

# Comparison of Rinsing and Sanitizing Procedures for Reducing Bacterial Pathogens on Fresh Cantaloupes and Bell Peppers

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## ABSTRACT

Increased consumption of fruits and vegetables is linked to health benefits but also to an increase in the number of outbreaks of foodborne illness. To determine the effectiveness of different sanitizing treatments for reducing bacterial pathogens on fresh produce, fresh cantaloupes and bell peppers were harvested and inoculated with suspensions of *Salmonella* Typhimurium and *Escherichia coli* O157:H7. The inoculated fruits were treated with water wash alone or were washed and then waxed or rinsed with 200 mg/liter hypochlorite, 10% Ca(OH)<sub>2</sub>, or 2% lactic acid solutions applied by dipping for 15 s or spraying for 15 s. Preliminary experiments with chlorine treatments indicated that spraying with a 200, 600, or 1,000 mg/liter hypochlorite solution reduced populations of both pathogens by 2.1 to 2.6 and 1.5 to 2.1 log CFU for *Salmonella* Typhimurium and *E. coli* O157:H7, respectively. In general, no differences were observed between chlorine solutions without pH adjustment (pH 9.2) and those with pH adjusted to 6.0. When different wash regimes were applied to inoculated cantaloupes or bell peppers, water wash alone produced significantly lower counts of both pathogens on bell peppers in comparison to untreated controls. However, this reduction was not observed on cantaloupes, indicating a possible surface effect. Application of 2% L-lactic acid by spray was the treatment that resulted in the lowest bacterial counts on both cantaloupes and bell peppers. This treatment did not produce any deleterious change in the sensorial characteristics of the products tested. None of the pathogens studied was able to grow during refrigerated storage (5°C for cantaloupes and 10°C for bell peppers), although numbers close to the detection limit of the counting method were found in randomly tested individual samples at days 14 and 28 of storage, indicating that these pathogens can survive for long periods on the produce surface. These results indicate that selected produce commodities could be sanitized at the packing facility. However, these interventions should not be applied as a replacement for but only as a complement to good hygiene practices.

Recent efforts of government agencies have been aimed at promoting an increase in consumption of these fresh fruits and vegetables (28). Concurrently, these products have been increasingly associated with outbreaks of foodborne illness (23). Outbreaks of foodborne disease associated with fresh and fresh-cut produce were summarized by the U.S. Food and Drug Administration (30). It is clear that *Salmonella* is commonly associated with produce. Several outbreaks of *Salmonella* infection have been associated with domestic and imported produce. For imported produce, food safety issues can result in loss of credibility and can affect sales, causing economic losses on one side and shortage of supply on the other. In 1996, a large multistate outbreak caused by *Cyclospora cayetanensis* affected areas of the United States and Canada (13). Between 1989 and 2001, several outbreaks in the United States were associated with cantaloupes. In most of these outbreaks, the contaminated produce was traced back to Mexican farms (5, 12, 14, 17, 19, 31), resulting in an import alert that is still in place for Mexican melons (31). Castillo et al. (10) studied the prevalence of *Salmonella* contamination and the

presence of *Escherichia coli* as an indicator of unsanitary operations in cantaloupe farms in Mexico and the United States. In this study, the packing house was identified as the site where most opportunities for bacterial contamination occurred. As a result of information of this type and of outbreak investigations associated with produce operations, the U.S. Food and Drug Administration is now recommending that establishments engaged solely in the harvesting, storage, or distribution of raw agricultural commodities be removed from the exclusion to comply with current good manufacturing practices (32). Another strategy for reducing pathogens during produce packing is produce disinfection. Numerous sanitizers, mainly in aqueous solutions, have been evaluated (11, 21), and hot water treatments have been recommended for cantaloupes and oranges (3, 18). Ukuku and Sapers (27) reported a reduction in the transfer of *Salmonella* to melon flesh during cutting after application of sanitizing treatments. However, in further studies, Ukuku and Fett (26) found that the level of reduction depended largely on the method of sanitizer application. The rough rind of cantaloupes provides an irregular and hydrophobic surface where bacteria can attach strongly and remain out of the reach of aqueous sanitizers (25). In addition to difficulties associated with intrinsic product

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