Influence of Blanching Treatments on Salmonella during Home-Type Dehydration and Storage of Potato Slices

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ABSTRACT

Recommended drying treatments may not enhance destruction of pathogens that could be present on home-dried foods. In this study, the effects of traditional and modified treatments on Salmonella were evaluated during preparation, home-type dehydration (60°C for 6 h), and storage of potato slices. Potato slices inoculated with five strains of Salmonella (8.4 log CFU/g) were left untreated or were treated by steam blanching (88°C for 10 min), water blanching (88°C for 4 min), 0.105% citric acid blanching (88°C for 4 min), or 0.210% citric acid blanching (88°C for 4 min). Slices were then dried (6 h for 60°C) and aerobically stored for up to 30 days at 25 ± 3°C. Cells were enumerated on tryptic soy agar with 0.1% pyruvate (TSAP) and on xylose lysine deoxycholate agar. Salmonella populations were reduced by 4.5 to 4.8 CFU/g and by >5.4 log CFU/g immediately following steam and water blanching, respectively. Populations were below the detection limit (0.80 log CFU/g) immediately following acid blanching, except for samples blanched in 0.105% citric acid and recovered on TSAP. After dehydration (6 h for 60°C), Salmonella reductions on blanched potato slices (5.3 to 5.6 log CFU/g) were significantly greater (P < 0.05) than those on untreated samples (1.9 to 2.7 log CFU/g). Populations on all samples continued to decrease throughout 30 days of storage but still were 3.1 to 3.9 log CFU/g on untreated samples. In comparison, bacterial populations on blanched samples were undetectable by direct plating following 30 days of storage (regardless of blanching method). Blanching treatments used in this study improved the effectiveness of drying for inactivating Salmonella inoculated onto potato slices and, therefore, may enhance the safety of the product.

An increasing association between minimally processed produce and foodborne infection has lead to concerns about the microbial contamination of these products (2, 40, 51). Salmonella is the most prevalent pathogen associated with produce and has been isolated from fresh cauliflower, cilantro, eggplant, endive, mangoes, melons, peppers, spinach, sprouts, and tomatoes (2, 19, 46, 52). Minimally processed fruits and vegetables seem to be associated more frequently with foodborne illness than is fresh whole produce (3, 12, 19) possibly because the peel or rind provides a physical and chemical barrier that prevents the establishment of microbes on edible surfaces (6, 12). This barrier is removed during processing and may result in the establishment of pathogen cells, leading to increased risk of foodborne illness (12, 19, 30). Salmonellosis has been associated with consumption of improperly processed and/or mishandled apple cider, cantaloupe, cilantro, lettuce, mangoes, orange juice, potatoes, tomatoes, and watermelon (5, 19, 34, 42, 45–48). One of the largest outbreaks of foodborne salmonellosis ever reported to the Centers for Disease Control and Prevention, affecting an estimated 3,400 people, occurred because of the improper handling of potato salad (23).

Dried foods traditionally have been considered unlikely sources of foodborne illness; however, dehydrated vegetables such as mushrooms and asparagus have long been known to be contaminated occasionally with salmonellae (33). Salmonellosis outbreaks also have been associated with consumption of low-moisture foods such as meat jerky, potato chips, savory corn snacks, and chocolate (7, 18, 21, 26, 27, 31). In New Mexico between 1966 and 1995, eight gastroenteritis outbreaks due to ingestion of meat jerky contaminated with Salmonella and Staphylococcus aureus resulted in 250 cases of illness (18). In Germany, an international outbreak of salmonellosis, resulting in an estimated 1,000 cases, was traced to contaminated paprika and paprika-powdered potato chips (33). Concentrations of 0.04 to 0.45 organisms per gram were found in the chips, leading investigators to conclude that even extremely low numbers of salmonellae adapted to the dry state are able to cause illness (33, 35).

