Assessment of the microbiological safety associated with the dynamics of the meat surface aw, pH and temperature during beef dry-aging process

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Introduction: Dry-aged beef meat is becoming more and more popular among the consumers, willing to pay a higher price for a piece of meat with a unique enhanced flavour. Despite the increasing number of works dealing with the technological aspects of dry aged of meat, the microbiological safety of this practice has been scarcely studied. The aim of the present study was to evaluate from a quantitative perspective the behaviour of the relevant microbial hazards as a function of the key factors associated with dry aged, i.e. pH, aw and temperature along the aging process.

Material and method: The two loins of six commercial culling cows (3 holstein and 3 brown swiss) were selected, cut in 12 pieces (10 cm width) and submitted to a dry aging in an aging room set at 2 ºC and 70 % RH, the actual temperature at the meat surface was recorded with a datalogger every 30 sec. Loins were sampled periodically, from time 0 to 58 days, deboned and a slice of 0.5 mm width of the dried surface was cut to determine the aw and pH. The recorded temperature, aw and pH were used as input values for microbial predictive models about the growth behaviour of the following relevant hazards: Escherichia coli, Salmonella spp. and Listeria monocytogenes. Growth/no growth and kinetic models based on 'cardinal growth parameters' (Rosso et al. (1995); Ross et al. (2003); Pin et al. (2011); Mejlholm et al. (2010)) were implemented in Excel in order to take the dynamics of the input factors along the drying time.

Results: The temperature of the surface of the beef cut oscillated mainly between 1-4 ºC (being 10% of the time below 2ºC, 18% between 2-3ºC, 63% between 3-4ºC; 8% between 4-5ºC and only 1% above 5ºC). Surface aw clearly decreased following a concave curve described with a quadratic polynomic equation, while the pH clearly increased linearly, and three scenarios were identified: (1) with maximum values of pH at each dry aging period; (2) with medium pH values and (3) with minimum pH values during the aging period. The predictive models indicated that the beef aging conditions recorded in this study did not support the growth of Gram-negative bacteria such as E. coli and Salmonella spp., with growth probabilities below 10% in all pH and aw conditions considered. Contrary, most (>90%) of loin pieces tested could support the growth of the psychrotrotolerant L. monocytogenes by more than 10% probability. However, the growth potential of this pathogen was relatively low (1 log unit in the worst-case scenario of pH, initially at 5.65) or not microbiologically relevant (less than 0.5 log units in the scenarios 2 and 3 of pH).

Conclusions: The results of the present study support the microbiological safety of the dry-aging process of beef provided that the meat cuts are properly selected (i.e. pH 5.5 ± 0.1) and the temperature is strictly controlled at ≤ 2ºC.

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