SENSORY PROFILE OF LOW SODIUM SALAMI ADDED OF POTASSIUM AND CALCIUM CHLORIDE BLENDS

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Abstract – The effect of reducing the content of sodium chloride in salamis on the sensory profile and consumer acceptance was evaluated. Salamis were produced with 50% replacement of NaCl by blends of KCl and $CaCl_2$ (FC=100% NaCl; F1=50% NaCl; F2=50% NaCl and 50% KCl; F3=50% NaCl and 50% $CaCl_2$; F4 =50% NaCl, 25% KCl and 25% $CaCl_2$). The experimental formulations and a commercial sample (FCOM) were subjected to a sensory profile study by quantitative descriptive analysis (QDA) and consumer acceptance test. The results showed that the salami produced with 50% $CaCl_2$ was less accepted by consumers, presenting rancid aroma, rancid flavor, and bitterness as more prominent attributes. In contrast, the other treatments were characterized by typical sensory attributes of fermented meat products. It can be concluded that the reduction of sodium chloride (50%) in salami requires the addition of enhancers and / or taste masking agents to minimize the undesirable effects resulting from the use of salt substitutes.

Key Words – Quantitative descriptive analysis, Consumer test, Potassium chloride, Calcium chloride.

I. INTRODUCTION

High sodium intake has led public health agencies to set targets for sodium reduction in different food categories around the world. However, this reduction can significantly alter the sensory acceptance of the product [1,2]. Regarding fermented meat products, the sodium chloride reduction represents a challenge to keep the characteristics of aroma, taste and texture of the final product.. In this category, the manufacturing process influences the sensory properties of the final product through chemical and biochemical reactions that occur during the process. Sodium chloride has a fundamental role in the development of ripening time of fermented sausages changing the activity of lipolytic and proteolytic enzymes [3]. Thus, reducing NaCl content may alter the formation of different compounds and confer unpleasant flavor and aroma, once it may enhance the bitter and metallic taste caused by some chloride salts, such as potassium and calcium [3]. One method that can describe the sensory profile of low sodium foods is the quantitative descriptive analysis (QDA), using a team of trained judges [4]. Along with consumer acceptance test, QDA allows for a better explanation of the sensory attributes that are relevant to the consumer choice. The aim of this study was to determine the sensory profile of low-sodium salamis by quantitative descriptive analysis methodology, and correlate the results with the sensory acceptance of these products by consumers.

II. MATERIALS AND METHODS

Treatments

Low-sodium salamis were produced with 50% replacement of NaCl by blends of KCl and $CaCl_2$. Treatments were prepared according to Table 1. The levels were defined based on previously studies performed on the subject [4].

Table 1. Levels of sodium chloride, potassium chloride and calcium chloride used in formulating the salami.

	Treatments (%)				
	FC	F1	F2	F3	F4
NaCl	2,5	1,25	1,25	1,25	1,25
KCl	-	-	1,25	-	0,625
$CaCl_2$	-	-	-	1,25	0,625

* FC- 100% NaCl, F1- 50% NaCl, F2- 50% NaCl and 50% KCl, F3- 50% NaCl and 50% $CaCl_2$, F4- 50% NaCl 25% KCl and 25% $CaCl_2$.

Sensory Profile

This study protocol (protocol n. 130260) was approved by the Ethics in Research Committee of the University of Campinas (SP, Brazil). Both samples of low-sodium salami and a commercial sample were subjected to sensory tests.

Quantitative Descriptive Analysis

The sensory profile of each treatment was determined by Quantitative Descriptive Analysis (QDA) as described by [5], with a team of 14 trained panelists. The judges drew up a list of 15 sensory descriptors, being three for appearance (brightness, red color and thickness of the board), four for flavor (acid, spicy, rancid, characteristic), six for taste (acid, salty, spicy, bitter, characteristic, and rancid) and two for texture (chewiness and oiliness).

Consumer Acceptance Test

The consumer acceptance test was conducted by 106 untrained consumers recruited among students and staff members from the faculty at UNICAMP - University of Campinas, aged between 18 and 54 years. The test was applied using the traditional 9-point hedonic scale with extremes ranging from "extremely dislike" to "extremely like" [5].

Statistical Analysis

The results were assessed by analysis of variance (ANOVA) and the averages were compared by Tukey's test at 5% significance level ($p \leq 0.05$) using the XLSTAT statistical package (version 5.02, 2012). Data from the ADQ were also analyzed by Principal Component Analysis (PCA), considering the average values assigned by the panelists for each sample as scores and the attributes as vectors.