Unlike most dehydrated vegetables, which are added to soups or stews or are otherwise cooked before consumption, dehydrated potato slices are often consumed as potato chips without further processing. The U.S. Cooperative Extension Services recommend steam blanching, water blanching, or immersion in a salt solution before drying or oven heating after drying to inhibit browning and/or extend the shelf life of home-dried potato slices (4, 13, 24, 29, 43, 44, 49). Although these treatments improve color and quality, DiPersio et al. (17) found that some commonly recommended treatments may not improve the safety of home-dried vegetables. DiPersio et al. (17) evaluated the influence of steam blanching (3 min), water blanching (3
min), or immersion in a 3.23% salt solution (5 min) before drying or oven heating (80°C for 15 min) after drying on inactivation of *Salmonella* (7.8 log CFU/g) during dehydration and storage of carrot slices. After 6 h of dehydration (60°C), bacterial reductions were 1.3 to 2.0 (control), 4.0 to 4.7 (steam blanched), 3.5 to 4.3 (water blanched), and 1.9 to 2.6 (3.23% NaCl) log CFU/g. Reductions for samples heated after drying were 1.7 to 2.4 log CFU/g. All samples had populations >1.7 log CFU/g after 6 h of drying and 30 days of storage and, therefore, may present a food safety risk. Results suggested that modified treatments, including extended blanching times, were needed to enhance inactivation of *Salmonella* in dehydrated vegetable slices.

In contrast to vegetables, fruits are traditionally immersed in organic acid solutions before home-type dehydration to preserve the inherent characteristics (appearance and texture) of the final product (1, 4, 22, 28, 38, 50, 55). DiPersio et al. (14) reported that treating inoculated Gala apple slices with acidic solutions enhanced inactivation of *Salmonella* during dehydration and storage. Populations on untreated or water-treated samples were reduced by 2.7 to 4.2 log CFU/g following 6 h of dehydration (60°C). In comparison, reductions were 3.8 to 5.7 log CFU/g on slices immersed in ascorbic acid (3.40%, 25 ± 3°C) or citric acid (0.210%, 25 ± 3°C) and then dried (60°C for 6 h). *Salmonella* populations were detectable by direct plating after 28 days of storage except on slices treated with ascorbic acid.

Outbreak investigations emphasize the risk for foodborne illness associated with consumption of home-dried foods (7–9, 37). The Cooperative Extension Services have long provided guidelines to consumers on how to dry foods at home, yet these guidelines have been imprecise and based on anecdotal experience rather than scientific documentation. Among recommended methods for home-drying produce evaluated by DiPersio et al. (14, 15, 17), blanching and immersion in acidic solutions prior to dehydration produced the best results. The objective of the present study was to evaluate the effect of extended steam blanching, water blanching, and blanching in acidic solutions on inactivation of *Salmonella* during preparation, home-type dehydration (60°C for 6 h), and storage of Russet potato slices.

**MATERIALS AND METHODS**

**Bacterial strains.** Microorganisms used in this study included *Salmonella* Typhimurium strains ATCC 14028, ATCC 700408, and F530 (UK1 isolated from an equine salmonellosis outbreak), *Salmonella* Agona (isolated from alfalfa sprouts), and *Salmonella* Copenhagen (isolated from cattle hides). All strains were available overnight. The five strains were subcultured twice (35°C for 24 h) and then combined to form a composite. Composite cell populations (8.4 log CFU/ml) were determined by plating on tryptic soy agar with 0.1% pyruvate (TSAP; Difco, Becton Dickinson) and incubating for 24 h at 35°C.

**Preparation and inoculation of samples.** White Russet potatoes were obtained from a local supermarket in the late spring and summer of 2004, washed, peeled, and sliced crosswise into 0.5-cm-thick slices. Each sample consisted of two potato slices that together weighed approximately 11 ± 3 g. Slices were placed on plastic trays and inoculated under a laminar-flow hood. Portions (0.25 ml) of the *Salmonella* inoculum were pipetted onto the upper surface of each slice and allowed to attach for 15 min at ambient temperature (25 ± 3°C). The slices were then flipped over and the other side was inoculated following the same procedure. The resulting concentration of inoculum was approximately 8.4 log CFU/g.

**Treatments.** Treatments were chosen for their possible antimicrobial effects (14, 15, 56) and their ability to maintain the color and quality of dehydrated vegetable slices (4, 13, 16, 22, 24, 29, 39, 41, 43, 44, 49, 50). The steam blanching treatment (88°C for 10 min) was extended from the longest time (9 min) recommended for steam blanching potato slices ½ to ¾ in. (0.32 to 0.64 cm) thick (1). The water blanching method (88°C for 4 min) was derived from the time most often listed for drying ½- to ¾-in.-thick vegetable slices (1, 4, 29, 49). The concentrations of the citric acid solutions (Fisher Scientific, Fair Lawn, N.J.) were derived from previous studies and U.S. Cooperative Extension Service fruit-drying recommendations (14–16, 28, 43). Citric acid was chosen because it acts as an antibrowning and antimicrobial agent (20) and is generally regarded as safe by the U.S. Food and Drug Administration (FDA) (11).

