

Sensory Evaluation and the Reduction of *Listeria monocytogenes* on Conventional and All Natural Beef Frankfurters using 5% Lactic Acid

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Abstract

Contamination of ready-to-eat meat products with *Listeria monocytogenes* during slicing and packaging continues to be a concern and thus, interventions are needed to reduce post-processing contamination. This study was divided into two phases and the objectives were as follows: 1) determine sensory difference between conventional and all natural frankfurters on day 0 and after 21 days; and 2) investigate the efficacy of 5% lactic acid on the reduction of *L. monocytogenes* on conventional and all natural beef frankfurters. During the first phase, two triangle tests were conducted using 60 and 67 panelists from Texas Tech University after storage periods of day 0 and day 21. The results showed that there was a significant difference between Conventional and All Natural beef frankfurters. On the second phase, chilled conventional and all natural beef frankfurters were surface-inoculated with 10^6 cfu/ml of four-strain *L. monocytogenes*; dipped in 5% lactic acid and in sterile water for ten seconds; vacuum packed and stored in a display cooler with the untreated frankfurters used as the control. At sampling time points day 0, 7, 14, 21 and 28, samples were serially diluted, spread plated onto modified oxford agar overlaid with tryptic soy agar, followed by incubation at 35°C for 24 hours. The pH of the samples dipped in 5% LA showed a reduction of 0.14 and 0.31 after treatment on days 0 and 28. When compared to the control, conventional frankfurters dipped in water resulted in a reduction of $0.53 \log^{10}$ cfu/g while a significant reduction of $0.93 \log^{10}$ cfu/g occurred when dipped in 5% lactic acid ($P < 0.05$). However, the reduction by lactic acid was not significantly different in comparison with the water treatment of conventional frankfurters. *L. monocytogenes* on all natural samples was reduced significantly by $1.99 \log^{10}$ cfu/g ($P < 0.05$) when dipped in lactic acid while a slight increase in the pathogen occurred when samples were dipped in water. These two interventions applied on conventional beef franks did not show significant difference in most likely due to physical washing rather than actually killing of the pathogen ($p > 0.05$). These results demonstrate that the commercial usage levels of LA (5.0%) on all natural beef frankfurters are sufficient to control *L. monocytogenes* in case of pathogen contamination.

Introduction

- Frankfurters remain to be very popular, widely consumed meat product in the US where July is recognized as the National Hotdog Month.
- The difference between conventional, natural and organic meat products is basically the way the animal is raised where meat comes from.
- *Listeria monocytogenes* is an enteric pathogen of concern in the meat industry. Refrigeration temperatures do not inhibit the growth of the microorganism during cold storage. Outbreaks of food-borne listeriosis have been caused by ingestion of RTE meat products mainly frankfurters and cold cuts (CDC, 1999). The second phase of this study was designed with one control or not treated sausages used as a comparison in the efficacy of the reduction.

Materials and Methods

Phase I

- Conventional and All Natural beef frankfurters in their original packages were stored in the refrigerated meat case at 2°C for 21 days. Samples were prepared by boiling the frankfurters for 5 minutes and then sliced equally into 1 inch x 1 inch sized portions. To determine the difference between Conventional and All Natural beef frankfurters on storage times day 0 and day 21, two sets of triangle test were conducted using a panel of 60 and 67 students, respectively from the Meat Science class at Texas Tech University.
- Each panelist received a sensory score sheet and a plate with three coded samples, two were identical and one was different. A statistical table (Meilgaard et al., 2007) was used to determine significant difference between the samples.

Phase II

- Samples were inoculated with 10^6 cfu/ml of the four-strain *L. monocytogenes* inoculum. Per inoculation batch, 45 frankfurters and two-liter inoculum were agitated in double rinse bags by shaking for one minute, followed by 20-minute attachment and drying in a biological safety hood.
- Forty-five inoculated samples in sterile, perforated basket were dipped in 5% lactic acid and another set in sterile water for ten seconds. Control and treated samples were vacuum packaged and stored at 2°–4°C.
- Buffered peptone water was added to the sample to make 1:10 dilution and then hand-stomached for three minutes. Samples were serially diluted, spread plated onto modified oxford agar overlaid with tryptic soy agar, followed by incubation at 35°C for 24 hours. The pH was measured and the amount of *L. monocytogenes* on the samples was enumerated on days 0, 7, 14, 21 and 28.



