

STUDY OF THE EFFECT OF SODIUM LACTATE ADDITION AND FERMENTATION TEMPERATURE ON *LISTERIA MONOCYTOGENES* INACTIVATION DURING SALAMI PRODUCTION

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I. INTRODUCTION

Listeria monocytogenes is a bacterium that may cause listeriosis. *L. monocytogenes* is commonly found in meat and meat products such as salami. In salami, lactic acid fermentation is used as a preservation method through pH reduction and competitive exclusion in a medium containing between 2 - 3 % of sodium chloride. The fermentation and drying conditions will determine *L. monocytogenes* growth, conditioning the decrease in pH and water activity (a_w) until reaching the restrictive values ($pH \leq 4.4$ or $a_w \leq 0.92$ or $pH \leq 5.0$ and $a_w \leq 0.94$) for *Listeria* growth. Sodium lactate (SL), used as pH regulator for sensorial purpose, has been reported to retard the growth of many microorganisms, including *L. monocytogenes* [1], and LAB [2]. The aim of the present work was to study the effect of SL and fermentation temperature (T_{ferm}) on *L. monocytogenes* inactivation.

II. MATERIALS AND METHODS

A challenge study was conducted using pilot-scale salami production inoculated with *Listeria innocua* as a surrogate microorganism for *L. monocytogenes* [3]. Salami samples were prepared in 25 kg batches within a pilot plant. The meat and fat mixture (75:25), was ground to a fine grain using a cutter (LASKA KR 60-2 MV, Linz, Austria). Subsequently, the minced mixture was transferred to the blender (LASKA T WU5 Vac/P, Linz, Austria) and 150 ppm sodium nitrite, 2.6 % sodium chloride, 0.1 % ascorbic acid, 0.40 % polyphosphate, 0.03 % peppercorns, 0.10 % ground nutmeg, 0.30 % coriander, 0.10 % dehydrated garlic, 1% dextrose and starter culture (FLC, Chr. Hansen) were added. Salami were prepared with and without SL (0 and 2 %). This mixture was homogenized and inoculated with 10^7 CFU/g of *L. innocua* ATCC 33090. After mixing, salami were stuffed in an artificial casing 9.15 cm caliber using a HANDTMANN VF 12 – 100 sausage stuffer (Servo, Poland). Salami were fermented at 27 or 30 °C in an ALFA LAVAL LR-6 chamber (Surrey, United Kingdom) at relative humidity (RH) of 90 ± 5 % for 2 days, and then, dried for 26 days in an ALFA LAVAL kkt 21021 chamber (Surrey, United Kingdom) at 17 ± 0.4 °C at RH of 78 ± 5 %. *L. innocua* counts and pH of salami were determined at 0, 1, 2, 7, 14, 21 and 28 days. *L. innocua* counts were obtained by plating appropriate dilutions on Palcam Agar Base (Oxoid Ltd., Hampshire, UK) and incubating at 37 °C for 48 hours. Water activity was measured at 0, 2, 7, 14, 21, and 28 days. *L. innocua* counts for each test condition over time were adjusted with Baranyi & Roberts equation using the software DMFit. *L. innocua* reduction in \log_{10} CFU/g between the counts of *L. innocua* at the beginning of the fermentation and the counts reached at the end of the drying stage, estimated by Baranyi & Roberts equation, was calculated for each test condition.

III. RESULTS AND DISCUSSION

Listeria reduction was significantly greater at T_{ferm} of 30 °C than at 27 °C (Figure 1). The addition of 2 % SL to salami interfered with *Listeria* reduction and pH drop (Figure 1 and 2) at both fermentation temperatures. The impact of SL addition on pH drop was greater at T_{ferm} of 27 °C than at 30 °C. For all conditions, after 7 days the salami reached the restrictive a_w (< 0.92) for *Listeria* growth and no effect of SL nor T_{ferm} was observed.

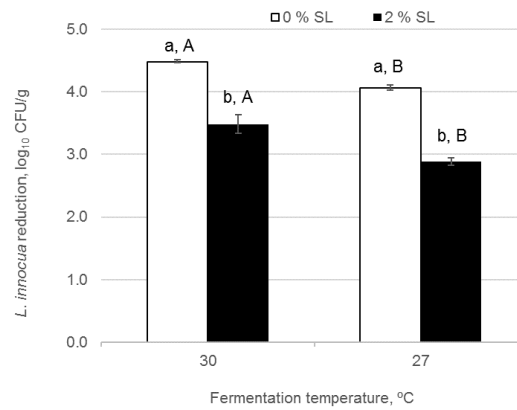


Figure 1. *L. innocua* reduction in presence or absence of sodium lactate (SL) at fermentation temperature 30 °C and 27 °C. The mean of two samples \pm standard deviation of the values is presented. Different uppercase letters indicate significant differences (LSD, $p < 0.05$) between the means at different fermentation temperature for the same SL condition. Different small letters indicate significant differences (LSD, $p < 0.05$) between samples with 0 and 2 % SL for each fermentation temperature.

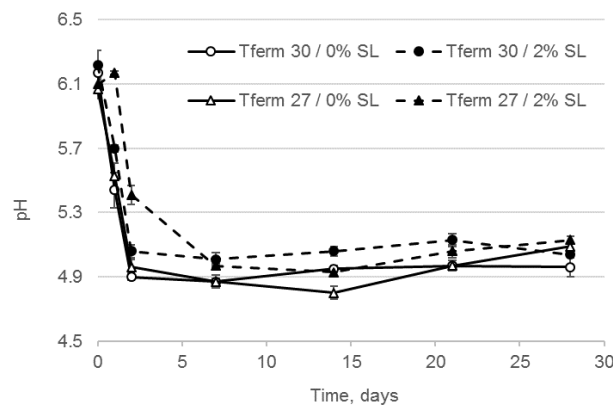


Figure 2. Evolution of pH at different fermentation temperature (Tferm) and in presence/absence of sodium lactate (SL). Each point represents the mean value of two samples \pm standard deviation.

IV. CONCLUSION

The use of 2 % sodium lactate is not recommended since it compromises product safety by not allowing a reduction of *Listeria* greater than 3 log₁₀ CFU/g as recommended by USDA-FSIS [4]. The addition of lower concentrations of sodium lactate should be studied.

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