Inoculated potato slices (40 slices per treatment; approximately 2.4 kg) were left untreated (control), steam blanched (88°C for 10 min), water blanched (88°C for 4 min), blanched in 0.105% citric acid (88°C for 4 min), or blanched in 0.210% citric acid (88°C for 4 min), dried (60°C for 6 h), and aerobically stored for up to 30 days at 25 ± 3°C. Sterilized distilled water was used to prepare all solutions to avoid contamination, pH differences, and other confounding factors. For blanching, potato slices (15 at a time) were arranged in a 1-liter metal strainer and held for 10 min over a 4-litter kettle of boiling water (steam blanched) or immersed for 4 min in a 4-litter kettle of boiling water or citric acid solution (88°C). The strainer was then removed from the solution, and slices were allowed to drain for 2 min (not rinsed). The drained slices were allowed to cool for 10 min (to permit handling) and then were arranged in single layers on dehydrator trays, dried for 6 h at 60°C (140°F), and stored in sterile plastic bags for up to 30 days at 25 ± 3°C and 30 ± 6% relative humidity (Digital Relative Humidity Meter, Control Company, Friendswood, Tex.).

**Dehydration.** All samples were dehydrated for 6 h at 60°C in four home-type dehydrators (model FD-1000, American Harvest Gardenmaster, Nesco, Chaska, Minn.) simultaneously such that all three trays of each dehydrator contained samples from each treatment (including controls). The dehydrators were preheated to 60°C for approximately 30 min and then loaded with trays containing the inoculated and treated potato slices. Circulating air and potato slice temperatures were monitored during drying using thermocouple probes and real-time data recording software (Pico Technology, Cambridge, UK) as described by DiPersio et al. (14).

**Sampling for analysis.** For each treatment, one sample consisted of two potato slices. One slice was randomly selected from the treated slices in each of the four dehydrators, i.e., two samples (four slices) were taken for each treatment. Each two-slice sample was aseptically transferred into sterile plastic bags at each sampling interval: immediately after inoculation, after blanching (con-
control samples were not blanched; 0 h), at 1.5, 3, 4.5, and 6 h of drying, and on days 5, 15, and 30 of storage. The weight of each sample was recorded, maximum recovery diluent (MRD; 1.0 g of Bacto Peptone and 8.5 g of sodium chloride in 1 distilled water; Difco, Becton Dickinson) (36) was added to the sample bag to total 21.5 g, and the samples were pummelled (IUL Instruments, Barcelona, Spain) for 120 s at ambient temperature (25 ± 3°C). The pH was measured from samples used for microbial analysis with a digital pH meter and a glass pH electrode (Denver Instruments, Arvada, Colo.). At each sampling interval, an extra slice was taken from each treatment and immediately analyzed for water activity with a water activity meter (model AwQUICK, Rotronic Instrument Corp., Huntington, N.Y.).

Microbial analysis. Serial decimal dilutions were made with 9 ml of 0.1% sterile buffered peptone water, and 0.1-ml portions were surface plated onto each of duplicate plates of TSAP and xylose lysine deoxycholate agar (XLD; Difco, Becton Dickinson), which were incubated at 35°C for 24 h. Mean number of colonies was used to determine the CFU per gram of potato, which was then converted into log values using the formula $W = X \times (Y + Z)/Z$, where $W$ is the average colony count from duplicate plates, $X$ is the dilution factor, $Y$ is the amount of MRD, and $Z$ is the weight of potato slices at each sampling time. When numbers of bacteria dropped below the detection limit for direct plating, the Salmonella enrichment, isolation, and identification methods outlined in the FDA Bacteriological Analytical Manual (53) were followed.

Statistical analysis. Three independent replicates of the study were conducted. The microbiological data were analyzed with a factorial design of 5 (number of treatments, including controls) × 5 (number of time intervals when samples were analyzed: 0, 1.5, 3, 4.5, and 6 h) × 2 (number of growth media) × 3 (number of replicates) factors. Storage data were analyzed with a factorial design of 5 (number of treatments, including controls) × 4 (number of time intervals when samples were analyzed, i.e., after 6 h of drying = 0 days and at 5, 15, and 30 days of storage) × 2 (number of growth media) × 3 (number of replicates) factors. For each replicate, the mean represented the average of two samples converted into log CFU per gram. All data analyses were conducted with the Statistical Analysis System (version 6.1, SAS Institute, Cary, N.C.) for analysis of variance (ANOVA) of main (fixed) effects and all interactions between fixed effects. When $F$ values were significant ($P < 0.05$), least significant differences (LSD) in surviving bacterial population counts between treatments were determined using the ANOVA mixed model procedure of SAS. Means and standard deviations for pH and water activity data were calculated.