III. RESULTS AND DISCUSSION

The averages for each sensory attribute assigned by the trained panelists in the quantitative descriptive analysis (QDA) are presented in Table 2. The brightness of the samples of low-sodium salami was not significantly different ($p<0.05$) when compared to the control formulation (FC). The commercial sample (FCOM) received lower scores for the attributes red color and thickness of the board, and no difference was observed between the low-sodium salamis for these attributes ($p <0.05$). Regarding the odor attributes, there was no difference between the salami samples for the acid aroma. The sample with 50% replacement of NaCl by $CaCl_2$ (F3) presented lower scores for spicy aroma than FC and FCOM. In addition, all samples with 50% replacement of NaCl by KCl and $CaCl_2$ were significant different from the samples FC and FCOM for the attribute characteristic aroma. Concerning the flavor attributes, there were no significant differences between all treatments for the attributes spicy and acid taste. The sample with 50% $CaCl_2$ (F3) received the highest score for the attribute rancid aroma, and was different from the other samples. The bitter taste characteristic of salts of potassium and calcium chloride were perceived by the trained panelists at a higher intensity in the sample containing 50% $CaCl_2$ (F3). Chewiness, which was measured from the texture attributes, received lower scores for the sample containing 50% KCl (F2). The average scores for the attribute oiliness showed no significant difference between the samples. Regarding the overall acceptance of salamis by untrained panelists, the commercial sample (FCOM) was the most accepted, with an average score of 7.29. Among the salami samples produced in the present study the one with 50% replacement of NaCl by $CaCl_2$ (F3) was the less accepted and significant different from the control sample (FC).

Figure 1 shows the principal component analysis (PCA) for the terms of the quantitative descriptive analysis (QDA) and sensory acceptance. In principal components analysis it was possible to explain 58.80% information within the data using only two principal components (PC). The first principal component explained 41.05% information, distinguishing the sample FCOM from the samples FC, F1 and F4. The commercial sample (FCOM) presented higher scores for the attributes oiliness, salty taste, brightness, spicy aroma, characteristic flavor and aroma. The salamis CF, F1 and F4 were characterized by acid flavor, chewiness, acid taste and spicy flavor. This quadrant was also characterized by the greatest consumer acceptance. For the second major component of this group, the explanation was 7.75%. The F2 and F3 samples were characterized by the attributes rancid aroma and taste and bitter flavor. This behavior may be due to the high

replacement of NaCl by KCl and $CaCl_2$, since these salts are known to develop bitter and metallic taste.

Table 2- Averages of sensory attributes raised by ADQ and overall consumer acceptance.

	FC	F1	F2	F3	F4	FCOM	MSD*
				Appearance			
Brightness	5,47^{bc}	5,92^{b}	5,93^{b}	5,20^{c}	5,68^{bc}	6,75^{a}	1.10
Red color	6,14^{b}	6,42^{a}	7,09^{a}	6,44^{ab}	6,49^{ab}	5,34^{c}	1.30
thickness of the board	1,12^{a}	1,23^{a}	1,23^{a}	0,95^{a}	1,03^{a}	0,32^{b}	0.92
				Odour			
Acid	6,39^{a}	6,10^{a}	6,15^{a}	5,65^{a}	6,03^{a}	6,41^{a}	1.45
Spicy	6,33^{a}	6,21^{ab}	6,32^{ab}	5,85^{b}	6,00^{ab}	6,63^{a}	1.14
Characteristic	6,54^{a}	6,44^{b}	6,47^{b}	5,78^{c}	6,27^{bc}	7,09^{a}	1.05
Rancid	0,50^{b}	0,46^{b}	0,72^{b}	2,70^{a}	0,65^{b}	0,18^{b}	1.09
				Flavor			
Acid	6,27^{a}	6,22^{a}	6,00^{a}	5,47^{a}	5,92^{a}	5,97^{a}	1.42
Salty	5,71^{ab}	5,16^{b}	5,72^{ab}	5,55^{ab}	5,37^{ab}	5,95^{a}	1.23
Spicy	5,40^{a}	5,09^{a}	5,05^{a}	4,65^{a}	5,09^{a}	4,91^{a}	1.58
Rancid	0,74^{bc}	0,89^{bc}	0,71^{bc}	3,07^{a}	1,09^{b}	0,28^{c}	1.26
Bitter	1,03^{c}	1,85^{b}	2,26^{b}	3,38^{a}	2,31^{b}	0,49^{c}	1.41
Characteristic	6,45^{b}	6,20^{bc}	6,28^{b}	5,51^{c}	6,12^{bc}	7,56^{a}	1.27
				Texture			
Chewiness	5,57^{a}	5,67^{a}	4,58^{b}	4,95^{ab}	4,86^{ab}	5,21^{ab}	1.31
Oiliness	5,62^{a}	5,68^{a}	5,88^{a}	5,90^{a}	5,68^{a}	6,17^{a}	1.39
				Consumer test			
Acceptance	6,00^{b}	5,69^{bc}	5,13^{cd}	4,62^{d}	5,68^{bc}	7,29^{a}	0.70

