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Determination of sodium nitrite residues in some cured meat products during chilling storage at +4°C

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SUMMARY

Cured meats represent a large portion of the consumed processed meat products. These processed meats are attractive in their color, flavor, texture and are popular because they combine variety with convenience reliability. Despite its numerous benefits and multifunctional properties in processed meat products, nitrite has often been a source of concern due to its heath hazards. This study was conducted to investigate the level of sodium nitrite in some cured meat products during their chilling storage period. Results showed that the means (± S. E.) of the sodium nitrite residues (mg/kg) of the Bastrami, Salami, Luncheon, Sausage and Smoked meat samples were (174.6 ± 9.27; 100.5 ±4.46; 116.9 ±4.12; 94.8 ±4.17 and 79.1 ±2.90) respectively at zero time and these values decreased significantly during all chilling the storage time till it reached (50.7 ± 2.57; 28.1±1.23; 40.8 ±1.78; 35.1 ±2.06 and 14.5 ±1.02) respectively at the end of the chilling storage period (4 months).

INTRODUCTION

Researches on extending the shelf life of fresh meat has been increasing because of several factors, including the centralization of meat production, the transportation of fresh meat to market far from the manufacturing plant, and the need for the meat with high water-holding capacity in the manufacture of emulsified meat products such as frankfurters and salami (Gill 1996). The most important point to be considered for extending the shelf life of meat is the preservation of its fresh quality during the storage period. Moreover, the proposed procedures should be economical to avoid added energy cost and

minimize risks for human health while attaining longer shelf life. The factors limiting the shelf life of meat during storage are the chemical or microbial deterioration of meat and undesirable changes in the fresh meat color (Gill 1996; Sadler and Swan 1997).

Prior to the availability of refrigeration, foods particularly fish and meat were preserved by salting, marinating or pickling, through a decrease in water activity, meat and fish were protected against microbial spoilage and other deteriorative processes. It was the process of treating meat with rock salt that lead to modern curing practices. Thus, meat curing historically defined as the addition of salt (sodium chloride) to meat is now referred to as the intentional addition of nitrite and salt to meat. Cured meats represent a large portion of the consumed processed meat products. These processed meats are attractive in their color, flavor, texture and are popular because they combine variety with convenience reliability (Okayama et al. 1991). Nitrite might also have an influence on the texture of finished meat products by cross-linking of meat proteins. Nitrite together with sodium chloride inhibits the production of neurotoxin by Clostridium botulinum, thus preventing food poisoning and botulism (Sofos et al.1979). Nitrate when used for some dry-cured, non-cooked meats is reduced to nitrite then to nitric oxide, which reacts with myoglobin (muscle pigment) to produce the red or pink cured color. If nitrite is used as the curing agent, there is no need for the nitrate reduction step, and the development of the cure color is much more rapid (Leth et al. 2008). Despite its numerous benefits and multifunctional properties in processed meat products, nitrite has often bean a source of concern due to its role in the formation of N-nitrosamine which are known carcinogens in a variety of animal species (Gloria et al. 1997). Since the rate of formation of nitrosamine is proportional to the square of nitrite concentration (Peg and Shahidi, 2000), reduction of the latter has an enlarged effect in reducing the amount of nitrosamine formed in meat products. The key point in the use of nitrate and nitrite as preservatives is to find a balance between ensuring the microbiological safety of and keeping as low as possible the level of nitrosamines in the final product (Toldra et al. 2009). These compounds are formed from the reaction of nitrite with free amino acids and amines in meat products under high temperatures experienced during frying in certain cured meats. Since, it is difficult to control the level of endogenous factors such as amino acids and amines, a reduction in the nitrite added to products or specifies of reaction and process conditions might be necessary. Thus the allowable levels of nitrite addition in cured meat have been reduced to a maximum of 150 mg/kg in different products. Accordingly, given the current FDA and USDA regulations on the use of nitrites, the risk of developing cancer

as a result of consumption of nitrites-containing foods is negligible. USDA regulations do not permit nitrites and nitrates in baby, junior, or toddler foods (FDA, 1998). Thus, current trends have concentrated in production of low-nitrite, low-fat and low-salt in all meat products.

