RESIDUAL NITRITE CONTENT OF SLICED-PASTIRMA AS AFFECTED BY OXYGEN SCAVENGERS AND MODIFIED ATMOSPHERE PACKAGING DURING REFRIGERATED STORAGE

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Abstract – Effect of modified atmosphere packaging (MAP-70% CO_2 +30% O_2) with or without oxygen scavengers (OS-200, OS-500) on residual nitrite content of sliced pastırma was determined as compared with the control packaged with Air during refrigerated storage for 120 days. Residual nitrite content in initial pastırma samples (32.8ppm) decreased ($p<0.05$) after day 30 in MAP control, OS-200, and OS-500 reaching to 26.5, 23.83 and 21.79, respectively at day 60. OS-200 and OS-500 groups had significantly lower residual nitrite at day 90 than Air control and MAP control while all groups had similar residual nitrite content at the end of the storage.

Key Words –Modified atmosphere packaging, Oxygen scavengers, Residual nitrite

I. INTRODUCTION

Active packaging technologies for food systems have gained great popularity over the last two decades for the purpose of maintaining the quality and extending shelf-life stability. One of the active packaging classes applied in meat systems is utilization of oxygen scavengers (OS). Since oxygen inside the package of meats or meat products results in accelerated spoilage, OS, by absorbing residual oxygen in the packaging atmosphere, might be applied as in combination with vacuum and modified atmosphere packaging (MAP) to slow down aerobic deterioration due to microbial activities and oxidative reactions, thus, to extend the shelf life of the product [1, 2].

Pastırma is a traditional Turkish dry-cured meat product preferred by consumers for its typical flavor [8]. Pastırma is generally produced using the muscles from particular parts of beef carcasses by first curing with typically salt and nitrite/nitrate, pressing and drying processes. After enough moisture loss is obtained, çemen paste is applied by spreading onto the meat cuts followed by subsequent drying step to a certain degree of moisture content [5, 9].

Nitrite/nitrate salts are the food additives utilized in meat products for controlling *Clostridium botulinum* growth and toxin production. When used in meat products, they also contribute to formation and maintenance of typical desirable cured meat color, prevention of oxidation reactions, and improvement of typical cured flavor [4, 5]. However, these curing salts have potential health risks when residual nitrite level is higher than a certain level in the final product mainly due to potential carcinogenic nitrosamine formation [6].

The objective of this study was to determine the effect of iron based oxygen scavengers with two absorbing capacities (OS-200 or OS-500) in combination with modified atmosphere packaging (MAP) on residual nitrite content of sliced pastırma during refrigerated storage for 120 days

II. MATERIALS AND METHODS

Pastırmas were manufactured using the methods reported by Yağlı & Ertaş [6], Aksu [7] and Uğuz [8] with some modifications. Beef *M. longissimus dorsi* muscles with an average weight of 6 kg each, obtained from two different animals (for the two replications) slaughtered in a local slaughterhouse in the area of Ankara 24 h postmortem were used for production. After 24h aging at 4°C in the laboratory, visible connective tissue and fat were trimmed. Each muscle was then cured by manually rubbing the meat with a curing salt mixture of 6% containing 0.150 g $NaNO_2$, 1.0 g sucrose and 1.0 g glucose in addition to 57.85 g NaCl. The salted meats were

placed in stainless steel trays and cured for 2 days at 4°C and %80-90 relative humidity (RH). After draining, the meat pieces were hung on stainless steel sticks and dried at 15°C and 80% RH for 2 days (first dying) followed by pressing under a flat marble slab at 10°C for 1 day. Meat strips were then subjected to second drying at 20°C and at 70–75% RH for 3 days and pressed again as described above for 15 h. After drying for 24 h at 10°C and 70% RH, the meat strips were immersed in çemen paste prepared by mixing 50% fenugreek flour, 35% crushed fresh garlic and 15% paprika with water (1:1.3) for 3 days, reforming çemen paste by manually spreading it over the beef cuts with a thickness of approximately 2 mm, and then, hung on stainless steel sticks for a stepwise drying schedule as follows: 1) at 15°C and 70% RH for 3 days, 2) at 18°C and 65% RH for 1 day, and 3) at 20°C and 60% RH for 4 days (final product). Dried samples were kept at 4°C no more than 2 days before slicing and packaging. Pastırma samples were sliced with a kitchen type slicer and packaged 1) in Air, 2) with modified atmosphere (MAP) containing 70% CO_2 and 30% O_2, 3) MAP with OS-200, or 4) MAP with OS-500. These four groups of packaged sliced pastırmas were kept at +4°C and analyzed at days 0, 15, 30, 60, 90 and 120 for pH value and residual nitrite.

