SENSORY PROPERTIES AND TEXTURE PROFILE ANALYSIS OF LOW SALT BOLOGNA SAUSAGE ELABORATED WITH MECHANICALLY DEBONED POULTRY MEAT AND DIFFERENTS ENHANCERS

Claudia N. Horita, Vanessa C. Messias, Maria T. E. L. Galvão, Marise A.R. Pollonio

Department of Food Technology (DTA), School of Food Engineering (FEA), University of Campinas (UNICAMP), Brazil, marise@fea.unicamp.br

Abstract – The texture and sensory properties of three formulations of meat products with sodium reduction (Control, 50% sodium chloride reduction and 75% sodium chloride reduction) added with 0,1% disodium inosinate and 0,1% disodium guanylate examined by instrumental texture profile analysis and consumer study. There was no difference in hardness, springiness, chewiness and cohesiveness when compared to the control (100% NaCl) and others formulations F1 (75% NaCl, 25%KCl; 0, 1% disodium inosinate and 0, 1% disodium guanylate) and F2 (50%NaCl, 50%KCl, with 0, 1% disodium inosinate and 0, 1% disodium guanylate). The assessors also don't observed significant differences among the samples. In these conditions, KCl can substitute NaCl regarding texture properties.

Key Words – bologna sausage, sodium reduction, flavors enhancers

I. INTRODUCTION

The positive correlation between diet and chronic diseases has led health agencies around the world to control the intake of certain food components that are thought to promote these disorders. Reducing sodium intake is among the most pressing challenges because of its proven role in the development of hypertension, one of the most important risk factors for cardiovascular disease [1].

Emulsified meat products such as bologna sausage require specific concentrations of NaCl in the original formulations to promote the extraction of myofibrillar proteins, especially complex actomyosin, which are soluble only in solutions of high ionic strength. Myofibrillar proteins extracted in the comminution process in the presence of NaCl are responsible for the water-holding capacity, emulsification and fat binding properties in the batter and the formation of stable gels in the cooking stage [2, 3]). Potassium chloride (KCl) has been the most investigated substitute for NaCl and its intake in various studies has reduced blood pressure in humans. From the technological point of view, this salt has been used to ensure the ionic strength necessary to develop stable emulsions; however, its use alone results in a bitter, astringent and metallic taste [4]. Currently, several studies have considered the use of flavor enhancers, in formulations as to minimize the effects of metallic and astringent tastes provided by the use of potassium chloride at concentrations above 50%. Aminoacids such as 5'-ribonucleotide disodium inosinate (IMP) and disodium guanylate (GMP) can reduce the sensory defects caused by KCl [5]. In this context, the objective of this study was to evaluate the texture profile analysis (TPA) and sensory analysis of bologna sausage with low content of sodium with potassium chloride and 0, 1% disodium inosinate e 0, 1% disodium guanylate).

II. MATERIAL AND METHODS

All bologna sausage formulations were processed in a pilot plant (UNICAMP.) on the same day according to industrial procedures. Batter formulations are shown in Table 1. Lean beef, pork and deboned chicken meat with different previously weighed combinations of salts were placed in a cutter (Mado, model MTK 662, Germany) and comminuted for 3–4 min at low speed to extract myofibrillar proteins. When the temperature reached 7–8 °C, other condiments and additives were slowly added. The temperature of the batters never exceeded 17 °C. Subsequently, the meat emulsion was mechanically embedded (Mainca, model EC12, Spain) in permeable cellulose wrappers (Viskase, 5, 91 in ø) with approximately 0.5 kg of product per package. The bologna sausage pieces were placed in a steam oven (Eller, Italy) at an initial inside temperature of 60 °C and relative humidity 98–99% where they remained for 15 min. After that, the temperature was raised at 5 °C every 10 min to reach the final core temperature of 72 °C. At this point, the temperature inside the steam oven was around 85 °C. A thermocouple was placed in the center of the samples to monitor and

control the internal temperature. After cooking (~2, 5 h), the products were immediately cooled in an ice bath, vacuum-packaged (Selovac, Minivac CU18) the products were stored under refrigeration (5 °C) until the analysis were performed. Texture profile analysis of bologna sausages produced with potassium chlorides as partial substitutes for sodium chloride was performed using a TA-xT2i texture analyzer (Texture Technologies Corp., Scarsdale, NY.). All samples were compressed to 30% of their original weight. Six 20-mm thick and 20-mm long portions were used for each treatment. A P-35 probe was used (long shaft, regular base). Measurements were made with the products at room temperature. The following parameters were determined: hardness (N/cm^2), maximum force required to compress the sample, springiness (cm), ability of the sample to recover its original form after the deforming force was removed, cohesiveness, extent to which the sample could be deformed prior to rupture (A2/A1, where A1 is the total energy required for the first compression, and A2 is the total energy required for the second compression), and chewiness (N/cm) work required to masticate the sample for swallowing. Texture profile analysis was measured after processing. The data were evaluated through a variance analysis (ANOVA). The averages were compared by Tukey's test at a confidence level of 5 %($p \leq 0.05$) using the SPSS statistical package (SPSS Inc., Chicago, IL, USA).

