

EVALUATION THE INFLUENCE OF FREE AND MICROENCAPSULATED SODIUM NITRITE AND SODIUM NITRATE IN FRESH SAUSAGE

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I. INTRODUCTION

Fresh sausage is the meat product most produced and consumed in Brazil [1]. In this products sodium nitrite is added and it is responsible for the formation of colour and flavor characteristics and also its preservative action, inhibiting the growth of *Clostridium botulinum* spores and the development of other pathogens such as *Bacillus cereus*, *Staphylococcus aureus* and *Clostridium perfringens* [2]. However, sodium nitrite is associated with the risk of some types of cancer, making it an additive feared by the consumer [3]. The objective of this work was to evaluate the influence of the addition of free and microencapsulated sodium nitrite and sodium nitrate at different concentrations and the use of ascorbic acid and Glucono Delta Lactone (GDL) on the properties of colour and residual nitrite content in fresh sausage storage under refrigeration.

II. MATERIALS AND METHODS

Six treatments of fresh sausage were prepared and the base of the treatments consists of: 65% ground lean pork, 20% ground bacon, 2% sodium lactate (Purac, Brazil), 1.5% salt, 0.5% condiment for fresh sausage (New Max Industrial, Brazil), 0.25% tripolyphosphate sodium (New Max Industrial, Brazil) and 0.05% sodium erythorbate. The differences among each formulation are shown in Table 1. The processing was done in duplicate (n = 2) on different days. The fresh sausages were vacuum packed in nylon-polyethylene bags and stored under refrigeration at 4 ± 1 °C and the analyses were performed on 1, 14 and 28 days.

Table 1 Difference between treatments (%).

Ingredients	C1(%)	C2(%)	F1(%)	F2 (%)	F3 (%)	F4 (%)
Water	10,5750	10,6050	10,4875	10,5175	10,5178	10,57175
Free sodium nitrite	0,02500	0,0250	0,0125	0,0100	0,0125	0,0100
Free sodium nitrate	0,05000	0,0500	0,0250	0,0150	0,0250	0,0150
Microencapsulated sodium nitrite	-	-	0,0125	0,0100	0,0125	0,0100
Microencapsulated sodium nitrate	-	-	0,0250	0,0150	0,0250	0,0150
Glucono delta lactone	0,0500	-	0,0500	0,05	-	-
Ascorbic acid	-	0,0200	-	-	0,0200	0,0200

The residual content of sodium nitrite was determined according to Araújo & Mídio [4]. The instrumental colour analysis was determined using a colourimeter with a CIELab colour specification system and the parameters obtained were the values of L*, a* and b*. For this analysis ten readings were made for each treatment. The statistical program Statistica 7.0 (Statsoft Inc., USA) was used for ANOVA and the Tukey Test (p<0.05).

III. RESULTS AND DISCUSSION

For the residual nitrite content, Table 2 shows that on day 1 of storage the treatments C1, C2 and F3 were similar (p<0.05). It can be observed that for the treatments C1, C2, F3 and F4 the results of residual nitrite are higher than the amounts of sodium nitrite initially added in the samples and this is due to the nitrate

salts added in meat products, which according to Waga et al. [2], are converted to nitrite by the action of bacteria. At 14 days of storage, C2 presented the highest values and, in 28 days, this was the only treatment that presented residual nitrite. Ruiz-Capillas et al. [5] reported that the reduction of sodium nitrite in meat products happens rapidly due to reactions of nitrite with meat components such as proteins and lipids or bonds between them. It was also observed that the highest values of residual sodium nitrite were presented by the treatments with ascorbic acid added when compared to treatments with the addition of GDL at 1 and 14 days of refrigerated storage.

Table 2 Mean values of instrumental colour and residual nitrite contents of fresh sausage during refrigerated storage

Parameter	Days	C1	C2	F1	F2	F3	F4	SEM	p-value
L*	1	52,13 ^{bc}	51,96 ^c	55,59 ^{ab}	54,77 ^{abc}	56,43 ^{aA}	53,57 ^{abc}	0,382	0,001
	14	54,34	54,22	55,60	55,09	55,60 ^{AB}	55,36	0,238	0,342
	28	52,16 ^b	52,47 ^{ab}	55,22 ^a	53,55 ^{ab}	53,92 ^{abB}	55,33 ^a	0,292	0,003
SEM		0,413	0,473	0,315	0,502	0,392	0,404		
p-value		0,065	0,100	0,866	0,415	0,023	0,118		
a*	1	11,39	11,50	10,64 ^{AB}	10,35	10,25	10,68	0,141	0,063
	14	11,29	11,42	10,76 ^A	10,45	10,71	11,10	0,120	0,143
	28	11,25 ^{ab}	11,68 ^a	9,75 ^{cB}	9,48 ^c	10,47 ^{bc}	10,25 ^c	0,126	0,000
SEM		0,162	0,193	0,164	0,194	0,131	0,176		
p-value		0,945	0,869	0,025	0,073	0,366	0,132		
b*	1	12,50 ^c	12,42 ^c	14,09 ^{aA}	13,17 ^{abc}	13,83 ^{abA}	12,62 ^{bcB}	0,138	0,000
	14	12,35 ^b	13,04 ^{ab}	13,18 ^{abB}	13,02 ^{ab}	13,05 ^{abAB}	13,68 ^{aA}	0,108	0,017
	28	11,60	12,71	12,35 ^B	12,40	12,80 ^B	12,77 ^B	0,136	0,084
SEM		0,187	0,219	0,173	0,147	0,179	0,159		
p-value		0,118	0,485	0,000	0,068	0,045	0,011		
RN	1	287,39 ^{aA}	291,50 ^{aA}	214,15 ^{bA}	147,49 ^{cA}	284,70 ^{aA}	226,08 ^{bA}	15,750	0,000
	14	105,95 ^{bB}	182,68 ^{aB}	< 0,20 ^{eB}	0,71 ^{eB}	94,72 ^{cB}	13,87 ^{dB}	20,431	0,000
	28	< 0,20 ^{bc}	0,40 ^{aC}	< 0,20 ^{bB}	< 0,20 ^{bB}	< 0,20 ^{bC}	< 0,20 ^{bC}	0,272	0,000
SEM		53,121	53,715	45,510	31,203	53,224	46,481		
p-value		0,000	0,000	0,000	0,000	0,000	0,000		

RN = Residual nitrite content; ^{a,d} Different lowercase letters in the same row indicate significant difference (p<0.05) between treatments. ^{A,C} Different capital letters in the same column indicate significant difference (p<0.05) between treatments.

The a* value is related to the acceptance of the meat products by the consumer, because colour is the main factor influencing the decision to purchase these products [6]. There was no significant difference (p>0.05) among the treatments for the a* values at 1 and 14 days of storage. At 28 days, the highest a* values were presented by the controls but C1 was similar to treatments F3 e F4.

IV. CONCLUSION

The addition of microencapsulated sodium nitrite and nitrate do not affect fresh sausage colour. Ascorbic acid assists in maintaining residual nitrite levels during storage.

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