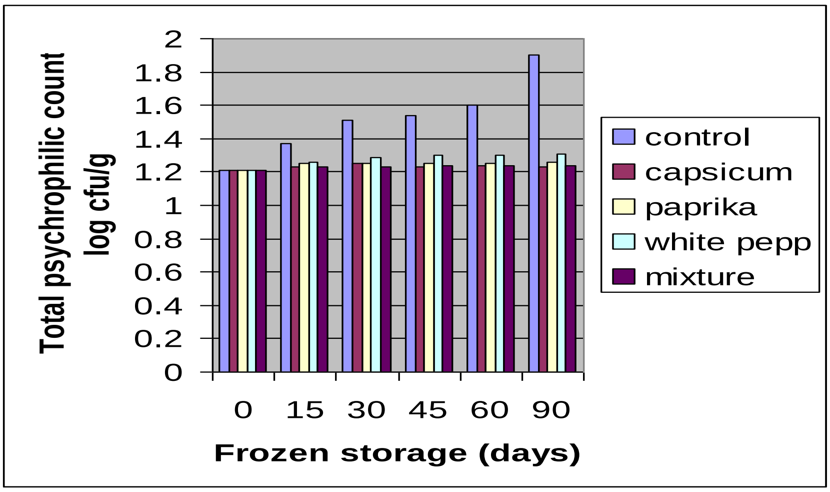


Fig 5. Effect of oleoresins on total psychrotrophic aerobic count in sausage during frozen storage at -18º C for 90 days.

Sensory evaluation of sausage

The sensory evaluation of sausage samples was statistically analyzed and the obtained data are shown in Table 5. From these results, it could be noticed that using of capsicum and paprika oleoresins (0.55 %) enhanced the product color of fresh sausage more than white pepper, however no significant differences were recorded between all samples including control sample. Regarding the texture, sausage formulated with either capsicum, paprika and white pepper oleoresins or their mixture recorded the same score of control one. The same results were observed for odor and taste, where no significant differences were noticed between sausage samples formulated with spice oleoresins and control sample. This might be attributed to the strong aroma of capsicum, paprika and white pepper oleoresins. Also, sensory evaluation was conducted after frozen storage at -18º C for 90 days, the results of the stored sausage sample signified that sausages formulated with capsicum, paprika or a mixture of these oleoresins have abundant color compared with that of control one. Meanwhile, no significant differences were recorded in texture between all sausage samples. Regarding odor, taste and overall acceptability, significant differences were recorded for sausage formulated with spice oleoresins compared with that of control one. In general, there is a consensus opinion during sensory evaluation test that, the spice oleoresins enhanced sensory evaluation characteristics, especially, after frozen storage.

Finally, reviewing the results obtained in present study, it could be conducted that oleoresins of capsicum, paprika and white pepper could be used either separately or combined to diminish the quantity of nitrite add to sausage by half, moreover to improve the quality characteristics of processed sausage during frozen storage at -18º C for 90 days.

T5

REFERENCES

Amaya- Guerra, C. A. ; Saldivar, O. S. ; Cardinas, E. and Muunoz, J. A. (1997).Evaluation of different solvent systems for the extraction and purification of oleoresins from peppers. Arch. Latinom. Nutr., 47: 127-130.

Andres, S. C.; Garcia, M. E. ; Zaritzky, N. and Califona, A. N. (2006). Storage stability of low –fat chicken sausages. J. Food Eng., 72:311-319.

A.O.A.C.(1995). Official Methods of Analysis of the Assoc. of Official Agric. Chem., 16 th ed. Washington DC, USA.

Belitz, H. D. and Grosch, W. (1999). Food chemistry, P. 910, Springer Pub., Berlin, Tokyo.

Binstok, G.; Campos, C. A. and Gerschenson, L. N. (1996). Determination of nitrites in meat systems: An improved procedure. Meat Sci., 42(1): 401-405.

Boelens, M. and Boelens, H. (2000). The chemical and sensory evaluation of edible oleoresins. Perfum. Flavor., 25(4): 10-12.

Borges, P.; Pino, J. A. and Fernandez, N. (1997). Obtainment of oleoresins of sweet pepper. II. Yield and characterization of the oleoresin. Alimentaria, 35(286): 61-62.

Dapkevicius, A.; Venskutonis R.; Van Beek T. A. and Linssen, J. (1998). Antioxidant activity of extracts obtained by different isolation procedures from some aromatic herbs grown in Lithuania. J. Sci. Food Agric., 77:140 - 146.

El-Adawy, T. A.; Mansour, H. and Khalil, A. H. (1996). Effect of *Nigella sativa* seed oil on the storage stability of sausage. Conference and Exhibition, Suez Canal Univ., Ismailia, 124-143.

El- Shamei, Z. A. and Shehata, H. A. (1993). Properties of beef sausage as influenced by meat particle size, fat level and frozen storage. 4 th Conference Agric. Dev. Res., Ain-Shams Univ., Cairo, 1-11.

Farrell, K. T. (1990). Spices, condiments and seasonings. 2 nd ed. An AVI book, New York.