The sensory analysis protocol for the bologna sausages developed in the experiments was previously approved by the Ethics in Research Committee of the State University of Campinas, SP, Brazil, under protocol number 268/2010. The sensory analysis was conducted by 60 panelists recruited among students, faculty and staff on campus, aged from 18–50 years. The acceptance test was used to assess the degree to which consumers liked or disliked the products mentioned in relation to appearance, aroma, flavor, texture. The samples were presented in random blocks in a sequential monadic manner with regards to the effects of the position of the samples and contrast [6].

A hedonic scale of nine points (1 — disliked extremely and 9 - like extremely) in balanced complete blocks (each session assessed 3–4 formulations) was used. Data were analyzed using analysis of variance (ANOVA) with significance level of 5%. The tests were conducted at the Sensory Analysis Laboratory of the Department of Food Technology in individual booths with lighting representative of daylight.

Table 1. Formulations of low sodium bologna sausage and flavor enhancer

Component (%)	FC (control)	F1	F2
Lean beef	28,330	28,130	28,130
Pork	15,000	15,000	15,000
Deboned poultry meat	30,000	30,000	30,000
Pork fat	10,000	10,000	10,000
Ice	11,000	11,000	11,000
Starch	3,000	3,000	3,000
Condiments	0,305	0,305	0,305
Sodium nitrite	0,015	0,015	0,015
Tripolyphosphate sodium	0,300	0,300	0,300
Sodium erythorbate	0,050	0,050	0,050
NaCl	2,000	0,500	1,000
KCl	-	1,500	1,000
Disodium inosinate	-	0,100	0,100
Disodium guanylate	-	0,100	0,100

III. RESULTS AND DISCUSSION

Texture Profile Analysis

The results for texture determination are given in Figure 1. There was no difference in hardness, springiness among the control (100% NaCl) and others formulations F1 (75% NaCl, 25%KCl, 0, 1% disodium inosinate and 0, 1% disodium guanylate) and F2 (50%NaCl, 50%KCl, 0, 1% disodium inosinate and 0, 1% disodium guanylate. Chewiness and Cohesiveness did not differ ($p<0, 05$) when the NaCl concentration was reduced by 50% and 75%. A similar pattern of results was obtained in low salt bologna sausage, although without flavor enhancers addition [7]. This study suggests that disodium inosinate and disodium guanylate had contributed, mainly in flavor or aroma, without changes in texture properties.

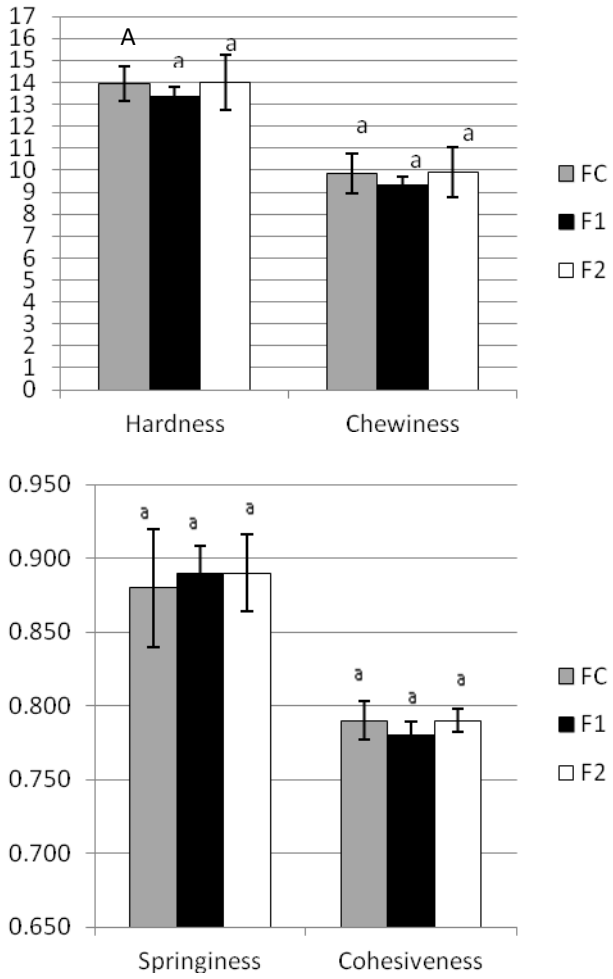

Figure 1. Texture Profile Analysis of bologna sausage with sodium reduction and flavors enhancers

