P-02-06

Potential microbial risks associated with innovative fenalår elaboration procedures (#539)

Elena Coll - Brasasa[1], Arícia Possas[1], Per Berg[2], Bjørg Egelandsdal[3], Trond Livden[2], Sara Bover-Cid[1], Elena Fulladosa[1]

[1] IRTA, Food Technology/Food Safety, Monells, Spain; [2] Nortura, SA, Tynset/Oslo, Norway; [3] Norwegian University of Life, Faculty of Chemistry, Biotechnology and Food Science, Ås, Norway

Introduction

Deboned dry-cured leg of lamb, fenalår, is a typical Norwegian meat product. Whole or deboned leg of fresh or thawed lamb, are salted with a combination of nitrite – salt and fine salt. The legs are stored at below 4 ºC for salt equalization and dried at 13-15 ºC until a final weight loss of 38 – 42 % and a_w <0.90. Innovative procedures are being studied to comply with nutritional recommendations (i.e. salt reduction) and clean label demands (e.g. avoid the use of curing additives (nitrite and nitrate salts). The aim of our study was to evaluate the potential increase of microbiological risk associated with two modified fenalår elaboration procedures, a Salt-Reduced (SR) and a Non-Nitrite Salt-Reduced (NNSR), in relation to the Standard Salting procedure (SS). For this purpose, predictive microbiology models were used to simulate the behaviour of relevant microbiological hazards as a function of intrinsic (pH, a_w, nitrite) and extrinsic factors (temperature) representative of each step of the manufacturing process.

Methods

Thirty fenalår were elaborated using the salting procedures (SS, n=15; SR, n=8 and NNSR, n=7) defined in Figure 1. After salting, the manufacturing process consisted of a cold phase at 2 - 4°C/40 days followed by a drying step at 18°C/2 days. Fenalårs were then dried at 13-15 °C and RH of 68-70%, smoked at 13 °C and pressed. All fenalårs were characterized at different moments of the manufacturing process (after 42, 54, 67, 74 and 90 days of processing).

At each sampling time, 6 fenalår were sampled in 2 areas (central and tip of the fenalår) and 2-3 regions of interest (RoI) were selected (Figure 1). From each RoI, a_w was measured with an AquaLab™ instrument. The pH was measured by direct measurement with a penetration probe. The growth capability of target pathogens (*Listeria monocytogenes, Salmonella, Staphylococcus aureus, Clostridium botulinum* non-proteolytic and proteolytic) was simulated using the predictive models available at the ComBase tool (www.combase.cc). As a conservative approach (worse-case scenario) the maximum value of pH, a_w and temperature were used as model inputs. Nitrite concentration (if available in the model) was assumed to be 150 ppm (ongoing concentration). Doubling time (h) were obtained and the potential increase of pathogen loads (in log units) was calculated for each sampling step.

Results

The results of the physicochemical analysis of fenalår are shown in Table 1. The a_w values decreased throughout the production process following a similar trend in all types of fenalår assessed. The pH was not affected by the different salt and nitrite amounts added at the different elaboration procedures.

The growth capability of microbial hazards varied depending on the species, the physicochemical characteristics of the products and the temperature occurring in each manufacturing step. During the cold phase, in agreement with its psychrotrophic nature, only *L. monocytogenes* was able to grow. At this phase, the other hazards would not be able to grow, either because the temperature was below the minimum growth temperature (e.g. *Salmonella*, *S. aureus*, *C. botulinum* proteolytic) and/or due to the presence of nitrites (e.g. *C. botulinum* non-proteolytic). The drying step at 18ºC/2 days immediately after the cold phase, provided favourable conditions for the growth of mesophilic pathogens in all products and *C.botulinum* proteolytic in products NNSR. According to model simulations, during processing steps at 13°C, *L. monocytogenes* and *S. aureus* would be able to grow in products. The decrease of a_w wouldd rastically reducethe growth of the other evaluated microorganisms, though the measured a_w was outside the simulation domain of the model. For *S. aureus*, the decrease of a_w from 0.967 to 0.928 along the process led to the decrease in growth rates from 0.099 to 0.016 h^{-1} in NNSR.

It is worth to mention that the simulations with ComBase usually provide fail-safe predictions (i.e. predicted growth faster than the growth that would actually occur in real food matrixes). Nevertheless, the tool provide useful simulations to compare the relative impact of different scenarios of input data. In the present study, NNSR was the most favourable formulation for microbial growth, while little differences of pathogens' growth potential between SS and SR were marked. For instance, the growth rates of *L. monocytogenes* in NNSR doubled those estimated for SR and SS products at all steps of the production process (Figure 2), which demonstrates the relevant microbiological role of this curing additive in meat products. The reduction of nitrite therefore increases the risk associated with the consumption of fenalår under the studied conditions and the implementation of other antimicrobial hurdles would be needed to manage them.

Conclusion

The elaboration of fenalår without nitrite must be cautions as it can increase the risk of exposure of consumers to microbial risks, mainly *L. monocytogenes* and *S. aureus*.

Acknowledgements

This work was supported by INIA CPD2015-0054 and CERCA programme from Generalitat de Catalunya.

Notes