REPLACEMENT SUBSTANCE IN THE CURING

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Background

Curing is one of the most important technological procedures that is used by the meat industry in the production of high quality products (VISIER, 1986). Sodium chloride, nitrate, nitrite and other reducers are added to the meat mixture and through some chemical reactions provoke the curing of the product, with positive reflexes in the sensorial characteristics such as the microbiological safety (GIRARD, 1991; TERRA, 1998). The nitrite produces a multifunctional effect that favors its typical color, flavor and odor, its antioxidative and antimicrobial protection of the cured meat product (THIEMIG et al, 2000). In spite of that, the residual nitrite, when reacting with the meat secondary amines can form the nitrosamines, which are highly cancerous compounds. This fact has stimulated, for many years, research that could eliminate or reduce the nitrite levels used in the curing process (LÜCKE, 2000). Until now, from the technological and microbiological point of view, the nitrite use is still very important in the processing of meat products.

Objective:

The objective of this study was to decrease the residual nitrite and the nitrosamines formation possibilities by substituting the nitrite for nitrosyl hemoglobin.

Methods

The nitrosyl hemoglobin was elaborated from bovine´s hemoglobin concentrate obtained through the erythrocyte paste dialysis. This erythrocyte paste was obtained in the Prenda S.A. (Santa Rosa, RS) plant, frozen and transported in an isothermal box to the Food Science and Technology Department, at the Federal University of Santa Maria (Brazil). Immediately, the natural dye nitrosyl hemoglobin was elaborated (HORNSEY, 1956). The sausages were elaborated according to the usual formulation in some local Plants (bovine's meat: 70Kg; double chin: 20Kg; ice: 10Kg; salt: 1,5Kg; color fixer: 0,250Kg; emulsifier: 0,250Kg; soy protein texturized: 2,0KG; sausage condiments: 1,00Kg; sodium glutamate: 0,100Kg). Hereafter, 200 $mg·Kg^{-1}$ of sodium nitrite (control), 100 $mg·Kg^{-1}$ of sodium nitrite supplemented with 0,5% of nitrosyl hemoglobin (treatment1) and 100 $mg·Kg^{-1}$ of sodium nitrite supplemented with 1,0% of nitrosyl hemoglobin (treatment2) was added. The sausage samples were maintained under refrigeration (+5°C) for 30 days. The pH (TERRA and BRUM, 1988), rancidity (TBA) (KONIECKO, 1979), aerobic mesophyllic microorganisms counting (SIQUEIRA, 1999) and sensorial analysis, a preference test (STONE & SIDEL, 1985) were done weekly. The sausages were boiled in water for 5 minutes before sensorial analysis. At the end of the refrigerated storage, the residual nitrite levels (TERRA and BRUM, 1988) were quantified.

