Changes in Quality and Antioxidant Properties of Dry Sausages Produced by Type and Dosis of Paprika

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Abstract: The objective of the study was to evaluate the effect of the highest doses of paprika and the different percentage of hot paprika on curing process of dry sausage "Chorizo Zamorano" evaluating texture, colour and antioxidant properties. Four types of dry sausage were elaborated, control made with 1.8% of intermediate hot paprika, Zam0% made with 2.8% of intermediate hot paprika, Zam15% made with 2.38% of intermediate hot and 0.42% of hot paprika and Zam30% made with 1.96% of intermediate hot and 0.84% of hot paprika. The results showed that increasing paprika doses and percentage of hot paprika, affect the curing process, resulting in a faster decrease in pH and in water activity. This elicits a more rapid development of texture, suitable hardness being reached in less time. Additionally, these products have greater colour intensity and colour remains more stable during the curing process, together with lower malonaldehyde contents.

Keywords: texture; TBARS; colour; hot paprika; ripening

INTRODUCTION

A major cause of meat product deterioration is oxidative rancidity. Oxidation of lipids in meat products is responsible for changes in its nutritional and sensory quality: colour, flavour, odour and texture. However, several authors have observed that during the ripening of dry sausages lipid oxidation did not occur [1, 2], probably due to the antioxidative action of the spices, curing agents and smoke. Nevertheless, the antioxidant effect of spices in these sausages and the repercussion over the sensory characteristics as texture has been little studied.

Some dry sausages manufactured in the northwest Spain, especially dry fermented sausage *Chorizo Zamorano*, are characterised by its highest content in paprika compared with other dry sausages. It is known that paprika decreases the rancidity of dry sausages [3] because of its content in flavonoids, capsaicinoids, tocopherols and carotenoids [4]. Indeed, capsaicin has an important antioxidant effect [5, 6], then the greater is its content in pepper fruits the highest is the antioxidant effect [7]. Moreover, Spanish paprika, which is commonly smoked, contains smoke's antioxidant compounds [8].

Spanish powdered paprika, coming from milling dry fruits of different varieties of *Capsicum annuum* L., is commercially classified according to its pungency in three different categories: hot, sweet and an intermediate one (ocal). Hot paprika is characterised by the different process of elaboration [9], because it includes a higher proportion of seeds, and composition due to the highest content in capsaicin.

The objective of the study was to evaluate the effect of total paprika content and the different percentage of hot paprika on curing process of dry sausage and compare them with and standard formulation.

EXPERIMENTAL

Samples manufacture. The dry sausages were prepared in a small-scale manufacturing plant in the laboratory of Food Technology in Zamora (Spain). The manufacture process began with the formulation of a mixture (w/w) consisting of 50% lean pork meat and 50% fat pork meat. Following additives and spices were used: 2.4% salt, 0.1% glucose (Merck Eurolab, Briare Le Canal, France), 0.045% ascorbic acid (E-300, Panreac, Barcelona, Spain), 0.015% sodium nitrite (E-250, Merck, Darmstadt, Germany), 0.01% sodium nitrate (E-251, Merck, Darmstadt, Germany), 0.15% garlic, 0.1% oregano, 0.1% black pepper and 1% (v/w) of liquid starter (Proveedora Biológica, Sevilla, Spain). Different total amount of paprika and percentage of hot paprika was used according to the following codes: Control made with 1.8% of agridulce (intermediate hot) paprika, Zam0% made with higher quantity of paprika 2.8% of agridulce paprika, Zam15% made with 2.8% of paprika: 2.38% of agridulce and 0.42% of hot paprika (15% of total paprika) and Zam30% made with a total amount of 2.8% of paprika in the following proportion: 1.96% of agridulce and 0.84% of hot paprika (30% of total paprika). Additives and paprika are expressed as a percentage of the total weight of meat/fat mixture.

At about 4°C, the meat and fat was separately chopped and minced (7.5 mm opening) in a meat mincer (TALSA P114K-U3, Valencia, Spain) then mixed with the other ingredients at vacuum for 3 min (CATO AV-30, Barcelona, Spain), and the sausage mixture was stuffed (TALSA H26EA, Valencia, Spain) into natural casings (32–34 mm diameter) previously treated with a solution of 1% lactic acid. The sausages were placed in a drying chamber at 12°C and 90% of relative humidity (RH) and, after a resting day, the temperature of chamber was increased till 23°C, fermentation step started and it lasted 48 hours. Thereafter, sausages were held in the ripening chamber at 13°C and the relative humidity was progressively decreased till 70% RH.

