Hot Water Deluge System for Pre-package Pasteurization of Frankfurters

P.M. Muriana, W. Robertson, and D. Howard

Story in Brief

Numerous outbreaks of foodborne illness and product recalls have been associated with ready-to-eat (RTE) meat products due to post-process contamination with *Listeria monocytogenes*. This has become a major concern for the meat processing industries and an important food safety concern. Our objectives were to examine a hot water deluge system (pre-package pasteurization) as a means of reducing incidental surface contamination of *L. monocytogenes* on hotdogs. A hot water deluge system and temperature-controlled water bath reservoir were used for surface pasteurization of hotdogs. The hotdogs did not contain lactate/diacetate. Hotdogs were inoculated by dipping into a cocktail of four strains of *L. monocytogenes* (5 sec), allowed to dry (5 min), and then pasteurized by hot water deluge for 5- or 10 seconds with water set at 70°F, 195°F, and 200°F. Using the hot water deluge system, we were able to achieve a 1.4- to 2.2-$\log_{10}$ reduction of *L. monocytogenes* on hotdogs with a 5- or 10- second residence time at 195°F or 200°F. These findings provide microbial validation of pre-package pasteurization of hotdogs via deluge rinse can be an effective tool in controlling *L. monocytogenes* surface contamination that may be acquired by inhouse handling.

Keywords: *L. monocytogenes*, Hotdogs, Frankfurters, Ready-to-Eat Meats, Pasteurization

Introduction

L. monocytogenes is potentially pathogenic to immunosusceptible individuals and neonates and serious infection can result in death. There are an estimated 2,500 cases and 495 deaths per year due to *L. monocytogenes*, which has been problematic for ready-to-eat (RTE) meat and poultry products for which there is a zero-tolerance for this microorganism. One of the major food safety concerns is the re-contamination of fully cooked products after thermal processing. An outbreak in 1998 caused the deaths of 21 individuals and more than 100 illnesses in 14 states due to the consumption of post-process contaminated hot dogs and luncheon meats. After a decline in the number of cases of listeriosis in 1996, *L. monocytogenes* has reemerged as a significant foodborne pathogen (Chikthimmah et al., 2001). In 1999, 92.2% of the 2,518 illnesses attributed to *L. monocytogenes* resulted in hospitalization (Novak et al., 2001). The USDA-FSIS RTE sampling program (1998-2001) showed the incidence rate of *L. monocytogenes* as 5.7% in ham and 3.1% on roast beef, emphasizing the need for controlling contamination in manufacturing environments and on products. *L. monocytogenes* is heat-tolerant, wide spread in the environment, can form biofilms on food processing equipment, is salt tolerant and can grow at refrigeration temperatures. Sanitation strategies and hygienic practices applied in processing plants are often insufficient to completely eradicate this organism from food processing establishments. Fully-cooked products may become contaminated when exposed to the processing environment during final packaging. The bacteria may be present on conveyors, heat transfer surfaces, air, standing water, and other places. Increased emphasis on pathogen reduction has led to the use of new hurdles to improve safety and reduce risk from RTE meat and poultry products.

Materials & Methods

Bacterial Strains. A four strain mixture of *L. monocytogenes* (Scott A, V7-2, 39-2, 383-2) was used for inoculation trials. These strains are resistant to Streptomycin (100µg/ml) and Rifamycin (10µg/ml) and are plated on general purpose agar (Tryptic Soy Agar, TSA) when selectively plating for the inoculum cultures in lieu of potential indigenous bacteria without the need for harsh selective media. The bacterial strains were cultured overnight by transferring a loopful of frozen culture into 10ml of Brain Heart Infusion (BHI) broth and incubated at 30^{o}C for use with the 'dip' inoculation treatment the next day.

Product Inoculation. Hotdogs that did not contain lactate/diacetae were obtained from a local retail supermarket, boiled for 5 min in boiling water, cooled, and used for dip inoculation. The boiling was to reduce any incidental indigenous contamination and remove any water soluble ingredients. For dip inoculation, products were removed from their bags and placed in a sterile steel bowl containing a cocktail of *L. monocytogenes* strains and then placed on a sterile tray for 5 min, to drain the excess and dry. The *Listeria* strains were streptomycin- (100 ug/ml) and rifamycin (10 ug/ml) resistant and could be plated on media containing these antibiotics to recover them in lieu of any other contaminating microorganisms.

Pre-Package Pasteurization. Inoculated product was passed through a hotdog pasteurizer (Unitherm Food Systems, Bristow, OK) for various times (5 sec, 10 sec) and temperatures (70^{o}F, 195^{o}F, 200^{o}F). As hotdogs were retrieved from the pasteurizer, they were placed in sterile bags to which was added 10 mls of chilled buffered peptone water.