Results

I Phase

In the two triangle tests, 45 out of the 60 panelists on day 0 and 49 out of the 67 panelists on day 21 were able to detect the difference between conventional and all natural beef frankfurters. A minimum number of 27 (n=60) and 29 (n=66) correct responses were required to establish a difference between the conventional and all natural beef frankfurters. Based on the results, Conventional beef frankfurters were significantly different from the All Natural beef frankfurters.

II Phase

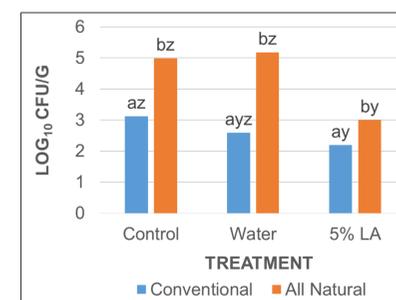


Figure 1. Quantification of *L. monocytogenes* on Conventional and All Natural Frankfurters Treated with Water and 5% LA treatments. Bars with different alphabetic notations differ significantly ($P < 0.0006$) All values are the means of two replications.

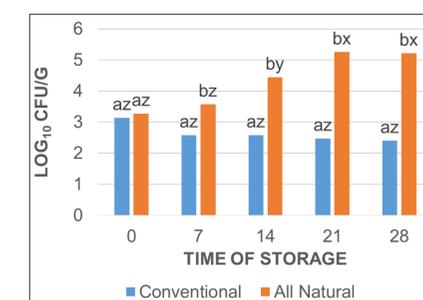


Figure 2. Quantification of *L. monocytogenes* on Conventional and All Natural Frankfurters with Storage Times of Day 0, 7, 14, 21 and 28. Bars with different alphabetic notations differ significantly ($P < 0.0001$) All values are the means of two replications.

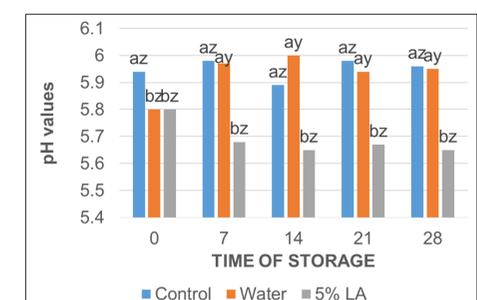


Figure 3. The Effect of Water and 5% LA Treatments on pH values of Beef Frankfurters with Storage Times of Day 0, 7, 14, 21 and 28. Bars with different alphabetic notations differ significantly ($P < 0.0001$) All values are the means of two replications.

Conclusions

- The results of the triangle tests on days 0 and 21 indicate that the students can perceive a difference between the Conventional and All Natural beef frankfurters, therefore the storage time in the meat case did not have an effect on the taste of the samples.
- Regardless of the type of frankfurters, 5% LA treatment had significantly lowered the pH values of the samples over storage time when compared to the control ($P < 0.0001$). These results were statistically significant but they were not biologically different.
- When compared to the control, Conventional frankfurters dipped in water resulted in a reduction of $0.53 \log^{10}$ cfu/g while a significant reduction of $0.93 \log^{10}$ cfu/g occurred when dipped in 5% lactic acid ($P < 0.05$). However, the reduction by lactic acid was not significantly different in comparison with the water treatment of Conventional frankfurters. These two interventions applied on Conventional beef franks did not show significant differences in most likely due to physical washing rather than actually killing of the pathogen ($p > 0.05$).
- *L. monocytogenes* on all natural samples was reduced significantly by $1.99 \log^{10}$ cfu/g ($P < 0.05$) when dipped in lactic acid while a significant increase in the pathogen occurred when samples were dipped in water.
- These results demonstrate that the commercial usage levels of LA (5.0%) on all natural beef frankfurters are sufficient to control *L. monocytogenes* in case of pathogen contamination.

References

- CDC (Centers for Disease Control and Prevention). 1999. Update: multistate outbreak of listeriosis—United States, 1998-1999. Morbid. Mortal. Weekly Rep. 47: 1117-1118.
- Byeslashov, O.A., P. A. Kendall, K. E. Belk, J. A. Scanga, J. N. Sofos. 2008. Control of *Listeria monocytogenes* on vacuum-packaged frankfurters sprayed with lactic acid alone or in combination with sodium lauryl sulfate. J. Food Prot. 71:728-34.
- Meilgaard, M, Civille, GV, Carr, BT. 2007. Sensory Evaluation Techniques. 4th ed. Boca Raton: CRC Press LLC. Pp. 433.