Meat, fat, casings and spices were supplied by local manufacturers. All chorizo sausages types were manufactured in duplicate. Samples of each batch were taken from the 2^{nd} to the 21^{th} day of the ripening process.

Analytical parameters. Thiobarbituric acid reactive substances (TBARS) content of the samples was determined according to [10] and expressed as mg of malonaldehyde per kg of sausage.

Extractable colour was determined in 2 g of product suspended in 100 ml of acetone using an Ultraturrax (IKA, Staufen, Germany) and the absorbance at 460 nm was measured in the clarified extract [11] with a 1 cm quartz cell. Colour index was expressed as absorbance units × 100.

A Universal TA-XT2i (Stable Microsistems, England) texture analyser was used to conduct texture profile analysis. Samples of 1 cm height were compressed to 50% of their original height with a compression platen of 50 mm diameter [12]. Force-time curves were recorded at a speed of 1 mm/s and hardness (g) was evaluated.

Statistical analysis. Statistical treatment of the data was carried out by analysis of variance (ANOVA). The statistical significance of each factor considered was calculated at the $\alpha = 0.05$ level using the *F*-test. The LSD Fisher-test was employed to test for statistically significant differences between samples. All statistical analyses were carried out using the Statgraphic Plus for Windows (1995 Manugistics, Inc.)

RESULTS AND DISCUSSION

Figure 1 shows the evolution of the TBARS values along ripening. It may be seen that a significant increase in such values occurred during the first days of ripening as a result of lipolysis and the later oxidation of the fatty acids released. As ripening progressed, such levels decreased again since the compounds formed evolved towards aromatic compounds [13].

A striking observation was the low levels of malonaldehyde recorded and, within small differences although statistically significant with the control at all the points, it should be noted that the products elaborated with higher amounts of paprika (Zam0%, 15% and 30%) showed the lowest TBARS levels along the ripening process. This is because the carotenoids of the paprika exert a protective effect against oxidation [3].

Additionally, the higher the amount of hot paprika, the lower the malonaldehyde content at all the recorded points. This could be due to the higher amount of capsaicin in hot paprika and then in the products made with higher hot paprika percentage. This result points out the high antioxidant effect of capsaicin, and that this effect remains in the protein matrix during the period of ripening of dry sausages.

Regarding the evolution of hardness (Figure 2) it was similar in all the batches up to day 11 of ripening, after which a greater increase in hardness was observed for the products with the higher levels of paprika. Moreover, among them it may be seen that the greater the proportion of hot pepper, the greater the final hardness. Differences were statistically significant among all the samples at day 19^{th}, and at the last sampling point the highest