This study was planned to investigate the level of sodium nitrite in some cured meat products during their chilling storage period.

MATERIALS AND METHODS

Collection of Samples:

Thirty six samples of Bastrami, Salami, Luncheon, Sausage and Smoked meat (each sample of about 1kg by weight) were collected from meat products factories at zero time and each sample was placed in an individual sterile plastic bag surrounded by ice bags in an ice box and transported immediately to the laboratory.

Determination of sodium nitrite was carried out directly after samples arrival to the laboratory and periodically every month during chilling at 4°C.

Statistical analysis: data were analyzed using one way anova (LSD test) in 3 replications according to SPSS program version 10.

Preparation of the test sample:

Meat sample was rendered in to a uniform mass by blending in a blender

Determination of sodium nitrite according to AOAC, (2000).

Five g of finely comminuted and thoroughly mixed test sample were Weighted into 50 mL beaker and ca 40 mL H_2O was Added and heated to 80°C and mixed thoroughly with glass rod and transferred to 500ml volumetric flask. The beaker and rod were thoroughly washed with successive portions of the hot H_2O, adding all washings to flask and enough hot H_2O was added to bring volume to ca300mL. The flask was transferred to steam bath and let stand 2h, shaking occasionally. The flask was cooled to room temperature and diluted to volume with H_2O and remixed. Filter and 2.5 ml sulfanilamide reagent were added to aliquot containing 5-50 g $NaNO_2$ in 50 mL volumetric flask and mixed. After 5 min. 2.5 mL NED reagent were added, mixed, diluted to volume, mixed, and the color let to develop for 15 min. Absorbance was determined at 540 nm against blank of 45 mL H_2O, 2.5 mL sulfanilamide reagent and 2.5 mL NED reagent. Determination of sodium nitrite present was done by comparison with straight line standard curve.

RESULTS AND DISCUSSION

Nitrites used in meat products for contribution in the development of a characteristic pink colour (Wirth, 1986); obtain on antioxidative activity (Morissey and Tichivangana, 1985);

responsibility to the production of the characteristic flavour of cured meat (Peg and Shahidi, 2000) and inhibition of the growth of food spoilage bacteria (Cammack et al., 1999) and most importantly, the growth of Clostridium botulinum, which produces the potential fatal toxin, botulin (Cassens, 1995; Sofos and Busta, 1980). However, despite of its important technological value, the presence of free nitrite in meat products and other foods is also associated with potential health risks.

Table (1): The mean values of Sodium nitrite (mg/kg) of the Bastrami, Salami, Luncheon, Sausage and Smoked meat during storage period at 4°C

Time in Months	Bastrami		Salami		Luncheon		Sausage		Smoked meat	
	Average	St. Error	Average	St. Error	Average	St. Error	Average	St. Error	Average	St. Error
0	174.6*	±9.27	100.5*	±4.46	116.9*	±4.12	94.8*	±4.17	79.1*	±2.90
1	156.8*	±7.26	91.6*	±3.88	101.4*	±3.75	82.6*	±3.84	52.3*	±2.42
2	138.1*	±5.91	73.4*	±3.64	86.5*	±3.21	77.3*	±3.59	30.4*	±1.78
3	90.3*	±3.34	42.9*	±1.77	65.6*	±2.92	53.7*	±2.61	23.2*	±1.32
4	50.7*	±2.07	28.1*	±1.23	40.8*	±1.78	35.1*	±2.06	14.5*	±1.02

*There was a significant difference ($P < 0.05$) between the means in the same column