Microbiological Analysis. To determine inoculation level or post-process survivors, inoculated products were placed into sterile bags and rinsed with approximately 10 mls of chilled sterile buffered peptone water (BPW). The bags were shaken and massaged for 5 min followed by appropriate serial dilutions and pour plated using Tryptic Soy agar (TSA) containing streptomycin and rifamycin. The plates were then incubated for 48 hr at 30^{o}C. Analysis of variance (ANOVA) was performed using the Holm-Sidak test for pairwise multiple comparisons to determine significant differences (P<0.05) using the software program SigmaStat 3.0 (SPSS Inc., Chicago, IL).

Results and Discussion

In this study we examined surface pasteurization by hot water rinse (hotdog pasteurizer) on *Listeria*-inoculated hotdogs using both room temperature and hot water rinses (Figs. 1 & 2). Using room-temperature water (70^{o}F), we observed only a 0.30-0.35 $\log_{10}$ reduction of *Listeria* by simple rinse removal from the surface of the hotdogs (Fig. 3). This reflects the reduction of *Listeria* that would be obtained by wash removal of inoculated cells from the product surface during deluge rinse and processing via non-lethal water.

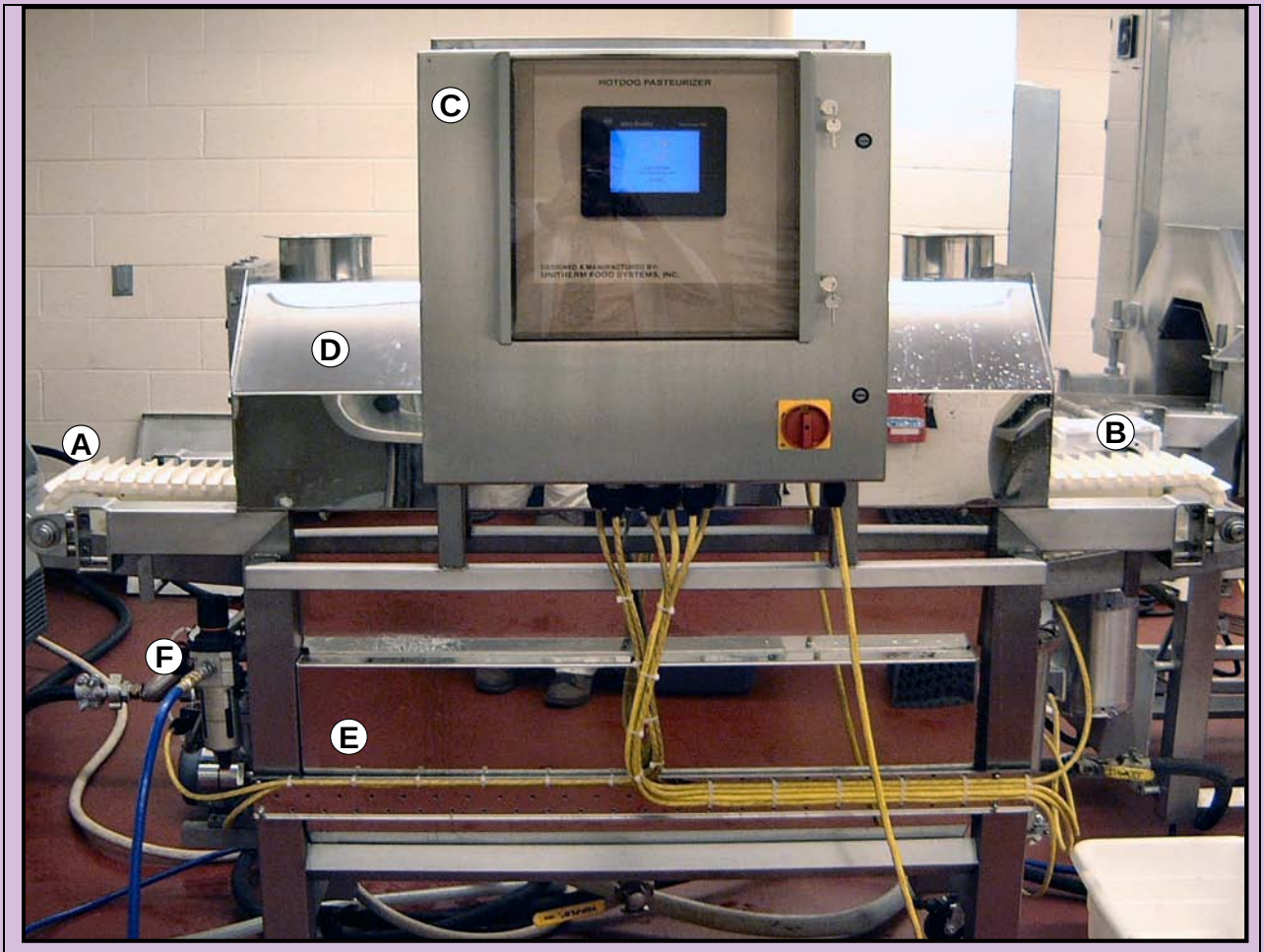

Figure 1. Hotdog pasteurizer used in this study. Product entrance/conveyor belt (A), product exit (B), control panel to regulate water temperature and residence time (C), water deluge chamber (D), water tank reservoir (E), and pneumatic air pump (F).