Results and discussion

The meat product color is the first attractive factor that determines its acquisition or rejection by the consumers. The meat color plays a decisive role from the commercial point of view since the red color is associated with meat freshness and the grayish color with meat deterioration. The nitrite has been substituted by the direct addition of hemochrome and the *Monascus* extract for the colour formation (RUBIN et al, 1990; LEISTNER, 1994). In the present study, the nitrite was partially substituted by the nitrosyl hemoglobin to reduce not only the nitrite level ingestion but also to reduce nitrosamine formation, a cancerous compound, so the nitrite antioxidant and antimicrobial effects were reached through the addition of 100 $mg·Kg^{-1}$ of nitrite. It was verified that the addition of 0,5% of nitrosyl hemoglobin had the same preference (Table 1) than that of 200 $mg·Kg^{-1}$ of nitrite, characterizing its effect on the color formation of the cured product, without altering its sensorial characteristics. The nitrite antioxidant action is fully consolidated due to its ability in joining together the iron ions, by removing them from the autoxidative environment (GRAY et al., 1981). When nitrosyl hemoglobin was added with 100 $mg·Kg^{-1}$ of nitrite, the antioxidative protection (TBA) (Table 2) was inferior of that observed for the controls at the end of the refrigerated storage period (30 days). The legislation of several countries contemplates the nitrite and the nitrate as an antimicrobial agents (LÜCKE, 2000). This property makes unfeasible any attempt in banishing the nitrite from the meat products. Its action against the *Clostridium botulinum* is thoroughly proved in different meat products (HAUSCHILD, 1982). The aerobic mesophyllic microorganisms were also shown to be sensitive to the nitrite action, because its population showed a little variation along the experiment (Table 3). This small microbial proliferation was observed by the small pH variation, presenting a stable behavior (Table 4). Several countries, trying to reduce the residual nitrite in the meat products, defined values to be used in the curing process that is 20% inferior of those used 20 years ago (CASSENS, 1997). Part of the added nitrite will be found as residual nitrite due to its high reactivity (THIEMIG et al., 2000). It is believed that 5 to 15% of nitrite added to the meat product is used on the nitric-myoglobin oxide pigment (WIRTH, 1991). In the present study, it was observed that the residual nitrite for the control samples was 40% of the initial dose (Table 5), overcoming the values described by ARNETH (1998). Such fact is explained by the difference of meat products using different technology and the different amounts of antioxidants added (TSUDA et al., 1999). The other samples that received nitrosyl hemoglobin supplemented with 100 mg·Kg^{-1} of nitrite presented a value equal or inferior of 20% of residual nitrite compared to that initially added, reducing the possible nitrosamine formation such as in the meat product as in the consumer's organism.

Conclusions

The obtained results showed that the addition of the nitrosyl hemoglobin fully substitute the nitrite in the color formation of the cured meat product, facilitating in this manner a substantial reduction of the residual nitrite in the product.

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TABLE 1. Sensorial analysis of sausages, with and without nitrosil hemoglobin (NOHb) as a nitrite substitute, stored by 30 days (+5°C).

SAMPLES	1º day	30º day
CONTROL	50 %	40 %
0,5% de NOHb	40 %	40 %
1,0% de NOHb	10 %	20 %

TABLE 2. Antioxidative action of nitrite in the control, and the samples that were added nitrite (100 ppm) plus 0,5% NOHb or 1% de NOHb, in sausages stored by 30 days at +5°C.

	STORAGE (days)				
SAMPLES	**1**	**8**	**15**	**22**	**30**
CONTROL	0,270	0,413	0,270	0,200	0,480
0,5% NOHb	0,364	0,270	0,310	0,175	0,444
1,0% NOHb	0,371	0,277	0,259	0,350	0,450

TABLE 3. Mesophyllic aerobic microorganisms of sausages with and without nitrosil hemoglobin (NOHb).

	STORAGE (days)			
SAMPLES	1	8	15	22
CONTROLE	$3,0x10^2$	$5,0x10^2$	$1,3x10^3$	$3,0x10^3$
0,5% de NOHb	$2,1x10^2$	$4,0x10^2$	$1,2x10^3$	$5,0x10^3$
1,0% de NOHb	$3,4x10^2$	$9,0x10^2$	$1,1x10^3$	$4,6x10^3$

TABLE 4. pH of sausages with and without nitrosil hemoglobin (NOHb), stored by 30 days at +5°C.

	STORAGE (days)				
SAMPLES	**1**	**8**	**15**	**22**	**30**
CONTROL	6,9	6,3	6,1	5,7	7,1
0,5% de NOHb	6,9	6,6	6,3	5,9	6,8
1,0% de NOHb	6,9	6,2	6,2	5,7	6,1

TABLE 5. Nitrite residual levels of sausages (control- 200 ppm de nitrite), nitrite (100 ppm) + 0,5% de NOHb (0,5% NOHb) and nitrite (100 ppm) + 1% NOHb (1,0% NOHb) after 30 days storage.

SAMPLES	NITRITE RESIDUAL (ppm - %)
CONTROL	80 (40%)
0,5% de NOHb	18 (18%)
1,0% de NOHb	20 (20%)