Chemical Preservatives in Some Meat Products

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A B S T R A C T

A grand total of 120 random samples of meat products represented by beef burger, beef sausage, beef minced meat and beef kofta (30 of each) were collected from different supermarkets located in Cairo and Giza. The average of nitrite, phosphate, ascorbic acid and monosodium glutamate levels (ppm) were 24.14 ± 1.96, zero, 111.33 ± 9.49 and 983.12 ± 45.71in the examined minced meat, respectively,38.53 ± 2.17, 0.13 ± 0.01, 190.10 ± 14.26 and 1849.27 ± 92.69in the examined kofta, respectively,36.89 ± 2.02, 0.21 ± 0.01,227.60 ± 16.81 and 1139.90 ± 73.14in the examined beef burger, respectively and 43.59 ± 2.33,0.16 ± 0.01, 265.67 ± 21.04 and 1958.83 ± 101.35in the examined sausage, respectively.

Key words: Meat products, Nutritional criteria, Chemical preservatives, Nitrite, Phosphate, Ascorbic acid, MSG.

(http://www.bvmj.bu.edu.eg) **(BVMJ-35(1): 58-65, 2018)**

1. INTRODUCTION

The modern technology in different fields gives chance for the meat processors to produce new products in different shapes, easily handled, stored and used. The need for meat products have many tasks includes, new flavor, preservation and low fat content and of low calories so, the quality of raw material (meat) as well as additives and final products are very important for public health. Therefore, the use of low quality ingredients in processing yields low quality meat products (Pearson and Gillette, 1996).

Food additives are used to accomplish certain functions such as coloring, antimicrobial, antioxidative, preservation, improved nutrition, increased emulsification, and altered flavor (Davidson, 2001).Acceptance of food additives has been hindered by problems involving assessment of the net benefits of their use. A serious public health problem has been arisen in many countries where the use of food additives has become more widespread (Denner, 1990).

Nitrite and nitrite addition is necessary to prevent spoilage and growth of pathogenic microorganisms (Pivinick *et al*., 1970) as its absence increase the risk of poisoning especially botulism(Jouve *et al*., 1980).

Phosphate are used in meat products for several reasons such as changing and/or stabilizing the pH value, increasing water holding capacity in order to lead higher yields, decreasing losses of weight in cooking, improving texture and sensory properties (tenderness, juiciness, color and flavor), extending shelf life, etc. In addition, phosphate in meat products are also sources

of supply of phosphorus for consumers through diet, which is an essential mineral for the life of humans (Long *et al.*, 2011).

Monosodium glutamate (MSG) is one of the most abundant naturally occurring amino acids which frequently added as a flavor enhancer. It produced a unique taste that cannot be provided by other taste (saltiness, sourness and bitterness), referred to as a fifth taste (umami). Glutamate serves some functions in the body as well, serving as an energy source for certain tissues and as a substrate for glutathione synthesis (Jinap and Hajeb, 2010).

Ground meat tends to become brown and rancid more rapidly than whole muscle retail cuts (Ho *et al.* 1996). Both myoglobin and lipid oxidation processes are closely related (Faustman and Cassens 1989), so it may be argued that the presence of an antioxidant as ascorbic acid would inhibit both discoloration and off-odor formation.

3. RESULTS

Regarding to data obtained in table (1), it is indicated that the nitrite levels (ppm) in the examined meat product samples was varied from 15.98 to 40.98 with an average of 24.14 ± 1.96 for minced meat, 16.24 to 81.34 with an average 38.53 ± 2.17for kofta, 20.56 to 68.65 with an average of 36.89 ± 2.02for beef burger and 7.02 to 83.01 with an average of 43.59 ± 2.33for sausage. The incidence of nitrite in the examined meat products, the detectable positive samples were 46.7%, 100%, 86.7% and 100% of the examined minced meat, kofta, beef burger and sausage, respectively.