Garcia, M. L.; Dominguez, R.; Galvez, M. D.; Casas, C. and Selgas, M. D. (2002). Utilization of cereal and fruit fibers in low fat dry fermented sausage. Meat Sci., 60:227-236.

Guadayol, J. M.; T. Baquero and J. Caixach (1997). Application of head space techniques to extraction of volatile organic compounds from paprika oleoresin. Grasas Y Aceites, 48(1):1-5.

Gupta, R. S.; Dixit, V. P. and Dobhal, M. P.(2002). Hypocholesterolaemic effect of the oleoresin of *Capsicum annuum* L. in gerbils. Phytotherapy Res., 16(3): 273-275.

Gustafson, J. E.; Liew, Y. C.; Chew, S. and Warmington, J. R.(1998). Effect of tea tree oil on *E. coli*. Lett. Appl. Microbiol.,26:194-198.

Haque, Z. Z.; Marnila, P. and Korhonen, H. (2002). Antioxidative potential of some commonly used spice oleoresins as determined by Luminol-enhanced chemiluminescence measurements. Annual Meeting and Food Expo- Anaheim, Session 46 C, California.

Jennings, W. G. and Wrolstad, R. E. (1961). Volatile constituents of black pepper. J. Food Sci., 26(5): 499-509.

Kanki, K.; Nishikawa, A.; Furukawa, F.; Imazawa, T.; Umemura, T. and Hirose, M. (2003). A-13 week subchronic toxicity study of paprika color in F344 rats. Food and Chem. Toxicol., 41:1337-1343.

Ke, P. J.; Cervantes, E. and Robles-Martinez, C. (1984). Determination of TBA values in fish tissue by an improved spectrophotometric method. J. Sci. Food Agric., 35: 1248-1254.

Kirschbaum-Titze, P.; Mueller- Seitz, E. and Petz, M. (2002). Pungency of paprika. 2. Heterogeneity of capsaicinoid content in individual fruits from one plant. J. Agric. Food Chem., 50: 1264-1266.

Lawson, T. and Giant, P. (1989). The mutagenicity of capsaicinoid and dihydro capsaicinoid in V79 cells. Cancer Lett., 48:109-113.

Madsen, H. L. and Bertelsen, G. (1995). Spices as antioxidant. Trends in food Sci. and Technol., 6: 271-277.

Maillard, M.; Giampaoli, P. and Richard, H. M. J. (1997). Analysis of seven capsaicinoids by HPLC. Flavor and Frag. J., 12: 409-413.

Mazza G.; Kiehn G. and Marshall, H.H. (1993) . Oleoresin, spice oil, essential oil, flavor, fragrances and condiments.*http: //www. pioneerherbs. com.*

Noil, P.; Briand, E. and Dumont, J. D. (1990). Role of nitrite in flavor development in uncooked cured meat products: Sensory Assessment. Meat Sci., 28: 1-8.

Palic, A.; Krizanek, D. and Dikanovic, L. Z. (1993). Antioxidative properties of spice in raw ripened sausage. Fleisch Wirtschaft, 73(6): 684-687.

Sammet, K.; Duehlmeier, R.; Sallmann, H. P.; Canstein, D.; Mueffling, T. and Nowak, B. (2006). Assessment of the antioxidant potential of dietary supplementation with – tocopherol in low nitrite salami-type sausage. Meat Sci., 72:270-279.

Sebranek, J. G.; Sang, P. M.; Topel, D. G. and Rust, R. F. (1979). Effect of freezing methods and frozen storage on chemical characteristics of ground beef patties. J. Animal Sci., 48:1101-1108.

Snedecor, G. W. and W. C. Cochran (1980). "Statistical methods". 7 th ed. The Iwoa State Univ. Press, Ames, USA.

Suzuki, T. and Iwai, K. (1984). Constituents of red pepper species: chemistry, biochemistry, pharmacology and food science. In the alkaloids: Chemistry and pharmacology, Bossi, A. Ed., Academic Press: Orlando, FL, pp. 227-299.

Wood, A. B.; Barrow, M. L. and James, D. J. (1988). Peperine determination in *Piper nigrum* L. and its oleoresins by HPLC method. Flavor and Frag. J., 3(2):55-64.

Zamora, R.; Hidalgo, F. J. and Tappel, A. L. (1990). Comparative antioxidant effectiveness of dietary beta carotene, vitamin E, selenium and co-enzyme Q10 in rat erythrocytes and plasma. J. Nutr., 121:50-56.

راتنجات التوابل الزيتية لتحسين الخصائص الكيميائية والميكروبية و الحسية للسجق البقري

شاهيناز أحمد حلمي، عبد الله صالح مهدي عمار، أحمد محمد اهاب حجازي
قسم الصناعات الغذائية- كلية الزراعة- جامعة القاهرة- الجيزة-مصر.