* MSD- Minimum significant difference.
Averages followed by the same letter, the same line did not present significant difference ($p \leq 0.05$) by Tukey's test. FC- 100% NaCl, F1- 50% NaCl, F2- 50% NaCl and 50% KCl, F3- 50% NaCl and 50% $CaCl_2$, F4- 50% NaCl, 25% KCl and 25% $CaCl_2$, FCOM- commercial.

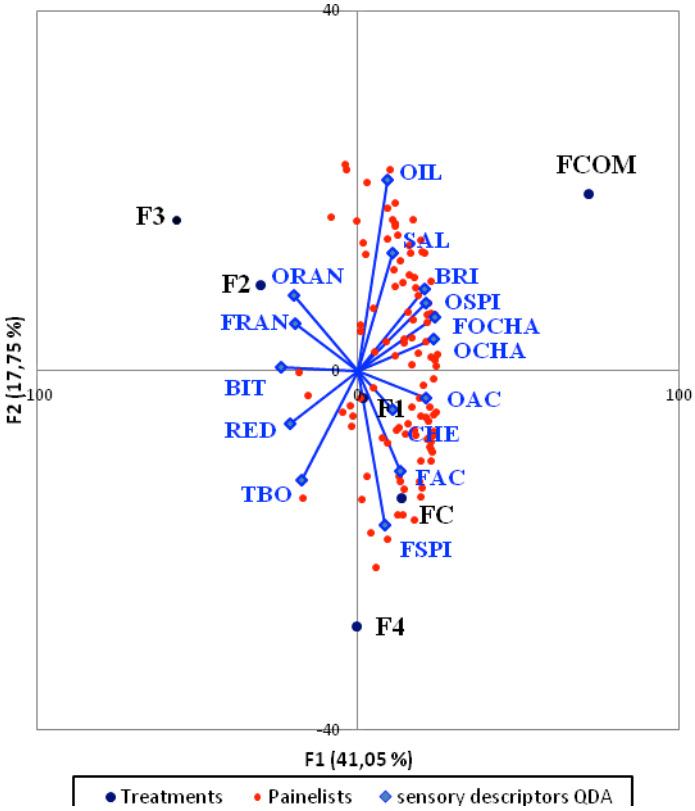

Figure 1.Principal components analysis (PCA) for the sensory attributes of ADQ and consumer acceptance test. * Legend- BRI- brightness, RED- red color, TBO- thickness of the board, OAC-acid,OSPI- spicy, ORAN- rancid, OCHA- characteristic, FAC- acid, SAL- salty, FSPI- spicy, BIT- bitter, FCHA- characteristic, FRAN- rancid, CHE- chewiness and OIL- oiliness.

IV. CONCLUSION

The study of the sensory profile of low-sodium salamis with a 50% replacement of NaCl using different blends of KCl and $CaCl_2$ showed that the key attributes that characterize the products, such as rancid aroma, rancid taste and bitter taste had interfered with the quality and acceptance of the reformulated products. These results indicate that the sodium chloride reduction in combination with salts blends of potassium chloride and calcium chloride shall be accompanied by the use of enhancers and / or taste masking agents to minimize the negative sensory impact that these salts provide the final product.

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REFERENCES

1. DESMOND, E.(2006). Reducing salt: A challenge for the meat industry. Meat Science, 74(1), 188-196

2. DESMOND, E. (2007). Reducing salt in meat and poultry products. In D. Kilcast & Angus (Eds.). Reducing salt in foods (pp. 233-255). Cambridge, UK: Woodhead Publishing Ltda.

3. Toldrá, F. (1998). Proteolysis and lipolysis in flavour development of dry-cured meat products. Meat Science 49:S101–S110.

4. Campagnol, P. C. B., Santos, B. A., Terra, N. N. & Pollonio, M. A. R. (2012). Lysine, disodium guanylate and disodium inosinate as flavor enhancers in low-sodium fermented sausages. Meat Science 91:334-338.

5. Stone, H.; Bleibaum, R.N. & Thomas, H.A.(2012). Sensory evaluation practices. 4. ed., New York: Academic Press.