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Plasma-activated water as alternative source of nitrite for beef jerky manufacture: Microbiological and quality effects (#429)

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Introduction

Nitrite (NO_2^-) is used a curing agent as it plays a role in the development of the distinctive cured meat colour and flavour, inhibits lipid oxidation, and controls spoilage and pathogenic microorganisms. Conventional curing processes generally use sodium nitrite as a nitrite source, for which the limits in brined products are set to 200 ppm. Concerns associated with the use of synthetic curing agents, consumers seem to prefer products manufactured using natural or clean label processes than the use of agents such as sodium nitrite. Plasma technology has shown significant potential for meat processing applications as a preservation technique. Plasmas are recognised as the fourth state of matter and result from applying energy (heat, voltage or light) to a gas, initiating a breakdown of individual gas molecules into free electrons, ions and metastable species including nitrate (NO_3^-) and nitrite (NO_2^-). Therefore, the objective of this study was to compare the quality of beef jerky cured by sodium nitrite and by plasma-activated brine (PAW) to evaluate the suitability of PAW as an alternative nitrite source in cured meat product manufacturing. Additionally, the effect of the PAW on inoculated meat with *Listeria innocua* was also monitored during the curing process.

Methods

Round of the eye beef slices (10×4×0.5 cm; L×W×H) were cured in four different brine solutions containing: 0, 50, 100 or 150 ppm of $NaNO_2$,150 ppm of NaCl and 100 ppm of sugar; plasma activated brine solutions were generated by hot plasma system for 10 min using Air or N_2 as gas sources. After 18 h curing at 4 °C, slices were drained and dried in a oven dryer at 68 °C for ~2 h. Nitrite concentrations (ppm) in the brines and in the jerky were quantified by the spectrophotometric Griess method. For quality, pH, thiobarbituric acid reactive substances (TBARS), colour parameters (*L*, a*, b**)and Shear force (N) were determined on jerky samples manufactured by standard curing (Control), Air-PAW and N_2-PAW treated brines. Moreover, *L. innocua* were inoculated on fresh meat slices at $\log_{10}$ 7 cfu/mL and monitored by spread plating on Listeria Selective Agar Base (Oxford) during the whole processing chain: fresh meat, brine solution, meat after curing and in the jerky. Average values and standard deviations of individual replicates were determined from the data. Differences between treatments were compared using factorial analysis of variance (ANOVA) followed by Tukey post hoc test at $P < 0.05$. Statistical analyses were performed using Minitab 17 Statistical Software (2010).

Results

No significant differences ($P < 0.05$) were found in the colour (*L*, a*, b**), texture parameters (WBSF) and lipid oxidation (TBARS) of samples treated with PAW compared to standard curing. However, significantly ($P < 0.05$) higher concentration of nitrites were observed in the initial water and after 18 h in Air-PAW brine (Fig.1). Based on these results, the inactivation of *L. innocua* in beef jerky cured with Air-PAW was monitored and compared with standard cured samples. Results showed ~ 1.0 log reduction in the Air-PAW brine after curing, regardless of the amount of nitrite added or generated in the brine (Fig.2A). On the meat surface, a significant reduction of *L. innocua* was observed in Air-PAW brines containing added $NaNO_2$, while in the jerky, significant reductions were observed in all plasma treated brine solutions (Fig.2B).

Conclusion

The PAW produced in this study contained enough nitrite to be used as a nitrite source for curing beef jerky. When beef jerky was manufactured with the addition of PAW, meat qualities were similar to those of jerky cured with the conventional curing method. These results also showed that PAW has the potential to reduce cross contamination in the brine. In conclusion, this technology can be used as an alternative nitrite source with minimal impact on product quality. However, further studies may be required to employ PAW for surface decontamination on meat products.

Notes

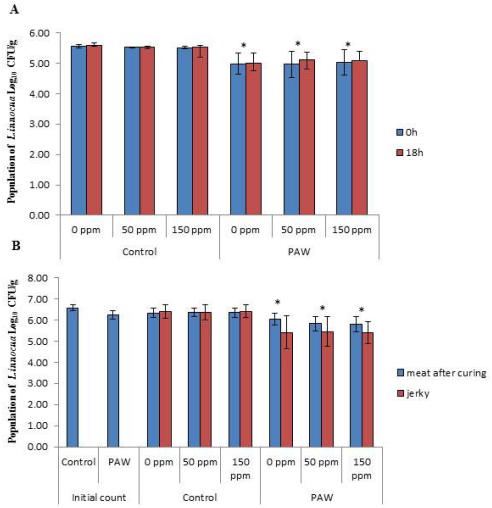

Figure 2 A) Population of L.innocua (log10 cfu/g) in the water used for brining; B) Population of L.innocua (cfu/g) in the meat after curing and in the jerky. Samples indicated by asterisk (*) are significantly different from the control solutions at P<0.05.

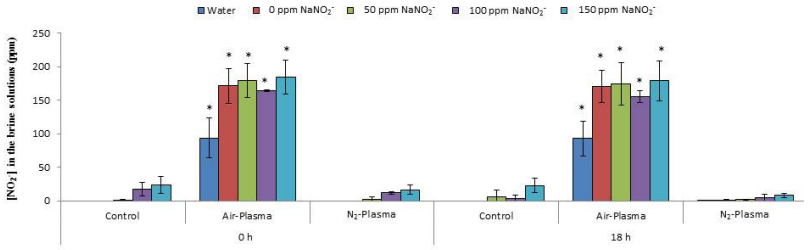

Figure 1 Concentration of NO2– detected in the brine solutions: control, Air-PAW and N2-PAW. indicated by asterisk (*) are significant different from control and N2-PAW at P<0.05.

Notes