

Evaluation of Sanitizing Treatments for Sizer Carriers in Stone Fruit Packinghouses

SUMMARY

Ensuring safety is a top priority of produce packing operations. This one-year project evaluated the levels of naturally occurring microflora on sizer carriers of eight commercial stone fruit packinghouses. Furthermore, the influence of environmental conditions on the survival of inoculated *Salmonella enterica* and *Listeria monocytogenes* on sizer carriers was investigated. The results suggest that the general practices for cleaning sizer carriers in Central California stone fruit packinghouses are capable of reducing potential bacterial contamination introduced from stone fruit and/or handling operations. No growth of either pathogen under combined conditions of 65-95% humidity and 22-40 °C was found. Moderate environmental conditions, such as the combination of 75% humidity and 40 °C, can help minimize microbial contamination of sizer carriers. We recommend further research to explore the application of moderate, yet lethal, environmental (humidity and temperature) conditions to combat microbial contamination on produce- and food-contact surfaces.

OBJECTIVES

The objectives of this study included

1. Surveying the levels of naturally occurring microflora on the fruit contact surfaces of sizer carriers in commercial stone fruit packinghouses;
2. Determining the growth potential of *S. enterica* and *L. monocytogenes* on sizer carriers; and
3. Investigating the potential of using humidity and temperature conditions to minimize the pathogens on sizer carriers.

METHODS

For Objective 1, fruit-contact surfaces of randomly selected sizer carriers in eight peach and nectarine packinghouses were swabbed before and after routine cleaning (n=192). Microbial enumeration included total microbial, yeast and mold, and coliform counts using 3M Petrifilm. For Objective 2, the potential growth of inoculated *S. enterica* and *L. monocytogenes* (~2 log CFU/cm²) was evaluated on clean (unused) and non-clean (used; with deposited wax, fuzz, etc.) sizer carriers at different temperatures (22, 28, 34 and 40 °C) and different humidities (95, 85, 75 and 65%) after incubation for 1, 3 and 6 days. Swab samples were plated on TSA overlaid with selective media. Presumptive isolates were confirmed using biochemical ID strips. For Objective 3, pathogens were inoculated at ~6 log CFU/cm² and the survival on sanitized carriers was evaluated under 34 and 40 °C at 85, 75 and 65% humidity. The t-test was performed to analyze log microbial population changes (P ≤ 0.05).

Figure 2. The influence of humidity and temperature conditions on the survival of inoculated foodborne pathogens on two brands (A and B) of sizer carriers. Bars represent the averages of log values ± of ≥ 3 replications. Symbols *** and **** indicate a 3-log and 5-log reduction, respectively, from the initial contamination measured at hour two.

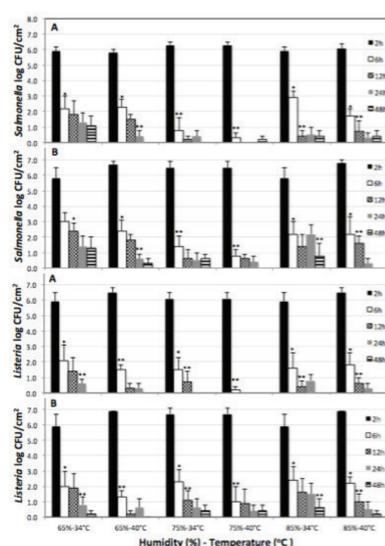


Table 1. Survival of artificially inoculated foodborne pathogens at varied environmental conditions on new (clean) sizer carriers obtained from two sizer carrier suppliers.

Pathogen	<i>Salmonella enterica</i> (log CFU/cm ²)				<i>Listeria monocytogenes</i> (log CFU/cm ²)				
	65%	75%	85%	95%	65%	75%	85%	95%	
Sizer Carrier A	Day 0								
	40 °C								
	34 °C								
	28 °C								
	22 °C								
	Day 3								
	40 °C								
	34 °C								
	28 °C								
	22 °C								
	Day 6								
	40 °C								
34 °C									
28 °C									
22 °C									
Sizer Carrier B	Day 0								
	40 °C								
	34 °C								
	28 °C								
	22 °C								
	Day 3								
	40 °C								
	34 °C								
	28 °C								
	22 °C								
	Day 6								
	40 °C								
34 °C									
28 °C									
22 °C									

*Data represent the means and SD of ≥3 replications.