RESULTS AND DISCUSSION

Dehydrator and sample temperature. Changes in dehydrator air temperature and potato slice temperatures were recorded throughout dehydration (Fig. 1). Placement of loaded trays into the preheated dehydrators reduced the mean circulating air temperature from 60 to 45°C at 0 h of dehydration. Potato slices were cooled (10 min) to permit handling; therefore, the average temperature of slices was 31°C at 0 h of dehydration (Fig. 1). The average circulating air temperature and internal potato slice temperature reached the target of 60°C by 1.5 and 2 h of dehydration, respectively. From 2 to 6 h of drying, the average temperature of the circulating air and potato slices ranged from 60 to 62°C (Fig. 1).

$pH$ and water activity during dehydration and storage. Untreated (control) samples had pH values (5.66 ± 0.23) within the normal range for potatoes (5.40 to 5.90) (54) throughout 6 h of dehydration and 30 days of storage (Fig. 2). Steam- and water-blanched potato slices had pH values (5.42 ± 0.29) similar to those of controls throughout dehydration and storage. Samples blanched in 0.105% (pH 3.08 ± 0.07) or 0.210% (pH 2.48 ± 0.21) citric acid had pH values (4.95 ± 0.55 and 4.90 ± 0.63, respectively) that were generally lower than those for all other treatments throughout dehydration and that were significantly lower ($P < 0.05$) than those for all other treatments throughout dehydration and storage.

Regardless of treatment, all samples had an initial water activity of 0.98 ± 0.01 at 0 h of dehydration. Water activity values ranged from 0.16 to 0.44 at 3 h of dehydration and from 0.12 to 0.17 at 6 h of dehydration and fluctuated from 0.12 to 0.47 throughout the 30 days of storage (data not shown). Potato slices were stored in plastic bags (aerobically) at ambient temperature (25 ± 3°C and 30 ± 6% relative humidity), which may have allowed some samples to gain moisture during storage. Nevertheless, all samples had a water activity below 0.65 throughout storage and, therefore, would be unlikely to sustain microbial growth (10, 25).

Bacterial populations immediately after blanching. Bacterial populations (1.3 to 2.1 log CFU/g) recovered from uninoculated potato slices were determined not to be Salmonella. Salmonella populations inoculated onto potato slices were significantly ($P < 0.05$) reduced immediately following Blanching compared with the control (Table 1). Specifically, initial populations (6.34 to 6.58 log CFU/g) were reduced by 4.57 to 4.78 log CFU/g and >5.35 log
TABLE 1. Mean bacterial populations on Russet potato slices inoculated with Salmonella, exposed to five predrying treatments, dried for 6 h at 60°C (140°F)*

<table>
<thead>
<tr>
<th>Processing step, time</th>
<th>Control</th>
<th>Steam blanch</th>
<th>Water blanch</th>
<th>0.105% citric acid</th>
<th>0.210% citric acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSAP</td>
<td>XLD</td>
<td>TSAP</td>
<td>XLD</td>
<td>TSAP</td>
<td>XLD</td>
</tr>
<tr>
<td>Following inoculation, 0.5 h</td>
<td>6.58 A ax (0.22)</td>
<td>6.34 A ax (0.29)</td>
<td>6.58 A ax (0.22)</td>
<td>6.34 A ax (0.29)</td>
<td>6.58 A ax (0.22)</td>
</tr>
<tr>
<td>Following pretreatment 0 h</td>
<td>6.58 A ax (0.22)</td>
<td>6.34 A ax (0.29)</td>
<td>2.01 b bx (0.30)</td>
<td>1.56 b bx (0.37)</td>
<td>1.23 B cx &lt;0.80 (0.62)</td>
</tr>
</tbody>
</table>

