

Validation of sanitizer disinfection of wash water in dump tank operation of apple packing lines



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Summary

During commercial processing, fresh apples are first handled by employing a dump tank and flume water system. Effective disinfection of the source water in the dump tank will be critically important to reduce the likelihood of *Listeria monocytogenes* and other foodborne pathogen contamination on apples. Despite disinfectants such as chlorine or peroxyacetic acid being used extensively in dump tank water, the practical antimicrobial efficacy of these sanitizers used in dump tanks has not been directly assessed. The overall goal of this study is to comparatively assess and validate critical operating parameters for commercially used sanitizers against *L. monocytogenes* in dump tank water, and to further seek effective intervention methods and verify their efficacies on multiple apple packing lines.

Objectives

1. Assess the efficacies of selected sanitizers to eliminate *L. monocytogenes* in wash water and cross-contamination in a simulated dump tank system.
2. Verify the selected sanitizer disinfections in representative commercial apple packing lines.

Methods

Work to date has mainly focused on Objective 1, to validate the efficacy of selected sanitizers against *L. monocytogenes* in wash water. Simulated dump tank water (SDTW) was formulated using exudate from nicked fresh apples, decayed apples, and soil as sources of organic matter. The chemical oxygen demand (COD) of SDTW was further monitored. SDTW of different levels of COD were inoculated with *L. monocytogenes* and then subjected to different concentrations of chlorine and peroxyacetic acid (PAA), two commonly used sanitizers in dump tank water interventions, for 0 to 5 min in a simulated dump tank water system. Survival of *L. monocytogenes* was analyzed per our established method.

Results to Date

- We have established a standardized protocol for simulated dump tank water, inoculation, and antimicrobial intervention of *Listeria* in SDTW.
- Chlorine at 25 ppm showed limited efficacy against *Listeria* in SDTW with 4000 ppm COD (**Figure 1A**). Anti-*Listeria* efficacy of 100 ppm chlorine was not impacted by 1000 ppm COD but was impacted by 4000 ppm COD. A 5-min contact of 100 ppm chlorine caused ~6-log₁₀ CFU/ml reduction in SDTW (**Figure 1C**).
- PAA at 40 ppm had higher efficacy than 100 ppm chlorine; a 5-min contact caused >8 log₁₀ CFU/ml reduction of *L. monocytogenes* in SDTW (**Figure 2A**). The anti-*Listeria* efficacy of PAA increased with concentration and contact time, which was minimally influenced by the presence or level of organic matter (**Figure 2C**).

Benefits to the Industry

The project is expected to develop information for apple producers about the practical efficacy of antimicrobial interventions under commercial dump tank practices. The outcomes of this project will provide a foundation for validated process controls, verification of standard operating procedures, and monitoring protocols that will be accessible to the apple industry to support compliance with FSMA Preventive Controls requirements.

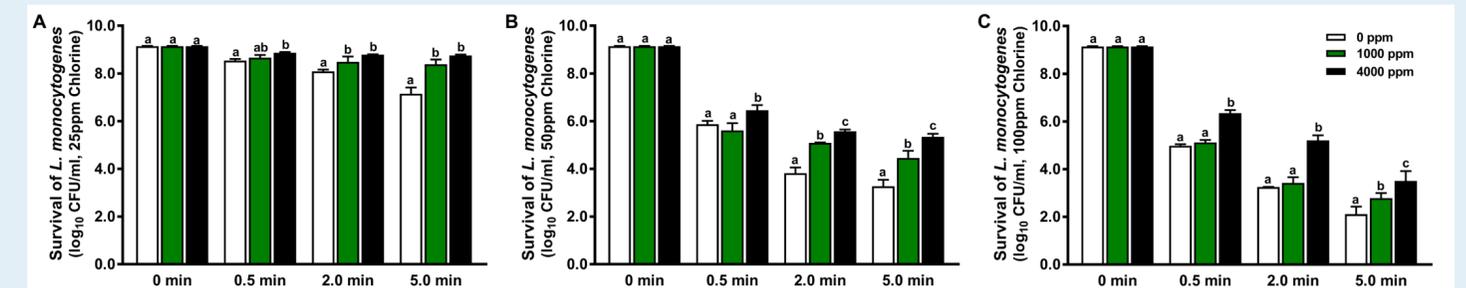


Figure 1. Fate of *L. monocytogenes* in chlorine-treated simulated dump tank water (SDTW) with different organic matter. (A) 25 ppm, (B) 50 ppm, (C) 100 ppm chlorine; chlorine used at pH 6.8. 0 ppm, 1000 ppm and 4000 ppm represent COD (chemical oxygen demand) level of SDTW. A 3-strain *L. monocytogenes* cocktail was inoculated at ~9 log₁₀ CFU/ml. Mean ± SEM, n = 9. Histogram bars with the same letter do not differ significantly at a P-value of 0.05.

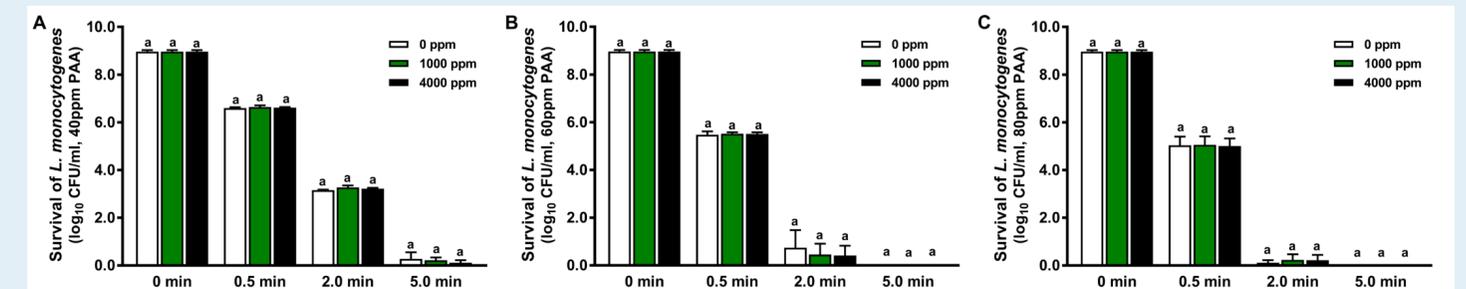


Figure 2. Fate of *L. monocytogenes* in peroxyacetic acid (PAA)-treated simulated dump tank water (SDTW) with different organic matter. (A) 40 ppm, (B) 60 ppm, (C) 800 ppm PAA. 0 ppm, 1000 ppm and 4000 ppm represent COD (chemical oxygen demand) level of SDTW. A 3-strain *L. monocytogenes* cocktail was inoculated at ~9 log₁₀ CFU/ml. Mean ± SEM, n = 9. Histogram bars with the same letter do not differ significantly at a P-value of 0.05.