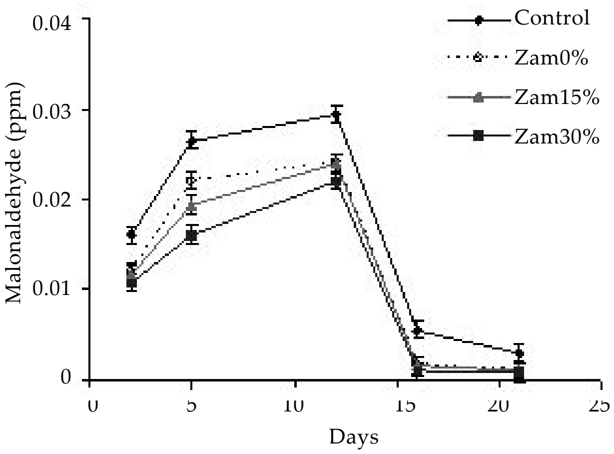

Figure 1. TBARS values evolution throughout the ripening process

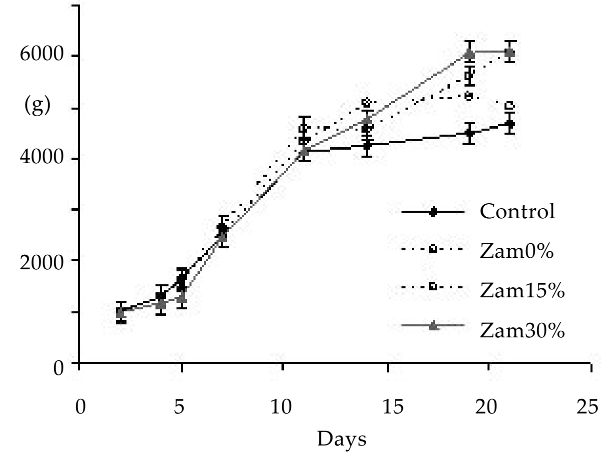

Figure 2. Hardness evolution throughout the ripening process

value corresponded to the High30% and High15% dried sausage.

The above findings are consistent with those corresponding to pH (Figure 3). It may be seen that during the whole process of ripening the control – with a lower paprika (only the agridulce variety) content – had the highest pH values, whereas the higher the paprika content the lower the pH. This evolution can be accounted for in terms of the greater presence of manganese achieved with higher paprika doses, favouring the development of LAB and hence a greater decrease in pH of the dry sausages with higher amounts of paprika. Additionally, the effect of the addition of hot paprika led to promote the development of LAB since the greater the levels of this spice, the greater the decrease in pH.

The evolution of extractable colour is shown in the Figure 4. It may be seen that for all the products colour increased during the first 11 days of ripening, the time at which it coincided with the almost complete disappearance of nitrites and the greatest development of the curing colour, which thereafter remained more or less constant up to the end of the period considered.

As expected, the products with the highest amounts of paprika in their formulation initially – and indeed along the ripening period – showed more extractable colour, being the values statistically different. It should also be mentioned that – despite the minimum differences – the higher the content of hot paprika, the less intense the colour, being the differences statistically significant. This

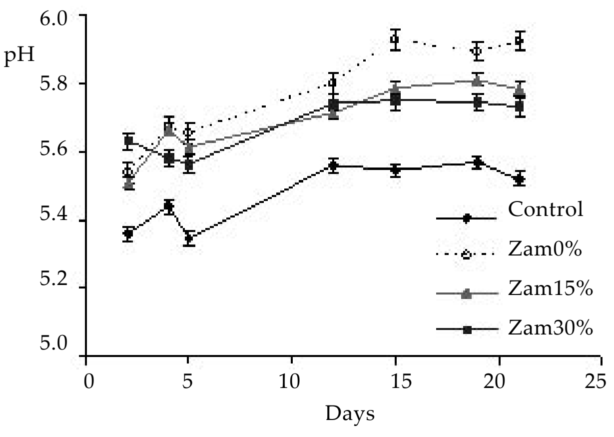

Figure 3. pH evolution throughout the ripening process

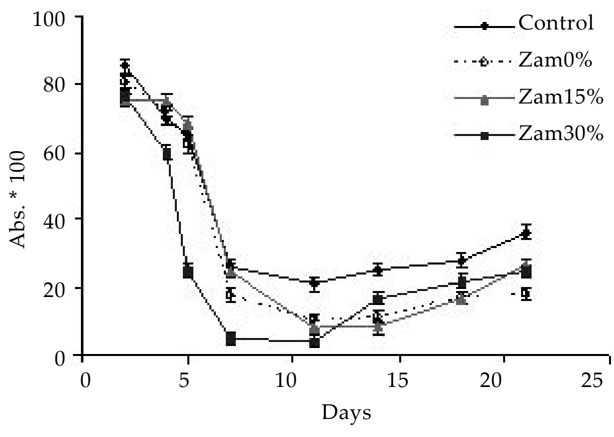

Figure 4. Colour evolution throughout the ripening process

was due to the greater content of paprika seeds, which elicit a slight decrease in colour.

CONCLUSIONS

From the results obtained in the present work it may be concluded that a greater content in paprika, especially the hot type, accelerates the ripening process of dry sausages. This leads to a fast drop in pH and a faster development of a suitable texture and it protects the material from lipid oxidation owing to the greater presence of carotenoids and capsaicin, both with antioxidant potential, and also affords a better coloration, which remains more stable with time.

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