FC- Control (100% NaCl)
F1- Low salt bologna sausage (25% NaCl, 75%KCl, 0, 1% disodium inosinate and 0, 1% disodium guanylate)
F2- Low salt bologna sausage (50%NaCl, 50%KCl, 0, 1% disodium inosinate and 0, 1% disodium guanylate)
a – the same letters did not differ significantly at p<0, 05 (Tukey's test)

Sensory Evaluation

The acceptabily study of control and modified bolognas sausages results of consumer study are presented in Figure 2.
All the formulations had similar scores for appearance, aroma and texture. However, F1(25% NaCl, 75%KCl, 0, 1% disodium inosinate and 0, 1% disodium guanylate) had the lowest score for flavor, which suggests that the flavor enhancer (mix of 0, 1% disodium inosinate and 0, 1% disodium guanylate) was not able to suppress the bitter flavor at 75% replacement of NaCl by KCl. These results are in line with previous study on fermented meat products added disodium inosinate and disodium guanylate [8] and others flavors enhancers with umami properties as a result of minimal flavor or aroma contributions to products in which it is added [9].
Similar study performed in sodium reducing of fermented meat products suggests that lysine addition can contribute as flavor enhancer beside disodium inosinate and disodium guanylate [10].

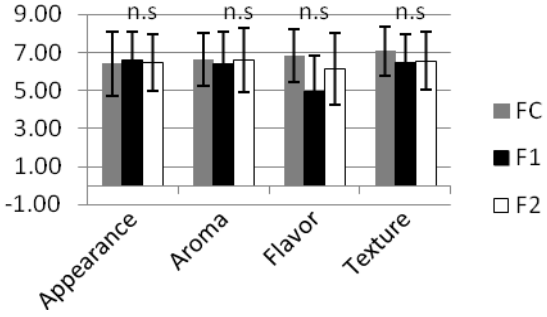

Figure 2. Mean sensory scores of low salt sausage with flavors enhancers

FC- Control (100% NaCl)
F1- Low salt bologna sausage (25% NaCl, 75%KCl, 0, 1% disodium inosinate and 0, 1% disodium guanylate)
F2- Low salt bologna sausage (50%NaCl, 50%KCl, 0, 1% disodium inosinate and 0, 1% disodium guanylate**)**
n.s. - not significant at p<0, 05 (Tukey's test)

IV. CONCLUSION

This study suggests that the use of (0,1% disodium inosinate and 0,1% disodium guanylate)

as flavor enhancer to increase overall acceptability, may have contributed to the suppression of the sensory quality defects caused by the KCl in 50% of NaCl reduction introduction, thus enabling the production of bologna sausages that have acceptable sensory qualities with half as much sodium content.

ACKNOWLEDGEMENTS

The authors would like to thank CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brazil) for its support.

REFERENCES

1. FERNÁNDS-GINÉS, J.M.; FERNÁNDEZ-LÓPEZ, J.; SAYAS-BARBERÁ, E.; PÉREZ-ALVAREZ, J.A. (2005). Meat products as functional foods: a review. Journal of Food Science**,** 70: 37-43.

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

3. 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.

4. GELEIJNSE, J.M., KOK, F.J., GROBBEE, D. E. (2003). Blood pressure response to changes in sodium and potassium intake: A meta regression analysis of randomized trials. Journal of Human Hypertension, 17, 471-480.

5. KURTZ, R. J., & FULLER, W. D. (1997). Specific eatable taste modifiers. US Patent 005631299A: United States.

6. MACFIE, H. J., BRATCHELL, N., GREENHOFF, K., & VALLIS, L. (1989). Designs balance the effect of order of presentation and first-order carry-over effects in hall tests. Journal of Sensory Studies, 4, 129−148.

7. HORITA, C.N.; MORGANO, M.A.; CELEGHINI, R.M.S.; POLLONIO, M.A.R. (2011). Physico-chemical and sensory properties of reduced-fat mortadella prepared with blends of calcium, magnesium and potassium chloride as partial substitutes for sodium chloride. Meat Science, 89, 426-433.

8. CAMPAGNOL, P. C. B.; SANTOS, B. A. ; MORGANO, M. A. ; TERRA, N. N. ; POLLONIO, M. A. R.(2011) . Application of lysine, taurine, disodium inosinate and disodium guanylate in fermented cooked sausages with 50% replacement of NaCl by KCl. Meat Science, 87, 239-243.

9. MCGOUGH, M.M.; SATO, T.; RANKIN, S.A.; SINDELAR, J.J. (2012) Reducing sodium levels in frankfurters using a natural flavor enhancer. Meat Science, 9, 185-194.

10. CAMPAGNOL, P. C. B.; SANTOS, B. A. ; MORGANO, M. 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, doi:10.1016/j.meatsci.2012.02.012