Dehydration

- 1.5 h: 5.05 AB ax (0.49), 4.58 B ax (0.35), 1.67 b bx (0.74), 0.84 b by (0.01), 1.24 b bx (0.57), 0.82 b bx (0.10), 1.52 b bx (0.71), 0.91 b bx (0.20), 1.36 b bx (0.49), 0.80 b bx (0.13)
- 3 h: 4.93 B ax (0.23), 4.16 BC ay (0.21), 1.60 b bx (0.94), 0.98 b bx (0.13), 1.33 b bx (0.16), 0.93 b bx (0.02), 1.46 b bx (0.27), 1.02 b bx (0.13), 1.44 b bx (0.69), 0.90 b bx (0.04)
- 4.5 h: 4.59 B ax (0.27), 3.41 D ay (0.27), 1.22 b bx (0.22), 0.91 b bx (0.02), 1.24 b bx (0.29), 0.94 b bx (0.02), 1.23 b bx (0.24), 0.91 b bx (0.06), 1.57 b bx (0.68), 0.91 b bx (0.01)
- 6 h: 4.73 B ax (0.17), 3.67 CD ay (0.18), 1.22 b bx (0.21), 0.90 b bx (0.06), 1.19 b bx (0.22), 1.09 b bx (0.26), 1.19 b bx (0.15), 1.05 b bx (0.27), 1.03 b bx (0.11), 0.93 b bx (0.04)

* Control, inoculated with bacteria and kept at 25°C for 30 min; steam blanch, 88°C for 10 min; water blanch, 88°C for 4 min; 0.105% citric acid blanch, 88°C for 4 min; 0.210% citric acid blanch, 88°C for 4 min. Cultures were grown on tryptic soy agar with 0.1% pyruvate (TSAP) and XLD agar. Values for bacterial populations (log CFU/g) are means of two samples in each of three replicates (standard deviation of the replicates in parentheses). The lowest detection limit for plating was 0.80 log CFU/g (LSD = 0.74 log CFU/g). Within a row, means with different small capital letters are significantly different (P < 0.05). For the same medium within a row, means with different lowercase letters (a through d) are significantly different (P < 0.05). For different media within a treatment row, means with different lowercase letters (x and y) are significantly different (P < 0.05).

CFU/g immediately following steam and water blanching, respectively. Salmonella populations were below the detection limit (0.80 log CFU/g) immediately following acid blanching except for samples blanched in 0.105% citric acid and recovered on TSAP (Table 1). Nevertheless, the addition of citric acid to the blanching water did not (P > 0.05) improve the effectiveness of blanching for inactivation of Salmonella. The heat of blanching most likely induced cell membrane damage, protein denaturation, and/or DNA damage and inhibited, destroyed, and/or removed cells from the potato slices (32).

**Bacterial populations during dehydration.** Dehydration of inoculated untreated (control) potato slices at 60°C for 6 h resulted in Salmonella reductions of 1.9 to 2.7 log CFU/g (Table 1). Bacterial population reductions on samples treated with steam blanching, water blanching, or blanching in 0.105% or 0.210% citric acid (5.3 to 5.6 log CFU/g) were significantly greater (P < 0.05) than those for controls after 6 h dehydration (Table 1).

DiPersio et al. (17) assessed the effectiveness of recommended methods for home-drying carrot slices, including steam blanching (3 min), water blanching (3 min), or immersion in a 3.23% salt solution (5 min) before drying or oven heating (80°C for 15 min) after drying, for inactivation of Salmonella (7.8 log CFU/g). After 6 h of dehydration (60°C), all samples had populations ≥2.3 log CFU/g and, therefore, may present a food safety risk.

In the current study, inoculated potato slices treated with extended steam blanching (10 min), water blanching (4 min), or acid blanching (4 min) had Salmonella populations of ≤1.22 log CFU/g after 6 h of dehydration. Results suggest that extended steam blanching and water blanching with or without the addition of citric acid to the blanching water may have enhanced destruction of Salmonella on vegetable slices compared with other vegetable drying methods evaluated by DiPersio et al. (17) and Yoon et al. (56).

Yoon et al. (56) assessed the influence of steam blanching (88°C for 3 min), immersion in 0.210% citric acid (25
TABLE 2. Mean bacterial populations on Russet potato slices inoculated with Salmonella, exposed to five pre-drying treatments, dried for 6 h at 60°C (140°F), and stored for up to 30 days at 25 ± 3°Ca

