THE EFFECTS OF REPLACING BEEF FAT WITH OLIVE OIL ON PROTEIN OXIDATION PRODUCTS (α-Aminoadipic semialdehydes-AAS and γ-glutamic semialdehydes-GGS) IN TURKISH DRIED FERMENTED SAUSAGE

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Abstract – The objective of this study was to investigate the effects of replacing beef fat with olive oil on protein oxidation products (α-Aminoadipic semialdehydes-AAS, γ-glutamic semialdehydes-GGS) in sucuk (Turkish dried fermented sausage) during storage at 4℃. Results showed that α-Aminoadipic (AAS) and γ-glutamic semialdehydes (GGS) were increased with the increasing amounts of olive oil. Total amount of semialdehydes which represent the sum of AAS and GGS, was increased during storage period.

Key Words – protein oxidation, sucuk, α-Aminoadipic semialdehydes-AAS, γ-glutamic semialdehydes-GGS

I. INTRODUCTION

Protein oxidation, in meat and meat products is one of the most innovative study topics in the food chemistry field. The oxidation of proteins causes changes in water holding capacity, color and texture of meat, also involves the loss of essential amino acids and decreases protein digestibility which affects its nutritional value during processing and storage [1,2]. The studies conducted so far have focused on occurrence and effect of protein oxidation, but have not provided specific information about particular protein oxidation products and oxidation mechanism. Recently, an advanced technique has been used for detection of specific protein oxidation products in order to understand the basic chemistry and the complex mechanism of protein oxidation in meat and meat products. α-Aminoadipic (AAS) and γ-glutamic semialdehydes (GGS) are considered the main carbonyl products of oxidized proteins and play up as protein oxidation biomarkers in biological systems [3]. AAS is the main oxidation product from lysine, whereas GGS derives from the oxidative degradation of arginine and proline [4].

II. MATERIALS AND METHODS

Three different formulations of sucuk, containing 4 kg meat each, were prepared. Each treatment was formulated to contain 20% total fat. Control (C) group was consisted of 100 % beef fat. Olive oil was replaced with beef fat at levels of 15% (O15) or 30 % (O30). After mixing all ingredients, sucuk doughs were stuffed into natural casings and were allowed to stand at 22.5°C and 60% relative humidity (RH) for 3 h before fermentation in a fermentation chamber and were pre-fermented at 23°C and 88% RH until the pH reached 5.4. After pre-fermentation, sucuks were fermented for 3 days at 21°C and 83% RH. Sucuk samples were then allowed to stand at 19°C and 73% RH for 2 days to drop the moisture to 40%. After production, sucuk samples were packaged under vacuum and stored at 4°C for 4 months. Samples were taken for analysis at the end of the production (final product) and each month. α-Aminoadipic (AAS) and γ-glutamic semialdehydes (GGS) were analyzed using the method described by Utrera and Estévez [4] upon derivatization with p-amino benzoic acid and analysis by HPLC. Standard AAS and GGS were synthesized in vitro from N acetyl-Llysine and N-acetyl-L-ornithine using lysyl oxidase activity from egg shell membrane, as described by Akagawa *et al.* [5].

III. RESULTS AND DISCUSSION

Changes in AAS and GGS values of sucuk samples during storage at 4°C were given in Table 1 and 2, respectively. Storage period had a remarkable impact on the oxidative stability of proteins as reflected in the significant increases of AAS and GGS at the end of the storage. During the storage period, lysine is degraded to AAS, while the oxidative deamination of arginine and proline residues leads to the formation of GGS [6].

Table 1 AAS content of sucuk treatments during storage

Groups	Initial	1st Month	2nd Month	3rd Month	4th Month
C	0,207±0,01a,Z	0,203±0,01a,Z	0,00a,W	0,00a,W	0,260±0,01a,V
O15	0,222±0,06b,Z	0,196±0,02ab,Y	0,00a,X	0,00a,X	0,268±0,01a,W
O30	0,212±0,01ab,X	0,165±0,09b,Y	0,00a,Z	0,00a,Z	0,251±0,01b,W

Data are presented as the mean values of 3 replications ± SD. Means within same column with different letters (a,b,c) are significantly different (P<0.05). Means within same row with different letters (X,Y,Z) are significantly different (P<0.05).

Table 2 GGS content of sucuk treatments during storage

Groups	Initial	1st Month	2nd Month	3rd Month	4th Month
C	0,00a,X	0,252±0,07a,Y	0,410±0,01b,Z	0,418±0,01a,Z	0,890±0,04a,W
O15	0,00a,X	0,254±0,01a,Y	0,245±0,01a,Y	0,418±0,01a,Z	0,480±0,01b,W
O30	0,00a,X	0,216±0,00b,Y	0,257±0,11a,Y	0,375±0,01b,Z	0,407±0,04c,W

Data are presented as the mean values of 3 replications ± SD. Means within same column with different letters (a,b,c) are significantly different (P<0.05). Means within same row with different letters (X,Y,Z) are significantly different (P<0.05).

Although AAS was initially detected, GSS was not detected in the final product. However, the formation of GGS was faster than that of AAS in sucuk samples during 4-months of storage. This situation coherents with the study of Estévez *et al.* [3]. While GGS content of sucuk samples was increased, some fluctuations were observed for AAS content during storage. This situation might be observed due to conversion of semialdehyde to each other. If the total amount of semialdehyde formation during storage is to be taken into consideration, semialdehyde content of sucuk samples was increased during storage under refrigerator conditions. On the other hand, using olive oil as a fat replacer decreased the AAS and GGS contents of samples. This situation can be explained with the presence of antioxidants in olive oil.

IV. CONCLUSION

The results of our study showed that fatty acid composition of sucuk has an effect on the formation of specific protein oxidation markers in terms of α-Aminoadipic semialdehydes (AAS) and γ-glutamic semialdehydes (GGS).

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