FORMATION OF BIOGENIC AMINES IN FRANKFURTER SAUSAGES TREATED WITH HIGH PRESSURE

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Introduction

It is known that the consumption of products with high concentrations of biogenic amines may have a toxicological risk for the consumer (Halász *et al.*, 1994). The production of biogenic amines is conditioned by the microbial load in the product and the type of microbiota (Halász *et al.*, 19943, Ruiz-Capillas and Jiménez-Colmenero, 2004), which in turn will depend on several factors: characteristics of the raw material, incorporation of processing additives, storage conditions and the application of different storage technologies like high pressure. In recent years this technology has aroused great interest for its use in meat products (Cheftel and Culioli, 1997). In the case of frankfurter sausages there is a risk of recontamination in the different preparation stages. The application of high pressure (HP) after packaging in this process would lead to less contamination. The purpose of this study was to discover how the application of HP conditions the formation of biogenic amines throughout storage.

Materials and Methods

The frankfurter sausages were prepared from post-rigor pork meat, back fat, water and additives (sodium chloride, sodium tripolyphosphate and 150 ppm of sodium nitrite) according to Jiménez Colmenero *et al.* (1995). The frankfurters were heat processed in a force air oven until the temperature inside reached 70ºC. After this the frankfurters were cooled, and the casing was removed before they were vacuum packed in plastic bags (Cryovac® BB4L). Then the bags were divided into three lots. The first lot was treated with pressurization processing in a high-pressure pilot unit ACB (France), using water as the pressurizing medium: 400 MPa/10 min/30ºC (HP). The second lot was heated in a boiling water bath for 2 minutes (B). The third lot was the control and was not subjected to treatment (C). The three lots were stored in a chill room at 2°C during storage. The parameters assessed were pH, microbiological analysis (total viable count, lactic acid bacteria *Enterobacteriaceae*), and biogenic amines following the methodology of Ruiz-Capillas and Moral (2001). The results were analyzed statistically using the SPSS 13.0 statistical package.

Results and Discussion

The application of treatments (HP and B) to reduce the contamination produced during the packaging process of frankfurter sausages led to a decrease in microbiota and this was greater in the HP lot, where there was a decrease of over 4 log cfu/g in the total viable count (Table 1). However, these treatments did not produce any significant changes in the biogenic amine levels, except in the case of spermine in the HP lot. This amine exhibited very high levels, between 24.20 and 27.66 mg/kg, similar to those observed for agmatine (25.24-26.86 mg/kg).

An increase in total viable count and lactic bacteria microbiota was observed throughout chilled storage. Lot C was the one that exhibited the highest levels of lactic and total microorganisms of 6.01 log cfu/g at 48 days of storage (Table 1). Similar levels were found in lot B until 114 days of storage, while in the HP lot levels were less than 3 log cfu/g throughout storage (Table 1). These recounts may be related to the decreases observed in pH that reached values of 5.8, as described by other authors (Samelis *et al.*, 1998).

Table 1: Viable count and acid lactic bacteria (log cfu/g) in the different lots.

Microbiota	Samples	Days of storage				
		0	13	48	62	141
Total Viable	C	4.63±0.08	4.81±0.13	6.01±0.05	6.24±0.02	
	B	3.36±0.12	3.47±0.61	3.22±0.11	3.59±0.09	6.90±0.60
	HP	2.47±0.08	2.95±0.07	2.15±0.21	2.15±0.15	2.80±0.28
Acid lactic bacteria	C	4.27±0.02	4.66±0.08	6.01±0.04	5.57±0.07	
	B	3.15±0.15	3.00±0.09	2.15±0.21	3.59±0.02	6.29±0.02
	HP	2.19±0.06	2.50±0.71	2.00±0.03	2.15±0.15	2.50±0.71

Spermidine, spermine, histamine and agamatine levels remained constant ($p \geq 0.05$) throughout storage. An increase ($p \leq 0.05$) in tyramine was observed at 48 days of storage and levels increased to 11.54 mg/kg in lot C, whereas in the other lots changes were observed at the end of storage (141 days), the period when tyramine levels were higher in lot B than in the HP lot (Figure 1). Increases ($p \leq 0.05$) in putrescine and cadaverine were observed only at the end of storage, and the highest levels of cadaverine were observed in the sample heated with hot water (8.22 mg/kg) (Figure 1).

Generally, the increases observed in biogenic amines matched the increases observed in the main microbiota responsible for the formation of these amines (Edwards *et al.*, 1987, Halász *et al.*, 1994).

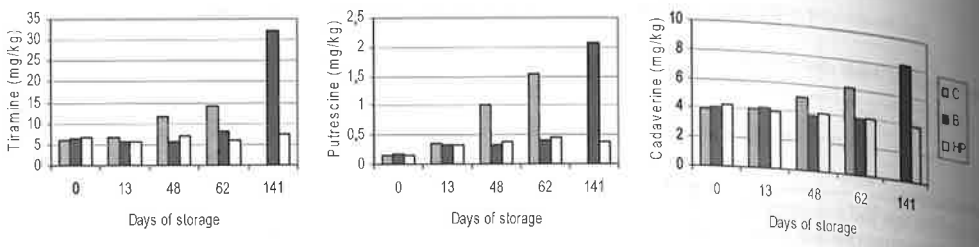

Figure 2: Evolution of biogenic amines in the different lots.

Conclusions

The application of high pressures can be used as an effective technology for reducing micobiota and limit the formation of biogenic amines that can grow and form respectively, during chilled storage of these products.

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