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>Control</th>
<th>Steam blanch</th>
<th>Water blanch</th>
<th>0.105% citric acid</th>
<th>0.210% citric acid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSAP</td>
<td>XLD</td>
<td>TSAP</td>
<td>XLD</td>
<td>TSAP</td>
</tr>
<tr>
<td>0</td>
<td>4.73 A ax (0.17)</td>
<td>3.67 A ay (0.18)</td>
<td>1.22 A bx (0.21)</td>
<td>0.90 A bx (0.06)</td>
<td>1.19 A bx (0.22)</td>
</tr>
<tr>
<td>5</td>
<td>4.19 A ax (0.05)</td>
<td>3.45 A by (0.05)</td>
<td>1.29 A bx (0.49)</td>
<td>1.09 A bx (0.27)</td>
<td>1.24 A bx (0.16)</td>
</tr>
<tr>
<td>15</td>
<td>3.62 n ax (0.83)</td>
<td>3.07 n ay (0.84)</td>
<td>1.30 A bx (0.13)</td>
<td>&lt;1.10b</td>
<td>&lt;1.10b</td>
</tr>
<tr>
<td>30</td>
<td>3.92 n ax (0.17)</td>
<td>3.14 n ay (0.06)</td>
<td>&lt;1.10b</td>
<td>&lt;1.10b</td>
<td>&lt;1.10b</td>
</tr>
</tbody>
</table>

a Control, inoculated with bacteria and kept at 25°C for 30 min; steam blanch, 88°C for 10 min; water blanch, 88°C for 4 min; 0.105% citric acid blanch, 88°C for 4 min; 0.210% citric acid blanch, 88°C for 4 min. Cultures were grown on tryptic soy agar with 0.1% pyruvate (TSAP) and XLD agar. Values for bacterial populations (log CFU/g) are means of two samples in each of three replicates (standard deviation of the replicates in parentheses). The lowest detection limit for plating was 1.1 log CFU/g (LSD = 0.47 log CFU/g). Within a row, means with different small capital letters are significantly different (P < 0.05). For the same medium within a row, means with different lowercase letters (a through d) are significantly different (P < 0.05). For different media within a treatment row, means with different lowercase letters (x and y) are significantly different (P < 0.05).

b Detectable only after enrichment.

± 3°C for 10 min), and drying (60°C for 14 h) on inactivation of Salmonella inoculated (7.1 to 7.4 log CFU/g) onto Roma tomato halves. Results indicated that steam blanching (3 min) had little effect on bacterial populations, but the combination of steam blanching and immersion in 0.210% citric acid enhanced inactivation of Salmonella during dehydration. In contrast, treatments used in the current study induced similar bacterial reductions throughout drying, regardless of whether samples were steam blanched, water blanched, or blanched in a citric acid solution. The use of an extended period of steam blanching (10 min) and water or acid blanching (4 min) induced significant bacterial reductions (P < 0.05) even before dehydration.

Bacterial populations during storage. Bacterial populations on all samples continued to decrease throughout aerobic storage at ambient temperature (25 ± 3°C) (Table 2). After 30 days of storage, Salmonella populations ranged from 3.14 to 3.92 log CFU/g on untreated potato slices dehydrated for 6 h at 60°C. Even extremely low numbers of salmonellae adapted to the dry state can cause illness (33). Therefore, potato slices left untreated and then dried may present a food safety risk. Salmonella populations on all blanched samples (regardless of blanching method) were undetectable by direct plating at 30 days of storage. Steam blanching (10 min), water blanching (4 min), or blanching in 0.105% or 0.210% citric acid (4 min) enhanced inactivation of Salmonella during home-type dehydration of potato slices and, therefore, may enhance the safety of the final product.

An increasing association between minimally processed produce and foodborne infections has led to concerns about microbial contamination of these products (2, 40, 51). Outbreak investigations indicate that only a very few Salmonella cells may be required to cause disease when consumed in low-water-activity foods (7–9, 21, 35, 37). The U.S. Cooperative Extension Services recommend blanching or immersion in a sodium chloride solution before drying or oven heating after drying to enhance the quality of home-dried vegetables. However, some commonly recommended treatments may not be effective in keeping Salmonella numbers low enough during home-type dehydration and storage of vegetable slices. The blanching treatments used in the present study significantly reduced Salmonella populations (P < 0.05) immediately following treatment, and numbers remained low throughout dehydration and storage of inoculated potato slices. Results suggest steam blanching (10 min), water blanching (4 min), or blanching in a citric acid solution (4 min) may be an important first step in enhancing the safety of home-dried potato slices. Further research is needed to evaluate the sensory characteristics (color and flavor) of potato slices blanched in organic acid solutions before dehydration. Studies are also needed to understand Salmonella survival in dried vegetables and to develop recommendations for the home-type dehydration of vegetables.

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REFERENCES


