The risk of salt reduction in chouriço - a dry-cured sausage assessed by the influence on the survival of Salmonella

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Introduction: Salt is used in food processing for its taste and preservation. The antimicrobial effect of salt relies on its ability to bind water and reduce water activity (aw) (Fraqueza et al., 2021). The association between salt and cardiovascular health has led to reducing salt intake (He et al., 2020). Among the pathogens occurring in dry-cured sausages, Salmonella represents a serious concern due to its high prevalence in the swine carcasses, resistance to some preservation hurdles, competition ability, and low infectious doses. It is recommended to guarantee that the manufacturing process results in a 5-log reduction in the Salmonella population in unheated meat products (USDA/FSIS, 2017). The reduction in aw, combined with other hurdles, is the primary way for controlling Salmonella in dry-cured sausages (Patarata et al., 2020).

The present work aimed to evaluate the influence of salt level (1% or 3% added), using or not phosphate and wine, on the behavior of Salmonella during chouriço processing.

Material and methods: A mixture of four Salmonella strains (CECT 4155, plus 3 strains isolated from meat products) was used for inoculation. The cultures were prepared as previously described (Patarata et al., 2020). The level of inoculation was 7 log cfu/g. The experiment was conducted with three batches of chouriço, each with the eight possible formulations from combination of the three effects: salt (1%, 3%); phosphate (0%, 0.5%); red wine (0%, 7.5%). Samples were analyzed in 11 sampling times: batter, stuffing, smoking, 1, 4, 8, 12, 17, 24, 32, and 46 days of drying. The aw was measured in 10 g of minced sausage in a Hygroscope DT apparatus with a WA40 probe. The counts of Salmonella were made from an initial dilution of 1:10 in Peptone Water. Serial dilutions were inoculated in Compass Salmonella (Biokar) (37°C for 24 to 48 h). The results are expressed as log cfu/g.

A logistic regression model was calculated to evaluate the odds of achieving a 5-log reduction in Salmonella counts, considering the effect of the salt level and the use or not of phosphate and red wine. When counts were below the detection limit, it was considered zero for data analysis purposes.

Results: The initial inoculation was 7.2±0.15 log cfu/g to have the possibility to demonstrate the 5-log reduction. Analyzing the evolution of the pathogen, it is clear that from the smoking phase, the effect of the higher level of salt promoted a faster reduction of the pathogen. At five days the differences were around 2 log cfu/g. In 3% salt dry-cured sausages, the 5-log reduction was achieved at 32 days when wine was used. At that sampling time, in the chouriço without phosphate, the count of Salmonella was 1.6±1.2 log cfu/g, and in chouriço with phosphate the count was 1.1±0.8 log cfu/g. The chouriço without wine only meets the 5-log reduction criteria later. At the maximum drying period tested, 46 d, when low salt was used, only the sausages without phosphate and with wine achieved the 5-log reduction.

The logistic model for a 5-log reduction showed that the use of 3% of salt, instead of 1%, corresponds to a 7.5- fold (95% CI: 2.0-28.4) probability of meeting the 5-log reduction criteria. It was observed that a 0.01 increment in aw reduces to half the odds of achieving the previewed reduction (OR=0.5, 95% CI 0.4-0.7). Both phosphates and wine were not significant to the model.

Conclusions: Reducing the level of salt addition from 3% to 1% has substantial implications on Salmonella's survival, directly or mediated by its implication on the aw. With 1% salt, the 5-log reduction in the Salmonella population was not always achieved, depending on the formulation.

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References:

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 38, 32–39.

He, F.J., Tan, M., Ma, Y., MacGregor, G.A., 2020. Salt Reduction to Prevent Hypertension and Cardiovascular Disease: JACC State-of-the-Art Review. Journal of the American College of Cardiology 75, 632–647.

Patarata, L., Novais, M., Fraqueza, M., Silva, J., 2020. Influence of Meat Spoilage Microbiota Initial Load on a naturally fermented sausage. Foods 9, 676.

USDA/FSIS, 2017. FSIS Salmonella Compliance Guidelines for Small and Very Small Meat and Poultry Establishments that Produce Ready-to-Eat (RTE) Products and Revised Appendix A. Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, D.C.