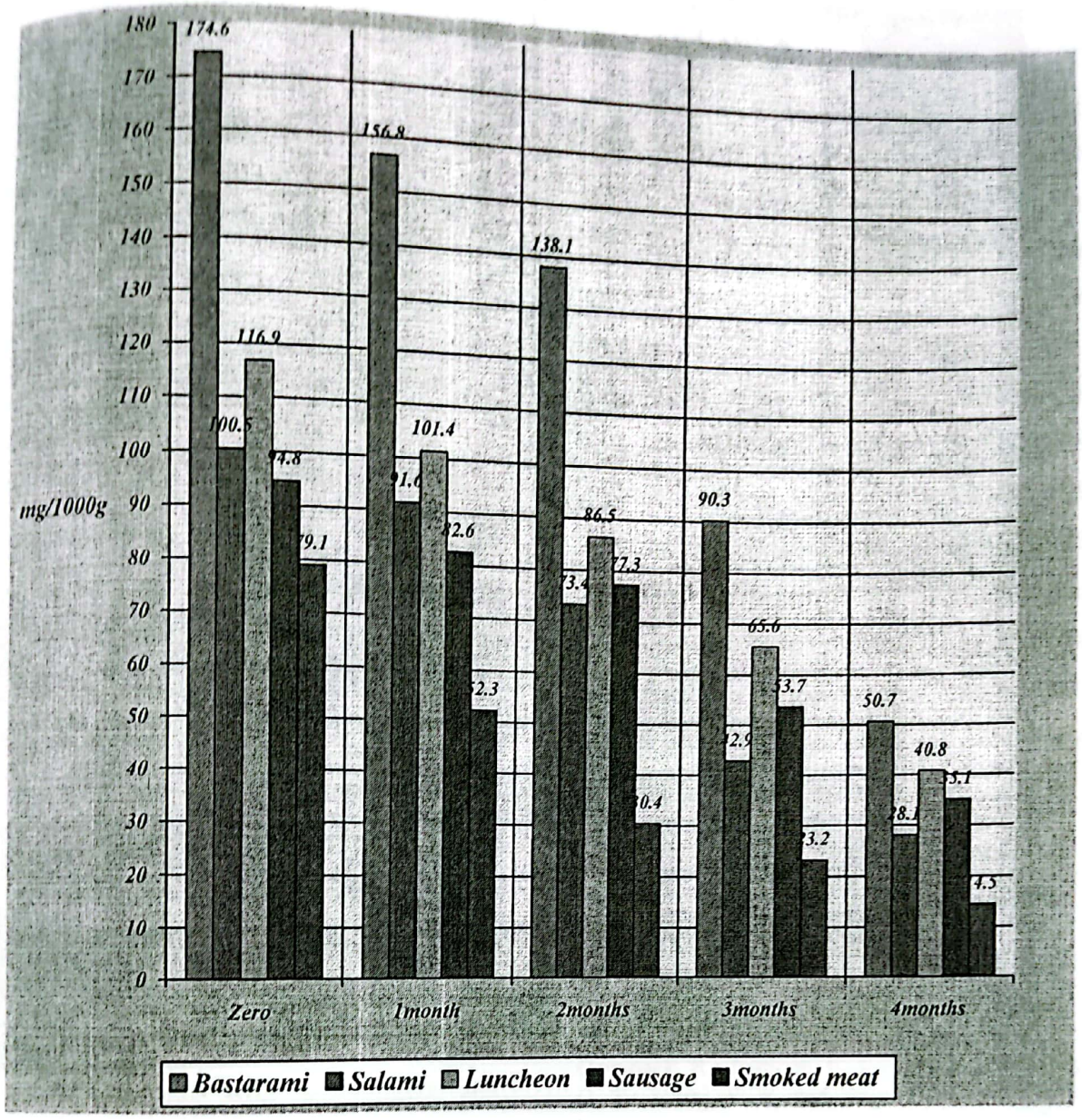

Fig (1): The mean values of Sodium nitrite (mg/kg) of the Bastrami, Salami, Luncheon, Sausage and Smoked meat during storage period at 4°C