في هذا البحث تم استخلاص الراتنجات الزيتية لكل من الشطة , البابريكا و الفلفل الأبيض باستخدام الأسيتون حيث بلغت نسب الاستخلاص ٢١,٤, ١٩,٢, ١٦,٣ % علي التوالي. كما تم تقدير مركبات النكهة الطيارة في الراتنجات الزيتية المستخلصة باستخدام GC/MS حيث أوضحت النتائج أن مجموعة الهيدروكربونات تمثل أعلي نسبة من المركبات و يعتبر مركب ثلاثي السيكلين المركب السائد من هذه المجموعة بالنسبة لكل الراتنجات الزيتية المستخلصة. كما أوضحت نتائج تقدير مجموعة المركبات الكابسيسينويدية و القلويدية باستخدام جهاز HPLC أن مركبي الكابسيسين و ثنائي هيدرو الكابسيسين يعتبرا من المكونات الرئيسية في الراتنجات الزيتية لكل من الشطة و البابريكا , بينما يوجد هذان المركبان بنسب أقل في مستخلص الفلفل الأبيض. بينما أوضحت النتائج أن مركب البيرين يعتبر المركب السائد و الفعال في مستخلص الفلفل الأبيض. و كجزء تطبيقي, تم تصنيع سجق بقري و اضافة الراتنجات الزيتية لكل من الشطة أو البابريكا أو الفلفل الأبيض أو خليط منهم بنسبة٠,٥٥ % من اجمالي وزن خلطة السجق , مع خفض نسبة نيتريت الصوديوم المضافة للنصف (من ٠,١ حتي ٠,٠٥ %) لتقليل كمية المستهلك منها لمخاطرها المتعددة. كما تم تخزين السجق المصنع بالتجميد علي -١٨ ° س لمدة ٩٠ يوم. و قد أكدت نتائج الدراسة أن اضافة أي من هذه المستخلصات لم يؤثر علي الفقد الكلي في الوزن خلال الطبخ مقارنة بالعينة الكونترل. من ناحية اخري, دلت قيم حمض الثيوباربيتيوريك علي الثبات الاكسيدى لعينات السجق المضاف لها هذه الراتنجات الزيتية مقارنة بالعينة الكونترل خلال فترة التخزين. كما تم تتبع العد الكلي للبكتيريا الهوائية خلال فترة التخزين حيث أكدت النتائج خفض هذا العدد في العينات المضاف لها الراتنجات الزيتية لكل من الشطة و البابريكا. بالاضافة لذلك فقد حصلت عينات السجق الطازجة المضاف لها الراتنجات الزيتية علي درجات مماثلة للتقييم الحسي لتلك المتحصل عليها من قبل عينة الكونترل رغم انخفاض نسبة نيتريت الصوديوم المضافة. بالاضافة لذلك فقد تم اجراء التقييم الحسي لعينات السجق المخزنة بعد ٩٠ يوم حيث أوضحت النتائج ارتفاع درجات التقييم الحسي لعينات السجق المضاف لها الراتنجات الزيتية مع وجود فروق معنوية بين هذه العينات و عينة الكونترول.

J. Agric. Sci. Mansoura Univ., 32 (9): 7473 - 7487, 2007

Table 5. Sensory evaluation of fresh and stored sausage formulated with spice oleoresins.

Sausage sample	Zero Time					90 days				
	Color	Texture	Odor	Taste	Overall acceptability	Color	Texture	Odor	Taste	Overall acceptability
Control	9.5 ab ± 0.42*	9.2 a ± 0.27	9.5 a ± 0.25	9.5 a ± 0.11	9.5 a ± 0.20	7.4 c ± 0.39	8.5 a ± 0.49	7.0 b ±0.36	7.3 b ± 0.25	7.5 b ± 0.21
Formula 1	9.7 a ± 0.19	9.3 a ± 0.17	9.5 a ± 0.14	9.6 a ± 0.18	9.6 a ± 0.13	8.7 a ± 0.23	8.7 a ± 0.24	9.3 a ±0.16	9.2 a ± 0.26	9.2 a ± 0.27
Formula 2	9.7 a ± 0.24	9.2 a ± 0.19	9.5 a ± 0.13	9.5 a ± 0.25	9.5 a ± 0.16	8.9 a ± 0.27	8.8 a ± 0.31	9.2 a ±0.25	9.3 a ± 0.51	9.2 a ± 0.31
Formula 3	9.3 b ± 0.32	9.3 a ± 0.14	9.6 a ± 0.12	9.6 a ± 0.12	9.5 a ± 0.17	8.2 b ± 0.41	8.7 a ± 0.22	9.3 a ±0.16	9.4 a ± 0.12	9.1 a ± 0.12
Formula 4	9.6 a ± 0.19	9.2 a ± 0.32	9.6 a ± 0.11	9.6 a ± 0.18	9.5 a ± 0.13	8.7 a ± 0.10	8.9 a ± 0.25	9.4 a ±0.21	9.4 a ± 0.25	9.2 a ± 0.36
LSD (5%)	0.29	0.21	0.21	0.22	0.13	0.40	0.45	0.32	0.27	0.45

Means which are not significantly different are followed by the same letter.
*** Standard deviation.**