Chemical composition (protein, ash, fat, moisture) of pastırma was determined by standard AOAC method [9].

Residual sodium nitrite level in pastırma was determined at 0, 30, 60, 90 and 120 days of storage at 4°C according to the AOAC methods [9]. All procedures were duplicated.

III. RESULTS AND DISCUSSION

Moisture, protein, fat and ash contents of pastırma samples were 49.0, 39.6, 3.4, and 7.0%, respectively (Table 1). Because there was no difference in pH values between the sliced pastırma groups during storage ($p>0.05$), the mean pH values were given in Fig. 1. Initial pH value of the sliced pastırma was 5.75 which reached to 5.94 at the end of storage period (at day 120).

Table 1. Initial chemical composition of pastırma*

Attribute	%
Moisture	49.0±0.8
Protein	39.6±0.5
Fat	3.4±0.6
Ash	7.0±0.2

* Mean ± standard deviation.

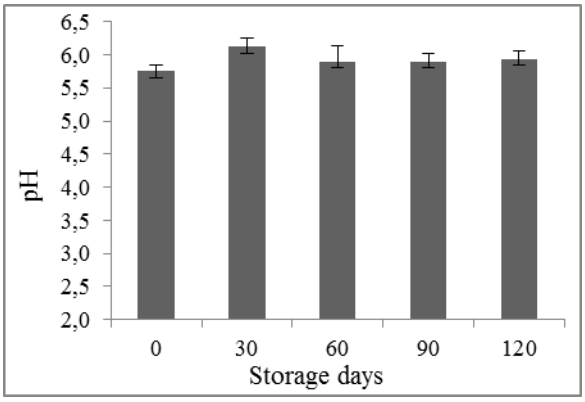

Fig. 1.The effect of air (a),MAP(b), MAP with OS-200 (c) and OS-500 (d) packaging on the pH value of sliced pastırma during storage.

Initial residual nitrite content in pastırma samples was 32.81mg/kg (Fig. 2). At day 60, a significant decrease ($p<0.05$) in residual nitrite level was observed in MAP, OS-200 and OS-500 groups which had 26.5, 23.83 and 21.79 mg/kg residual nitrite, respectively as compared to the initial value. OS utilization was effective in reducing residual nitrite content of sliced pastırma samples at days 60 and 90 of the refrigerated storage. At day 120, although samples packaged with OS had numerically lower residual nitrite contents than Air and MAP groups, there was no statistically significant difference ($p>0.05$) in nitrite levels of the four groups at day 120.

