Validation study for the tree fruit industry: effective strategies to sanitize harvest bins and picking bags

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Summary

When harvesting tools, bins, and containers are not effectively cleaned and sanitized, microorganisms can develop and provide a reservoir for cross-contamination of produce. The use of chemical sanitizers is the most common practice used to prevent and control microbial risk. While the produce industry has recognized the importance of these recommendations, the wide diversity and size of farm management systems and the undefined recommendations for cleaning and sanitation of food contact surfaces encountered during harvesting have created challenges for the industry. The antimicrobial efficacy of 5 commercially available sanitizers was evaluated against *Listeria monocytogenes*, *Salmonella*, and Shiga-toxigenic *E. coli* on experimentally inoculated coupons representative of food contact surfaces commonly used in harvest bins and bags in the apple industry. Chlorine dioxide and silver dihydrogen citrate were selected for the validation study at commercial operations.

Objectives

1. Evaluate the effectiveness of commercially available sanitizers in reducing *Listeria monocytogenes*, *Salmonella*, and Shiga-toxigenic *E. coli* on experimentally inoculated coupons representative of food contact surfaces commonly used in harvest bins and bags in the apple industry.
2. Select and validate sanitizer strategies in representative commercial apple orchards and packinghouses.

Methods

The antimicrobial efficacies of chlorine (200 ppm for 1 or 2 min), chlorine dioxide gas (200 ppm for 1 or 2 hours), peracid (100 ppm for 1 or 2 min), steam (2 atm for 1 or 2 min), and silver dihydrogen citrate (ready-to-use solution at 0.003% of silver ions stabilized with citric acid at 4.846% for 1 or 2 min) were evaluated on wood, plastic, and nylon against *Listeria*, *Salmonella*, and *Escherichia coli*. Food contact surfaces were obtained from used harvest bins as well as used picking bags.

Two bacteria forms were investigated. For the sessile form, bacteria were allowed to grow overnight, and the lawn was harvested and used to experimentally inoculate surfaces. A CDC biofilm reactor was used to grow mature biofilms for 96 hours.

Results to Date

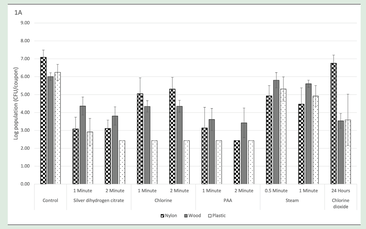
All the interventions evaluated showed a significant log reduction on plastic as compared to wood and nylon when coupons were inoculated with *Listeria* (**Figure 1A** and **1B**). Nevertheless, peracid (PAA) and silver dihydrogen citrate (SDC) had a significant reduction also on nylon and wood. Steam was the sanitizer with the lowest efficacy.

Salmonella results are shown in **Figure 2A** and **2B**. All the sanitizers showed greater activites on plastic; peracid and steam also worked effectively on nylon and wood, and chlorine dioxide reduced the population under detectable limits.

Figure 3A and **3B** present the results obtained for *E. coli*. Chlorine and steam worked well, while lower reductions were observed on wood and nylon. A significant effect was observed with peracid, and chlorine dioxide reduced microbial population under detectable limits.

Benefits to the Industry

This project will improve the competitiveness of tree fruit crops by increasing the number of available sanitation methods and science-based recommended practices that can be implemented by growers and packers, while managing food safety risks tied to sanitation of picking bags and harvest bins. Our goal is to validate, through lab and field testing, several strategies for cleaning and sanitizing these surfaces in collaboration with growers and packinghouses. The experimental design is vetted with the commercial collaborators to mimic actual conditions, so that results obtained can be directly applied to apple growers and handlers, as well as other produce crops.



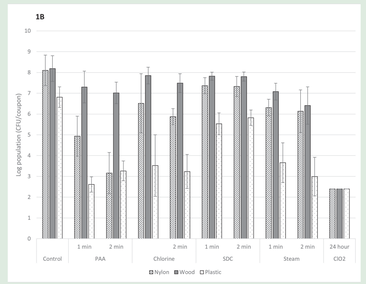
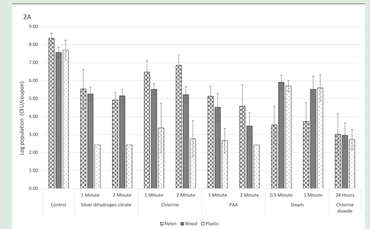


Figure 1. Log population of sessile (A) or biofilm (B) *Listeria monocytogenes* on common food contact surfaces when treated with sanitizers at two different contact times.



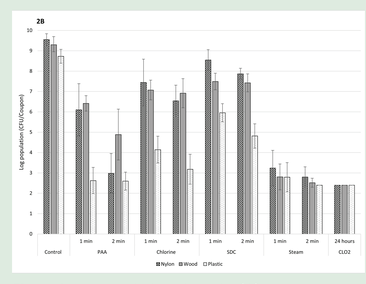
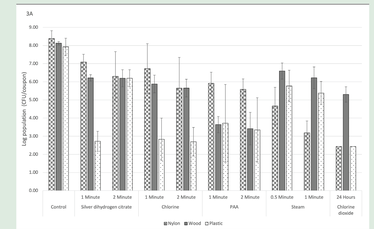


Figure 2. Log population of sessile (A) or biofilm (B) *Salmonella* on common food contact surfaces when treated with sanitizers at two different contact times



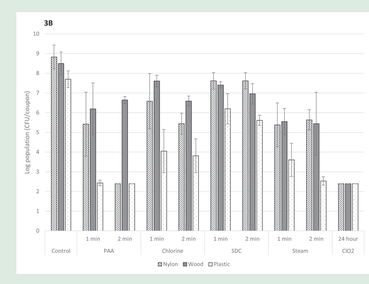


Figure 3. Log population of sessile (A) or biofilm (B) *E. coli* on common food contact surfaces when treated with sanitizers at two different contact times.