Also, table (6) showed that14 samples (46.7%) of minced meat, 18 samples (60%) of kofta, 25 samples (83.33%) of beef burger and 13 samples (43.33%) of sausage contain nitrite and not prescribed on the label of these samples and this disagree with the recommendation of EOS (2010).

Therefore the present study was planned to investigate the chemical preservatives of some meat products as beef burger, kofta, minced meat and sausage.

2. MATERIALS AND METHODS

2.1. Collection of Samples:

A grand total of 120 random samples of meat products represented by beef burger, beef sausage, beef minced meat and beef kofta (30 of each) were collected from different supermarkets located Cairo and Giza and transferred to the laboratory in an insulated ice box.

2.2. Determination of chemical preservatives:

2.3.1. Determination of nitrites (AOAC, 2016).

2.3.2. Determination of phosphate content(EOS 4485, 2008).

2.3.3. Determination of ascorbic acid (AOAC, ٢٠١٦).

2.3.4. Determination of Monosodium glutamate by HPLC (Lateef *et al.*, 2012).

The results reported in table (2) revealed that the phosphate % in the examined meat product samples was varied from 0.05 to 0.30 with an average 0.13 ± 0.01for kofta, 0.11 to 0.28 with an average of 0.21 ± 0.01for beef burger and 0.05 to 0.35 with an average of 0.16 ± 0.01for sausage. Phosphate failed to detect in all examined minced meat samples, while detected in 100%, 40% and 100% of examined beef kofta, beef burger and sausage samples, respectively. Also, the results in table (2) indicated that the phosphate detected in all examined minced meat, kofta, beef burger and sausage were prescribed on label.

Moreover table (3) revealed that the ascorbic acid (ppm) in the examined meat product samples was varied from 106.6 to 115.7 with an average 111.33 ± 9.49 for minced meat, 180.6 to 203.0 with an average of 190.10 ± 14.26for kofta, 213.7 to 250.4 with an average of 227.60 ± 16.81for beef burger and 261.0 to 270.0 with an average of

265.67 ± 21.04 for sausage. The detectable positive samples were 6 samples (20%), 6 samples (20%), 6 samples (20%) and 26 samples (86.7%) of the examined minced meat, kofta, beef burger and sausage, respectively. Also, the results in table (3) indicated that the ascorbic acid detected in all examined minced meat, kofta, beef burger and sausage were prescribed on label.

Concerning the results obtained in table (4) revealed that the monosodium glutamate levels (ppm) in the examined meat product samples was varied from 588.1to 1284.7with an average 983.12 ± 45.71for minced meat, 1119.8 to 3026.2 with an average of 1849.27 ± 92.69for kofta, 752.3 to 1618.5 with an average of 1139.90 ± 73.14for beef burger and 935.2 to 2675.1 with an average of 1958.83 ± 101.35for sausage. Monosodium glutamate detected in all examined samples. Moreover, table (4) showed that 30 samples (100%) of minced meat, 12 samples (40%) of kofta, 6 samples (20%) of beef burger and 6 samples (20%) of sausage contain monosodium glutamate and not prescribed on the label of these samples and this disagree with the recommendation of EOS (2010).

Table (1): Statistical analysis of nitrite contents (ppm) in the examined samples of meat products (n=30).

Meat products	+ve samples		Not prescribed on label		Min	Max	Mean ± S.E
	No	%	No	%			
Minced meat	14	46.7	14	46.7	15.98	40.98	24.14 ± 1.96 [c]
Kofta	30	100	18	60	16.24	81.34	38.53 ± 2.17[ab]
Beef burger	26	86.7	25	83.33	20.56	68.65	36.89 ± 2.02 [b]
Sausage	30	100	13	43.33	7.02	83.01	43.59 ± 2.33 [a]

Table (2): Statistical analysis of phosphate contents (%) in the examined samples of meat products (n=30).

Meat products	+ve samples		Not prescribed on label		Min	Max	Mean ± S.E
	No	%	No	%			
Minced meat	0	0	0	0	-	-	-
Kofta	30	100	0	0	0.05	0.30	0.13 ± 0.01 [a]
Beef burger	12	40	0	0	0.11	0.28	0.21 ± 0.01 [a]
Sausage	30	100	0	0	0.05	0.35	0.16 ± 0.01 [a]

Table (3): Statistical analysis of ascorbic acid contents (ppm) in the examined samples of meat products (n=30).