RESULTS TO DATE

Figure 1 shows that routine cleaning significantly reduced total microbial and coliform counts on carrier surfaces from 3.9±0.3 to 3.2±0.3 and 1.5±0.4 to 0.9±0.5 CFU/cm², respectively. Data in Table 1 & 2 shows no growth of either pathogen under all experimental humidity and temperature conditions on the surfaces of clean and non-clean carriers. At 95% humidity, *Salmonella* counts persisted over 6 days at 34 °C on used carriers. Figure 2 shows that combined humidity at 65, 75 or 85% and temperature at 34 or 40 °C conditions caused 3-log reductions of *Salmonella* and *Listeria* in 4 hours (from hour 2 to 6) except at 65% humidity and 34 °C. The combination of 75% humidity and 40 °C was most lethal and achieved a 5-log reduction for both pathogens in 4 hours. All conditions, except the combination of 65% humidity and 34 °C, resulted in ≥5 log reductions of the pathogens within 2 days.

BENEFITS TO THE INDUSTRY

Results of this study revealed that the general practices for cleaning sizer carriers in Central California stone fruit packinghouses were capable of reducing potential bacterial contamination introduced from stone fruit and/or its handling operations. The fruit-contact surfaces of commercially used sizer carriers may not support the growth of pertinent pathogens such as *S. enterica* and *L. monocytogenes* under the experimental combinations of humidity (65-95%) and temperature (22-40 °C) conditions. The study also suggests that moderate environmental conditions, such as the combination of 75% humidity and 40 °C, can be considered as a potential approach to minimize microbial contamination of stone fruit sizer carriers. We recommend further research to explore the application and practicality of using moderate, yet lethal, temperature and humidity conditions to combat microbial contamination on produce- and food-contact surfaces.



Figure 1. Microbial loads of sizer carriers before and after cleaning at stone fruit packinghouses. Data represent the means and SE of eight packinghouse evaluations.

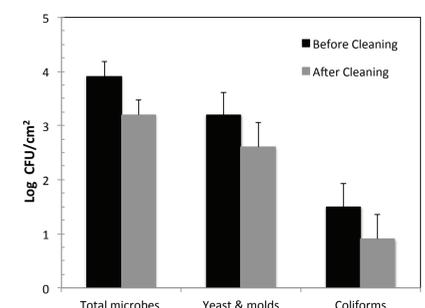


Table 2. Survival of artificially inoculated foodborne pathogens at varied environmental conditions on used (non-clean) sizer carriers obtained from two stone fruit packing operations.

Pathogen	<i>Salmonella enterica</i> (log CFU/cm ²)				<i>Listeria monocytogenes</i> (log CFU/cm ²)				
	65%	75%	85%	95%	65%	75%	85%	95%	
Sizer Carrier A	Day 0								
	40 °C								
	34 °C								
	28 °C								
	22 °C								
	Day 3								
	40 °C								
	34 °C								
	28 °C								
	22 °C								
	Day 6								
	40 °C								
34 °C									
28 °C									
22 °C									
Sizer Carrier B	Day 0								
	40 °C								
	34 °C								
	28 °C								
	22 °C								
	Day 3								
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	34 °C								
	28 °C								
	22 °C								
	Day 6								
	40 °C								
34 °C									
28 °C									
22 °C									

*Data represent the means and SD of ≥3 replications.



CONTACT Steven Pao
California State University, Fresno
Department of Food Science and Nutrition
spao@csufresno.edu
559.278.1624

AUTHORS Steven Pao, Erin Dormedy, Kelli Williamson, and Li Lin, Department of Food Science and Nutrition, California State University, Fresno.

ACKNOWLEDGEMENTS

We appreciate the technical assistance from the California Fresh Fruit Association. The contributions of research materials by Compac Sorting Equipment Ltd., Visalia, CA and Aweta Americas Inc., Fresno, CA is acknowledged.

LENGTH OF FUNDING

January 1, 2016 – December 31, 2016