2010

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Recommended Citation
DOI: https://doi.org/10.31274/ans_air-180814-655
Available at: https://lib.dr.iastate.edu/ans_air/vol656/iss1/15

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Improving the Control of *Listeria monocytogenes* on No-Nitrate-or-Nitrite-Added (Natural or Organic) Frankfurters with Clean Label Antimicrobials

A.S. Leaflet R2494

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Summary and Implications

Consumers are critical of the ingredients used in the production of processed meat products. With the increased growth in natural and organic processed meats, suppliers have begun to offer clean label solutions to improve the safety of minimally processed foods. This study investigated the growth of *Listeria monocytogenes* on uncured, no-nitrate-or-nitrite-added frankfurters with or without clean-label antimicrobials, during a 120 day storage period. No-nitrate-or-nitrite-added brands with no antilisterial control measures exhibited a decreased lag time period. In addition, a negative control was also manufactured and contained no nitrite or antimicrobial interventions. All treatments contained the same level of salt, dextrose, spices and added water. Thermal processing procedures were dependent upon the alternative curing system used. After chilling, frankfurters were vacuum packaged and transported to the Food Safety Research Laboratory for further analysis.

Materials and Methods

**Frankfurter Manufacturing Procedures**

Beef and pork frankfurters were manufactured at the Iowa State Meat Laboratory utilizing two alternative curing systems and two clean-label antimicrobial options available to commercial processors. Three batches of frankfurters were manufactured from each curing system, one batch contained no antimicrobial and the second batch contained a blend of cultured corn sugar and vinegar, while the third batch contained a blend of vinegar, lemon powder, and cherry powder. A conventionally cured product that contained sodium nitrite, sodium erythorbate, and a potassium lactate/diacetate blend served as the positive control to demonstrate typical *L. monocytogenes* inhibition. In addition, a negative control was also manufactured and contained no nitrite or antimicrobial interventions. All treatments contained the same level of salt, dextrose, spices and added water. Thermal processing procedures were dependent upon the alternative curing system used. After chilling, frankfurters were vacuum packaged and transported to the Food Safety Research Laboratory for further analysis.

**Evaluation of Clean-Label Antimicrobials**

Whole frankfurters were aseptically removed from the package and surface inoculated with 1 ml of a 5-strain cocktail mixture of *L. monocytogenes*. Samples were hand massaged for 10-15 seconds to distribute microorganisms, vacuum sealed and stored at 4°C for 120 days. Evaluations were performed weekly for the first six weeks and bi-weekly for the remainder of the study. Samples were...
prepared in duplicate by first blending whole frankfurters with sufficient 0.1% peptone water to achieve a 1:5 dilution of each sample. Appropriate dilutions were then plated on modified oxford media (MOX) and incubated at 35°C for 48 hours to allow for enumeration of *L. monocytogenes*.

**Results and Discussion**

Figure 1 shows the growth of all treatments over the 120 day sampling period. The positive control, containing sodium nitrite, sodium erythorbate, and potassium lactate/diacetate blend, resulted no detectable growth throughout the challenge study. Furthermore, it is clear that the no-nitrate-or-nitrite-added treatments that contained no antimicrobial interventions (TRTs 1, 4) were unable to repress the growth of *L. monocytogenes* throughout the 120 day sampling period. These treatments mirrored the growth of the negative control which contained nitrite or antilisterial controls, and both treatments resulted in a final population that was 4-5 log CFU/g greater than that of the conventionally processed control and the alternatively cured products with clean label alternatives. Treatments that contained clean label antimicrobials (TRTs 2, 3, 5, 6) demonstrated superior control in uncured, no-nitrate-or-nitrite-added frankfurters compared to those with no antimicrobial interventions.

These results were similar regardless of the curing system or clean-label alternative that was applied. The results of this study further emphasize the need for additional antimicrobial measures for natural and organic, uncured, no-nitrate-or-nitrite-added RTE processed meats. Clean label antimicrobials offer natural and organic friendly solutions to control *L. monocytogenes* in minimally processed meats through 120 days of storage. In doing so these products allow processors to meet USDA-FSIS regulations for these high risk products and can provide consumers with the level of safety that is expected of conventionally cured meat products.

**Acknowledgments**

This research was supported through a grant funded by the National Integrated Food Safety Initiative (Grant no. 2006-51110-03609) of the United States Department of Agriculture Cooperative State Research, Education, and Extension Service, the National Pork Board (NPB# 06-008) and the Iowa State University Food Safety Consortium.