Meat products	+ve samples		Not prescribed on label		Min	Max	Mean ± S.E
	No	%	No	%			
Minced meat	6	20	0	0	106.6	115.7	111.33 ± 9.49 [d]
Kofta	6	20	0	0	180.6	203.0	190.10 ± 14.26 [c]
Beef burger	6	20	0	0	213.7	250.4	227.60 ± 16.81 [b]
Sausage	26	86.7	0	0	261.0	270.0	265.67 ± 21.04 [a]

Table (4): Statistical analysis of monosodium glutamate contents (mg %) in the examined samples of meat products (n=30).

Meat products	Not prescribed on label		Min	Max	Mean ± S.E
	No	%			
Minced meat	30	100	588.1	1284.7	983.12 ± 45.71 [c]
Kofta	12	40	1119.8	3026.2	1849.27 ± 92.69 [a]
Beef burger	6	20	752.3	1618.5	1139.90 ± 73.14 [b]
Sausage	6	20	935.2	2675.1	1958.83 ± 101.35 [a]

4. DISCUSSION

The obtained nitrite level (ppm) results were nearly lower than that reported by Mohammed (1997) (30.2 ppm) for minced meat, Mohammed (1997) (62.9 ppm), Hamed (2001) (75.13 ppm)Nayel (2013) (79.56± 6.25) and Amnah (2013) 50.60±5.37 for the examined beef kofta samples, Tolba *et al*. (1994) (112.8±10.5 ppm), EL-Zahaby (2013) (17.68 ppm),Nayel (2013) (94.04± 5.20) and Amnah (2013) (91.63±9.26 ppm) for the examined beef burger and Mohammed (1997) (117.6 ppm),Hamed (2001) (94.06 ppm),Nayel (2013) (127.15± 6.24), Amnah (2013) (85.99±7.87) and EL-Zahaby (2013) 125.25 for the examined sausage samples.

Regarding to the percentage of samples contain nitrite and not prescribed on the label, lower results were reported by Nayel (2013) 2 samples (10%) for beef burger and one sample (5%) of kofta.

According to EOS (2005),it was evident that 100% of the examined minced meat, kofta, beef burger and sausage were accepted (table 13). While 2 beef kofta samples (6.66%) and 2 sausage samples (6.66%) were unaccepted according to (Codex, 192/1995) (revised 2017) which mentioned that nitrite in meat and meat products must be not more than (80 ppm).

Nitrite undergoes many different reactions and the residual content of nitrite in

cured meat products is generally only a small fraction of the amount added because the nitrite reacts with components of the meat during processing and storage (Hammes, 2012).

Adding of nitrite to cured meat develops flavor and colour and retards the development of rancidity and off-odours and off-flavours during storage of cured meats. Nitrite prevents the growth of a harmful bacterium called *Clostridium botulinum* and it may also have preservation effects on other harmful and spoilage bacteria (Manassaram *et al*., 2006).

According to the obtained phosphate results for the examined samples, higher results were reported by Nayel (2013) (0.38±0.029%) and Salim and El-Roos (2013) (0.41 ± 0.025) for beef kofta, EL-Sayed (2006), EL-Zahaby (2013) (0.399%) Nayel (2013) (0.43±0.02%) and Salim and El-Roos (2013) (0.4 ± 0.019%) for beef burger, also, higher results were recorded by Salim and El-Roos (2013) (0.53 ± 0.020%) EL-Zahaby (2013) (0.414%) Nayel (2013) (0.43± 0.019%) for the examined sausage samples.

Regarding to the percentage of samples contained phosphate and not prescribed on the label, similar results were reported by Nayel (2013).