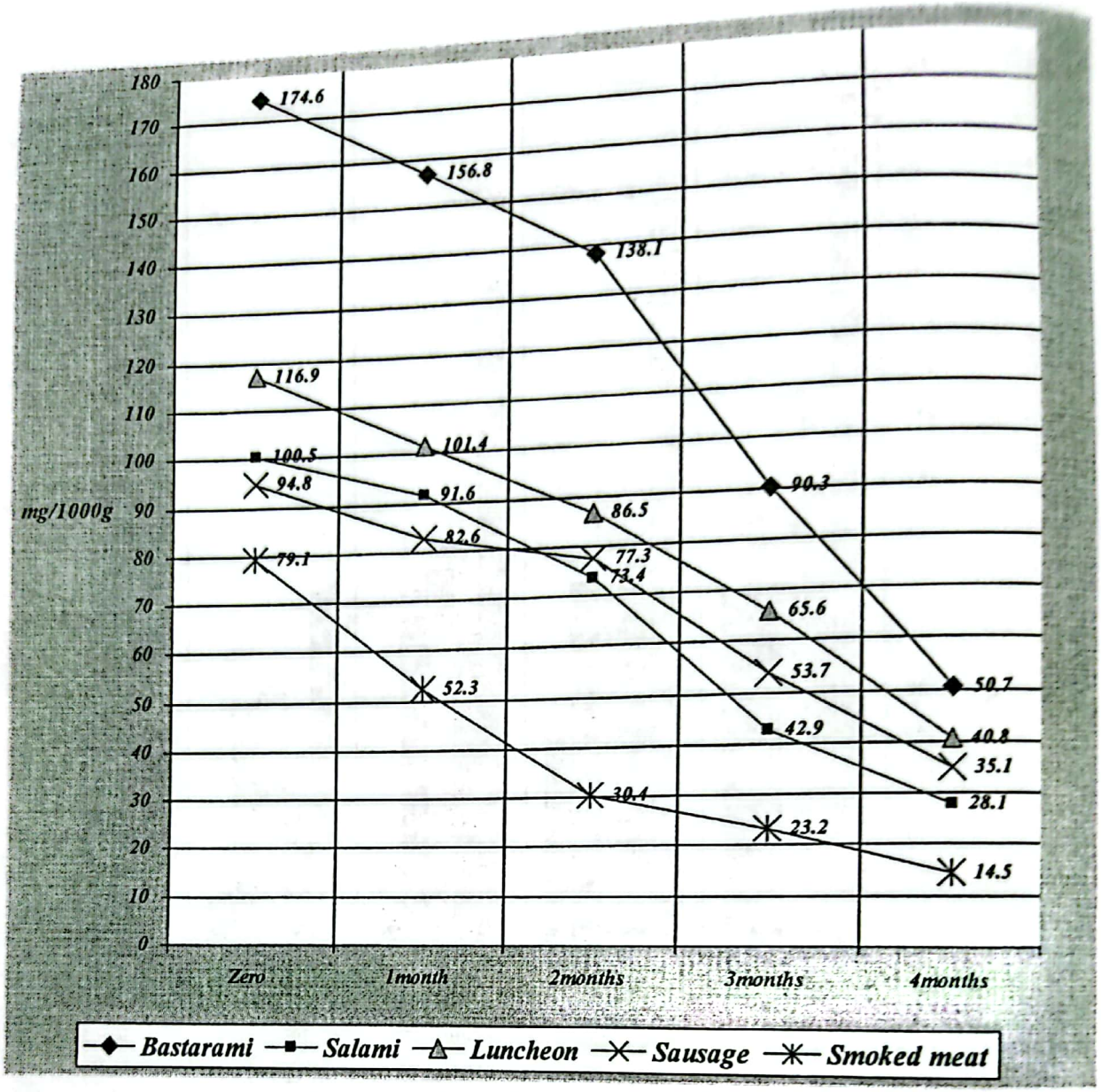

Fig (2): The mean values of Sodium nitrite (mg/kg) of the Bastrami, Salami, Luncheon, Sausage and Smoked meat during storage period at 4°C

The fate of nitrite when added to meat has been extensively investigated. Added nitrite can be accounted for as follows: 5-15% complexes with myoglobin, 1-5% evolved as gas and 26-50% forms sulphydryl lipid and protein complexes 1-10% becomes free nitrate and 5-20% remains free nitrite, (Cassens et al., 1979).

