SALT REDUCTION STRATEGIES FOR MEAT PRODUCTS

Patrícia Bernardo[1], Maria J. Fernandes[1], Maria H. Fernandes[1], Maria P. Teixeira[1], C. Serrano[2,3], Luís Patarata[4] and Maria J. Fraqueza[1*]

[1]CIISA - Centre for Interdisciplinary Research in Animal Health, Faculty of Veterinary Medicine, Associate Laboratory for Animal and Veterinary Sciences (AL4AnimalS), University of Lisbon, Lisbon, Portugal

[2]INIAV - National Institute for Agrarian and Veterinary Research, Oeiras, Portugal

[3]LEAF—Linking Landscape, Environment, Agriculture and Food—Research Center, Instituto Superior de Agronomia, Associated Laboratory TERRA, University of Lisbon, Lisbon, Portugal

[4]CECAV - Animal and Veterinary Research Center, University of Trás-os-Montes and Alto Douro, Vila Real, Portugal

*Corresponding author email: mjoaofraqueza@fmv.ulisboa.pt

I. INTRODUCTION

The excessive consumption of sodium contributes to numerous health issues, particularly cardiovascular diseases. The World Health Organization (WHO) [1] set a goal of reducing salt intake by 30% by 2025, driving a growing demand for food items with lower sodium content. However, sodium chloride ensures the safety and the development of desirable sensory characteristics of meat products [2]. Potassium chloride [3] and oleoresins of aromatic herbs [4] are potential alternatives to reduce sodium chloride and warrant further investigation. The present study aims to develop and formulate a low sodium cured meat sausage (CMS) using KCl and oleoresins as sodium replacers, and to assess its quality attributes during shelf life.

II. MATERIALS AND METHODS

Three batches of each CMS were formulated and produced in three different working days: C1-Control1.5% NaCl; F1- 1% NaCl and 0.5% KCl; F2- 1% NaCl and 0.5% encapsulated oleoresins with 0.3% KCl; F3- 1% NaCl and 0.5% encapsulated oleoresins without KCl. The mixture rested for 48h at 7ºC, then it was stuffed into a natural thin pork casing and tied in a horseshoe shape. Sausages were dried and cold smoked for 6h at 25ºC, with smoke generated by burning holm wood scraps. After this first cycle of drying/smoking, sausages were kept a 4ºC for 12h. The smoking and maturation (curing) steps were repeated in three consecutive days. After the third smoking cycle, sausages remained at 4ºC for five days. Sausages were then vacuum packed and stored at 4ºC. Analysis were performed on the meat seasoning phase, before stuffing, on the final product, and during storage (2, 4, 6 months). Microbial analysis was performed according to ISO Standards: Lactic Acid Bacteria (LAB), Coagulase Negative Staphylococci (CNS) *Enterobacteriaceae* counts, and *Listeria monocytogenes* detection and counts. Water activity (A_w), pH, and TBARS were evaluated. The L*a*b* color was measured with a Konica Minolta CR-400/410 (Konica Minolta, Japan) illuminant D65. Sensory analysis was carried out on the final products. A consumer test was performed with 97 participants, which included a hedonic evaluation, a yes/no question for the presence of metallic taste, and Just About Right (JAR) scale to assess the adequacy of saltiness.

III. RESULTS AND DISCUSSION

The different CMS formulas for salt reduction presented no difference regarding A_w and pH. The sausages' color was significantly ($p<0.0001$) affected by the formulations, presenting F2 sausages the higher a* (15.79). The effect of formulations was highly significant ($p<0.0001$) on TBARS, with a sausages prepared with KCl and, or oleoresins (F1= 0.59 mg MDA/kg, F2= 0.45 mg MDA/kg and F3= 0.39 mg MDA/kg) presenting lower lipid oxidation than the control (0.77 mg MDA/kg). The antioxidant

