Inhibitory Effect of Provian® (A Co-Spray Dried Mixture of Sodium Lactate and Sodium Acetate) on the Growth of Listeria Monocytogenes in Low-sodium Frankfurters Stored at 4, 7, or 10°C

Iksoon Kang1,2, Lei Zhang3, Yanyang Xu2, Elliot Ryser2, Jong Jeong1, and Janice Harte1
1Department of Animal Science and 2Department of Food Science & Human Nutrition
Michigan State University, East Lansing, MI 48824, United States

Introduction

• Listeria monocytogenes is a pathogenic organism that can be easily killed by cooking to 70°C for 2 minutes.
• Listeria has been more problematic than other pathogens in ready-to-eat meats due to re-contamination during handling and post-thermal processing refrigeration.
• Research has shown that lactate and diacete salts contribute to antimicrobial activity against Listeria, but the lactate salts need to be in liquid form as a result of hydroscopic property and the diacetate negatively impacts flavor due to a strong acetic acid taste.
• Kemira ChemSolutions b.v. developed a co-spray dried powder of sodium lactate and sodium acetate (Provian®), and a mixture of Provian® powder with sodium diacetate (Provian®D) for ease in handling, shipping, storing and mixing, compared to liquid forms currently on the market.

Objective

The purpose of this research is to evaluate the effects of Provian® (PP) and Provian®D (PD) powders, and 60% potassium lactate and sodium diacetate (PL-SD) solution on Listeria/mesophilic aerobic bacteria (LAB) growth in low-sodium frankfurters (1% salt).

Materials and Methods

Manufacture of Frankfurters

• Both pork butts and back fat were coarsely ground/mixed using a 0.95 cm plate, and ground-lean-beef (85/15) was prepared separately.
• In three of the replicates, four batches (23.68 lb/batch) of low-sodium frankfurters were generated with pre-blended pork and beef, 1% salt, other frankfurter spices, and one of the following preservatives – 0% Control, 1% PP, 0.65% PD, and 2.5% of 60% PL-SD.
• Bator was cooked in a bowl chopper to 12°C, stuffed/linked into cellulose casings, and cooked in a smokehouse without smoke to the internal temperature of 70°C.
• After cooking, frankfurters were chilled to 4°C, pooled, and vacuum-packaged.

Microbial Analysis

• Six different serotypes of L. monocytogenes were used for inoculation.
• Frankfurters, in a mesh bag, were submerged into the Listeria cocktail for 1 min, while stirring.
• After an inoculation (4 log CFU/G), frankfurters were transferred to vacuum bags and sealed.
• Microbial counts were taken at 4, 7, and 10°C after 0, 15, 30, 45, 60, 75, and 90 days.
• L. monocytogenes and mesophilic aerobic bacteria (MAB) were enumerated from inoculated and non-inoculated samples, respectively.

Sensory Analysis

• Refrigerated frankfurters were heated (72°C) in boiling water and kept in a warmer (63°C) in a sealable bag.
• Samples from 3 different treatments were cut (4 cm) and presented to each panelist.
• Samples of 1% Provian® were not included due to the USDA regulation, not permitting sodium acetate levels higher than 0.25%.
• In each of the replicates, 100 consumer panels were recruited to assess 3 samples for appearance, texture, flavor, and overall acceptability based on a 9-point hedonic scale.

Physicochemical Analysis

• Seven physicochemical parameters were evaluated for frankfurters.
• pH, protein, fat, moisture, and water activity were measured by pH meter, nitrogen analyzer, fat extractor, dry oven, and Aquablab water activity meter, respectively.
• Sodium content was analyzed using a pH/ION analyzer.
• Cooking yield was calculated by comparing the weight difference before and after cooking.

Results and Discussion

• Using 1% PP, 0.65% PD or 2.5% PL-SD, Listeria population increased less than 2 log CFU/G from the initial inoculation (4 log CFU/G) during 60 and 30 days at 4 and 7°C, respectively (Fig 1a).
• In the control, Listeria grew more than 7 log CFU/G after 45 days at 4°C and 30 days at 7°C.
• The three inhibitors suppressed the growth of MAB by 1 to 3 log CFU/G, compared to the control (Fig 1b).
• In sensory, no significant differences were seen in appearance, texture, flavor, or overall acceptability regardless of formulations (Table 1), although both control and 0.65% PD scores were numerically higher for flavor and overall acceptability than the samples of 2.5% PL-SD solution.
• In physicochemical properties, sodium contents in control and 2.5% PL-SD were lower than those of 0.65% PD and 1% PP (Table 2). Sodium levels in low sodium frankfurters (1% salt), however, were lower than those of regular (2% salt) frankfurters (Data not included).
• Frankfurters with 0.65% PD showed pH lower than other three treatments.
• Results of proximate analysis (protein, fat and moisture), cooking yield and water activity were very similar, regardless of treatments.

Conclusions

• Both Provian® and Provian®D (PP and PD) and liquid (PL-SD) inhibitors effectively subdued the growth of Listeria monocytogenes.
• Given these similar results in microbial inhibition, sensory properties, and cooking yield, Provian® powders appear to provide a viable alternative to liquid inhibitor (PL-SD).

References

3. Low JC and Donovan W. 1997. A review of Listeria monocytogenes in commercial ham, formulated with or without antimicrobials under conditions simulating contamination in the processing or retail environment and during home storage. J. Food Prot. 57:139-229.

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