The presented data in table (1) and figure (1) revealed that the mean values (± St. Error) of the sodium nitrite residues (mg/kg) of the Bastrami, Salami, Luncheon, Sausage and Smoked meat samples were (174.6 ±

9.27; 100.5 ±4.46; 116.9 ±4.12; 94.8 ±4.17 and 79.1 ±2.90) respectively at zero time and these values decreased gradually during the storage time till it reaches (50.7 ± 2.57; 28.1±1.23; 40.8 ±1.78; 35.1 ±2.06 and 14.5 ±1.02) respectively at the end of the chilling storage period. Also, these results cleared that the decrease in the values of Sodium nitrite residues was significantly during all chilling storage period.

The results for nitrite content determined in our study were in line with the findings of many investigators like Hasiak et al. (1984). They found that the residual nitrite levels in Turkey hams were decreased significantly during storage at 2° C for up to 11 wk; Chia and Chin (1995) which showed that residual sodium nitrite in the sausages significantly declined as storage time increased ($P < 0.05$); Sadler and Swan (1997) found that within 24hr (0 time), the sodium nitrite content in the hot-boned minced beef from all treatments with added nitrite had dropped to 68 ppm from the initial level of 100 ppm and after 16 weeks storage, the sodium nitrite plus nitrate content had decreased to only 20-40 ppm; Kajak and Koozyn-Krajewska 2006) showed that the addition of NaNO2 at the level of 60 ppm affected the inhibition of the number of microorganisms in a statistically significant way; Dong-Qing et al. 2007) pointed out that the nitrite residue contents were decreased during cold storage of cooked sausages;) Leth et al. 2008) who reported that the maximum permitted added amounts of sodium nitrite in Denmark (60 mg kg-1 for most products and up to 150 mg kg-1 for special products; Mathew et al. (2008) which cleared that the residual nitrite levels of the smoked buffalo meat chunks significantly declined with the period of storage;

Conclusion: From the achieved results it could be concluded that the sodium nitrite residue in cured meat products decreased significantly during all chilling storage period and could be suggested that the decrease might be due to the reaction of nitrite with other chemical ingredients in the meat tissue and or its degradation and consumption by proteolytic spoilage bacteria.

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تقدير كمية نيتريت الصوديوم المتبقية في بعض منتجات اللحوم أثناء فترة حفظها بالتبريد

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تعد منتجات اللحوم المحفوظة بمادة نيتريت الصوديوم من الأكلات المفضلة لدى كثير من الناس لما لها من العديد من المزايا مثل اللون و الرائحة و الملمس و الطعم المميز ونظرا للخطورة البالغة على صحة المستهلك إذا ما تعدت نسبة مادة نيتريت الصوديوم الحدود المسموح بها طبقا للمواصفات القياسية المصرية و منظمة الأغذية والأدوية الأمريكية فقد أجريت هذة الدراسة لتقدير كمية نيتريت الصوديوم في بعض منتجات اللحوم المحفوظة بها خلال فترات حفظها بالتبريد. أظهرت النتائج أن مستوى نسبة نيتريت الصوديوم ± (الخطأ المعياري) مجم/كجم في البسطرمة و السلامي و اللنشون و السجق و اللحوم البقرية المدخنة (**174.6** ± 9.27; **100.5** ±4.46; **116.9** ±4.12; **94.8** ±4.17 and **79.1** ±2.90) على الترتيب وأنها تقل معنويا خلال فترات الحفظ بالتبريد في جميع منتجات اللحوم التي تم دراستها حتى تصبح (**50.7** ± 2.57; **28.1**±1.23; **40.8** ±1.78; **35.1** ±2.06 and **14.5** ±1.02) على الترتيب في نهاية فترة الحفظ و أن معظمها في الحدود المسموح بها طبقا للمواصفات القياسية الصرية (١٢٥ جزء في المليون).