Combining predictive microbiology and computed tomography to assess the impact of the reduction of salt and curing agents during dry-cured ham processing

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Introduction: Reduction of salt and curing additives in dry-cured ham to comply with nutritional recommendations and clean label requirements can compromise the microbiological safety. Predictive microbiology tools can be used to evaluate the microbiological safety consequences of changes in food processing (Messens et al., 2018). The aim of this study was to evaluate the behaviour of relevant microbial hazards in a salt reduced dry-cured ham process by using predictive microbiology fed with data from traditional physicochemical and computed tomography (CT) analysis. The effect of fat content and elimination of nitrite was also evaluated.

Material and methods: Thirty dry-cured hams with different fat content (Lean< 12. 5 ± 2.3% and Fat> 12.5± 2.3%) and a reduced salt content (<3.2 ± 0.4 %) were elaborated following the conventional procedure that comprises a salting, a resting and two drying steps at different temperatures. The water activity (aw) and pH of the product were characterized through the process, specifically after 6, 9, 12, 39 and 49 weeks, using conventional physicochemical analysis. A CT scanner (HiSpeed Zx/I; GE Healthcare, UK) was also used to obtain salt, water and aw distributions inside the ham (Santos-Garcés et al. 2010). Predictive models available in ComBase were used to assesses the impact of the recorded pH, aw and temperature values on Salmonella spp., Listeria monocytogenes, Staphylococcus aureus and Clostridium botulinum in each step of the process. The effect of fat content and processing time on physicochemical characteristics was evaluated using a two-way ANOVA procedure and differences were tested by means of Tukey's test ($p \leq 0.05$).

Results and discussion: At earlier elaboration stages the increase of temperature to 5 and 12ºC resulted in a net increase of the growth capacity of all the microorganisms evaluated. Microbiological safety concerns may arise when no nitrite is added, mainly due to a considerable increase of growth potential of L. monocytogenes and non-proteolytic C. botulinum, as psychrotrophic organisms. The increase of growth potential of proteolytic C. botulinum was found to be limited in comparison with other hazards. From week 39, the aw value rendered the environment favourable for the non-thermal inactivation. The reduction of L. monocytogenes was slightly faster than that of Salmonella. The higher aw found in fat hams at the end of process supposed higher growth (at earlier stages) and lower inactivation potential (from week 39) of the considered hazards. Salt content and aw distributions of lean and fat hams at different points of the process using CT were different and provided extra information to conventional physicochemical analysis that might facilitate a better assessment of the microbiological safety implications.

Conclusions: Predictive microbiology together with the distribution of aw in dry-cured ham obtained using CT through the process may facilitate the evaluation of microbiological safety concerns of dry-cured ham elaboration processes, especially when salt content and preservatives are reduced.

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Literature:

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