All of the examined beef kofta, beef burger and sausage were accepted according to EOS (2005). While 2 kofta samples (6.66%), 2 beef burger samples (6.66%) and 6 sausage samples (20%) were unaccepted according to (Codex, 192/1995) (revised 2017) which mentioned that phosphate in meat and meat products must be not more than (0.22%).

In the processing of meat and meat products phosphates are essential for several reasons such as, increasing pH, increasing water holding capacity (WHC; structure of muscle protein is opened) in order to lead to higher yields and stabilized meat emulsions, decreasing cooking losses of weight, improving texture and sensory properties (tenderness, juiciness, color, flavor). In addition to extending shelf life (Lampila and Godber, 2002).

The phosphates offer a means of reducing sodium chloride concentrations without major losses in the water binding ability of the meat matrix. Phosphates have been shown to be significant contributors to antioxidant activity and flavor protection in processed meats, particularly in uncured products where nitrite is not included (Vasavada *et al.,* 2006).

Regarding to the recorded ascorbic acid results for the examined samples, higher results were reported by Nayel (2013) 487.82±22.84 for beef burger, 417.67±20.08 for sausage and 461.29± 15.78 for kofta.

Concerning to the percentage of samples contained ascorbic acid and not prescribed on the label, these results agree with (Nayel, 2013) for the results of beef burger and sausage, but disagree for the results of kofta 4 samples (20%) not prescribed on label.

All of the examined minced meat, beef kofta, beef burger and sausage were accepted according to EOS (2005).Ascorbic acid in meat and meat products must be manufactured according to good manufacturing practice (GMP) (Codex, 192/1995) (revised 2017).

The current routine use of ascorbates (ascorbic acid, sodium ascorbate, erythorbic acid and sodium erythorbate) by the meat processing industry is important not only because it accelerates and improves the curing process but also the use of ascorbates inhibits nitrosation reactions which might result in formation of carcinogenic nitrosamines (Mirvish *et al.,* 1995). Moreover, ascorbic acid resulted in much faster and more efficient reduction of the residual level of

nitrite than several other antioxidants (Li *et al.,* 2013).

Regarding to the incidence of monosodium glutamate in the examined samples lower results were reported by Nayel (2013) (50%) for beef burger, (10%) for sausage and (5%) for kofta.

Concerning to the percentage of samples contain monosodium glutamate and not prescribed on the label, lower results were reported by Nayel (2013) 2 samples (10%) for sausage and one sample (5%) of kofta, while beef burger 7 samples (35%) were higher than the obtained results.

All of the examined minced meat, beef kofta, beef burger and sausage for monosodium glutamate were accepted according to EOS (2005). While Codex (192/1995) (revised 2017) mentioned that monosodium glutamate in meat and meat products must be manufactured according to good manufacturing practice (GMP).

When monosodium glutamate is added to foods in small quantities, the palatability of those foods is increased (Chi, 1998). Therefore, it is used to enhance flavor and are recognized as the "umami" (pronounced: oo-marmi) taste in the oriental cuisine. Many researchers believe that umami is a fifth taste, independent of the four basic tastes. MSG contributes a delicious umami taste to foods when used at levels in excess of their independent detection threshold, and they enhance flavors at levels below that (Barbut, 2002).Monosodium glutamate used in low fat foods to make up the flavor that lost when fat is reduced or eliminated (Gadekar, 2009).

Finally from the present study it was observed that there is a difference in chemical composition, amount and types of some preservatives detected in the same meat products with the same company, same preservatives and amount on the label. This indicated inadequate quality control and improper manufacture practice.

5. RECOMMENDATION:

Nitrosamine inhibiting agents as ascorbate, alpha tocopherol or both during the processing of meat products should be added to reduce the hazardous effects. Due to the potential for increased toxic effects of the chemicals used, and for the overall push for more natural products in the food industry, the food industry should look for more natural alternative for safe processing and storage of meat. Some berries, leaves, bulbs, roots and stems are known to contain substances that inhibit bacterial growth. In some plants the concentrations of these compounds is so high that they could perhaps be used to preserve foods. This theory should be tested in organic and conventional meat products.

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