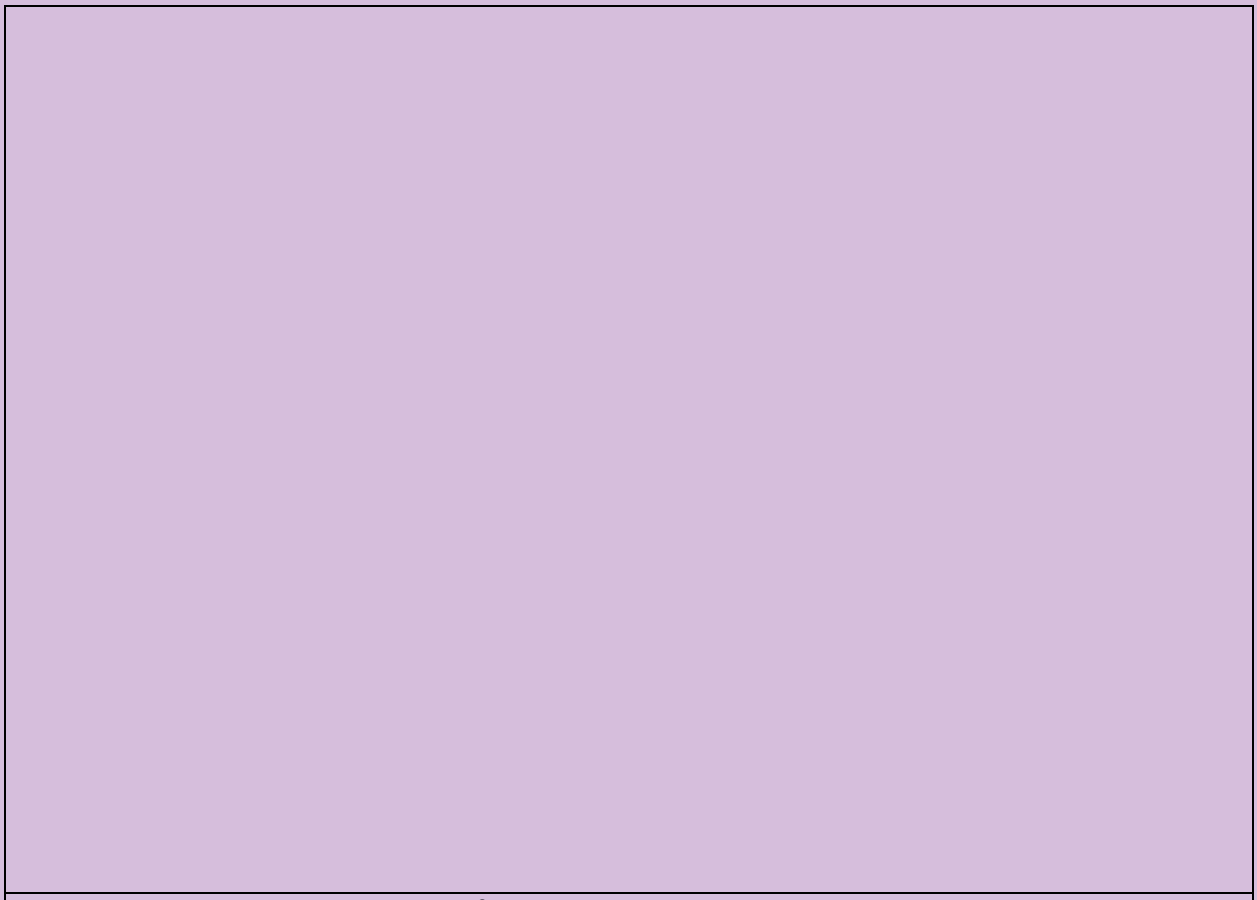

Figure 2. Inoculated hotdog exiting from the pasteurizer. In actual commercial operation, the hotdogs would be already collated and ready to be received by packaging equipment.