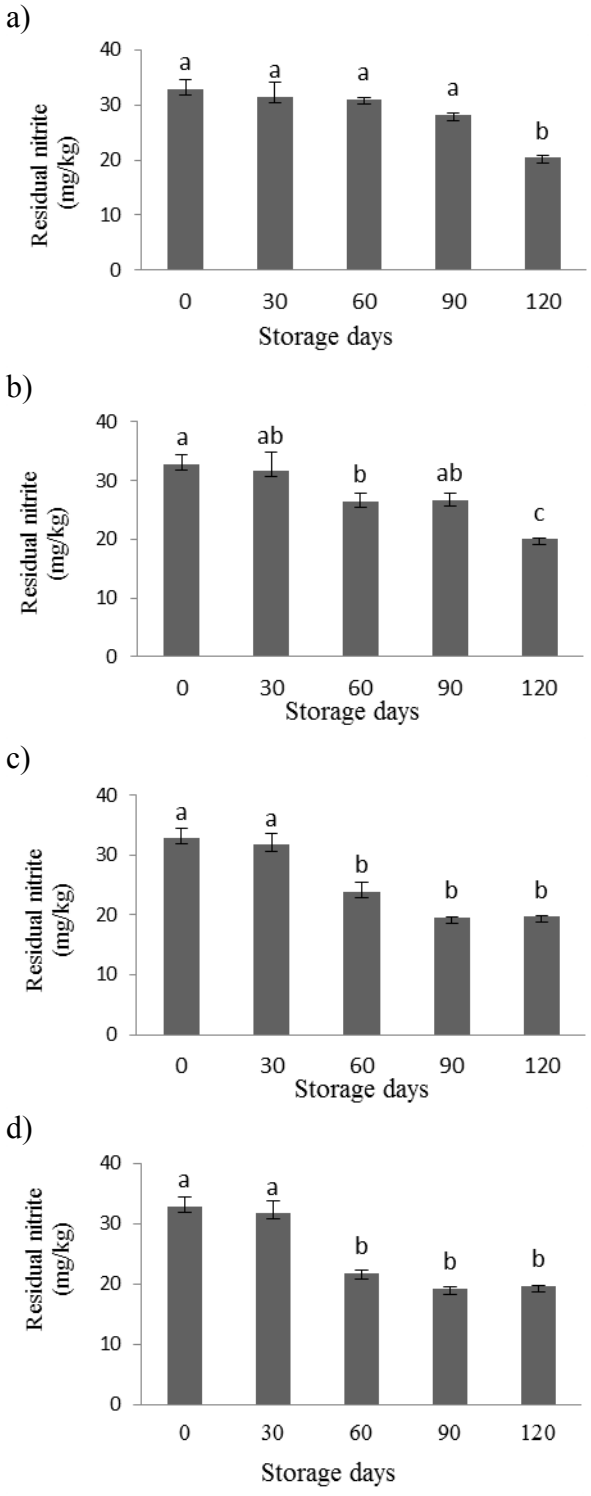

Fig. 2.The effect of Air (a), MAP (b), MAP with OS-200 (c) and OS-500 (d) packaging on residual nitrite level of sliced pastırma during storage.

IV. CONCLUSION

Active packaging with utilization of oxygen scavengers in combination with modified atmosphere packaging of sliced pastırma exhibited significant reduction in residual nitrite level over the refrigerated storage in comparison to Air control. This study confirmed that oxygen scavengers used to control oxidative deteriorations in meats and meat products in addition to contribution to cured color stabilization could also be effective in reducing the health risk in cured meat products.

REFERENCES

1. de Abreu, D.A.P., Cruz, J.M. & Losada, P.P. (2012). Active and Intelligent Packaging for the Food Industry. Food Reviews International 28: 146-187.

2. Gill, C.O. &McGinnis, J.C. (1995).The use of oxygen scavengers to prevent the transient discoloration of ground-beef packaged under controlled, oxygen-depleted atmospheres. Meat Science 41: 19-27.

3. Kilic, B., Cassens, R.G.&Borchert, L.L. (2002). Effect of turkey meat, phosphate, sodium lactate, carrageenan, and konjac on residual nitrite in cured meats. Journal of Food Science 67: 29-31.

4. Sancak, Y.K., Ekici, K. &İşleyici, Ö.(2008). Fermente Türk Sucuğu ve Pastırmalarda Kalıntı Nitrat ve Nitrit Düzeyleri. Yüzüncü Yıl Üniversitesi Veterinerlik Fakültesi Dergisi19: 41-45.

5. Bayraktar, N., Gökçe, R.&Ergün, Ö. (1998). Gıdalarda Nitrat ve nitrit kalıntılarının insan sağlığı üzerine etkileri. Ekoloji Çevre Dergisi 28: 28-30.

6. Yağlı, H. and Ertaş, A.H. (1998). Pastırmanın Bazı Kalite Özelliklerine Sodyum Askorbatın Etkisi.Turkish Journal of Agriculture & Forestry 22: 515-520.

7. Aksu, M.İ. (1999). Pastırma üretiminde starter kültür kullanım imkanları üzerinearastırmalar, Gıda Mühendisliği, Atatürk Üniversitesi: Erzurum. 153.

8. Uğuz, Ş. (2007).Pastirmadaki proteolitik değismelere tuz miktarinin etkisi, in Gıda Mühendisliği, Ankara Universitesi: Ankara. 73.

9. Anonymous (1995).Official Methodsof Analysis of AOAC International. 16 ed, Arlington, VA, USA

10. McClure, B.N. Sebranek, J. G., Kim, Y. H. & Sullivan, G. A. (2011). The effects of lactate on nitrosylmyoglobin formation from nitrite and metmyoglobin in a cured meat system. Food Chemistry 129: 1072-1079.

11. PerezRodriguez, M.L., BoschBosch, N. &GarciaMata, M. (1997). Residual nitrite and nitrate levels of frankfurters along with their shelf-life. Food Additives and Contaminants 14: 803-808.

12. Aksu, M.İ., Kaya, M. &Ockerman, H.W. (2005). Effect of modified atmosphere packaging, storage period, and storage temperature on the residual nitrate of sliced-pastırma, dry meat product, produced from fresh meat and frozen/thawed meat. Food Chemistry 93: 237-242.

13. Ahn, H.J.,Kim, J. H., Jo, C., Lee, C. H. & Byun, M. W. (2002). Reduction of carcinogenic N-nitrosamines and residual nitrite in model system sausage by irradiation. Journal of Food Science 67: 1370-1373.

14. Jo, C.,Ahn, H. J., Son, J. H., Lee, J. W. & Byun, M. W. (2003). Packaging and irradiation effect on lipid oxidation, color, residual nitrite content, and nitrosamine formation in cooked pork sausage. Food Control 14: 7-12.