effect of aromatic plant oleoresins to meat product formulations could be explained by bioactive compounds, such as phenolic compounds [5]. The absence of *L. monocytogenes* in 25g of the final product was confirmed. These pathogens counts were always below 10 cfu/g till the end of storage (6 months). The different formulas had no effect on *Enterobacteriaceae*, LAB, or CNS counts. LAB and CNS populations presented an increase only during the period of manufacture but not during the shelf life. A metallic taste is often associated with salt substitutes containing potassium chloride. Despite this association, the chi-square test showed no significant association ($p>0.05$) between the presence of a metallic taste and the inclusion of KCl in the formulations, even for the highest concentrations tested (0.5% KCl). When evaluating consumer' adequacy evaluation of saltiness using the JAR test, it is commonly agreed upon that if approximately 50% of consumers consider the characteristic to be "just about right," the product is ready to launch in the market [6]. Hence, in both CMS formulation control (55%) and F1 (54%), the salt content was evaluated as ideal by more than 50% of consumers. In CMS formulas with encapsulated oleoresins, the salt content was considered ideal by 42% (F2) and 45% (F3) of the consumers. These results suggest that encapsulated oleoresins in CMS have potential, but still needs further optimization. Non-ideal evaluations, namely low salt content, were evaluated by 31% (C), 37% (F2), 43% (F2), and 44% (F3) of consumers, which resulted in penalties of 1.58, 0.77, 1.30, and 1.25 units in the 9-point hedonic evaluation, respectively. Nevertheless, hedonic evaluation results showed that all samples were classified above the center of the scale (5 in the 9-point scale), with no statistical differences ($p>0.05$) found between formulations.

IV. CONCLUSION

The salt content of CMS produced with 1% NaCl and 0.5% KCl was considered ideal by enough consumers to launch the product in the market. Results from this study show that it is possible to achieve 33% sodium replacement with KCl without jeopardize CMS organoleptic characteristics nor its safety. The KCl and plant oleoresins used in CMS delayed lipid oxidation during storage. All CMS produced with KCl (F1 and F2) improved the desirable red color. Further studies are required to optimize the use of encapsulated oleoresins, to achieve ideal saltiness. The formulation with 1% NaCl and 0.5% KCl might be a solution to reduce sodium intake associated with the consumption of meat products.

ACKNOWLEDGEMENTS

The scholarship of the first author was funded by Fundação para a Ciência e Tecnologia (FCT)—UI/BD/152824/2022.This work was supported by: Centre for Interdisciplinary Research in Animal Health, Faculty of Veterinary Medicine, University of Lisbon UIDB/00276/2020, LA/P/0059/2020 - AL4AnimalS- Associate Laboratory for Animal and Science with financial support of the project AL4A-PROJ-LT1.3 - Safety and acceptability assessment of Green label cured meat products.

REFERENCES

1. [WHO] World Health Organization (2023). WHO global report on sodium intake reduction. Geneva.
2. Fraqueza, M.J.; Laranjo, M.; Elias, M.; Patarata, L. (2021). Microbiological hazards associated with salt and nitrite reduction in cured meat products: control strategies based on antimicrobial effect of natural ingredients and protective microbiota. Current Opinion in Food Science 40: 32–39.
3. Kim, T.; Yong, H.; Jung, S.; Kim, H.; Choi, Y. (2021). Technologies for the production of meat products with a low sodium chloride content and improved quality characteristics: A review. Foods 10: 957.
4. Serrano, C.; Sapata, M.; Oliveira, M.C.; Gerardo, A.; Viegas, C. (2020). Encapsulation of oleoresins for salt reduction in food. Acta Scientiarum Polonorum Technologia Alimentaria 19(1): 57–71.
5. Bernardo, P., Patarata, L., Lorenzo, J.M. & Fraqueza, M.J. (2021) Nitrate Is Nitrate: The Status Quo of Using Nitrate through Vegetable Extracts in Meat Products. Foods 10: 3019.
6. Patarata L.; Carvalho F.; Fraqueza M.J. (2022). Nitrite-Free Implications on Consumer Acceptance and the Behavior of Pathogens in Cured Pork Loins. Foods 11: 796.