Using water heated at 195^{o}F, we obtained approximately 1.3-1.5 $\log_{10}$ reduction of *L. monocytogenes*, significantly greater than was obtained by cold water rinse alone ($P<0.05$). Also, using 200^{o}F water for 5 sec, we obtained approximately the same level of reduction with either 5- or 10- sec at 195^{o}F. However, using a 10-sec deluge rinse at 200^{o}F, we obtained approximately a 2.2-$\log_{10}$ reduction of *L. monocytogenes*, which was significantly greater ($P<0.05$) than was obtained for the other treatments. Although the data presented herein are with limited trials performed with the hotdog pasteurizer, the data suggests that the process may have application towards reducing potential surface pathogen contamination that may be acquired by inhouse contact with environmental or food contact contamination. We plan to employ a variety of tests with hotdogs to determine an appropriate process lethality using this process and/or in combination with biocidal rinses (i.e., liquid smoke extracts or others) that could augment the reduction either directly at point of application or during storage. The use of antimicrobials in conjunction with the pasteurization may allow for reduced temperatures or length of residence time resulting in less heat uptake by the product. Successful application of the hotdog pasteurizer would be an efficacious and facile process given the small size of the equipment necessary to perform such an important task that goes a long way towards contributing to product safety and risk reduction. Considerations must also be made to chill product back below 40^{o}F either before or after packaging.

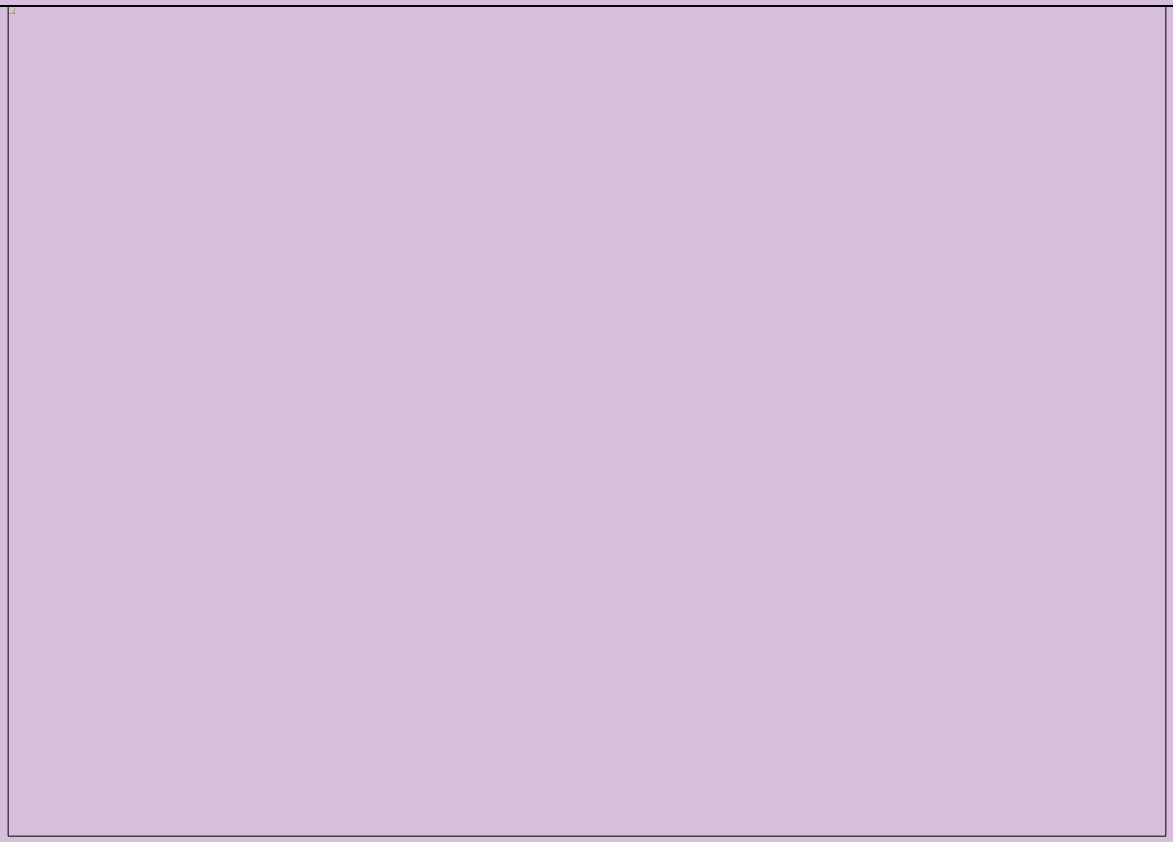

Figure 3. Thermal inactivation of *Listeria monocytogenes* on inoculated hotdogs processed through the hotdog pasteurizer. Cold water rinse to determine reduction levels attributed to 'washing'. Pasteurization was performed at 195^{o} and 200^{o}F for 5- and 10 seconds. Bars with the same uppercase letters are not significantly different (P>0.05).

Literature Cited

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