Microbial Quality of Water Used in Potato Packinghouse Operations

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Objective: Monitor *Escherichia coli* populations in water and on potato during post-harvest handling and packing

Abstract

Postharvest handling of potatoes regularly includes the use of flumes, dump tanks, and spray washers. Soil, plant matter, and disease-causing pathogens can potentially accumulate during postharvest water uses. This project evaluated the microbial quality of water used in potato packinghouse operations using generic *Escherichia coli* (*E.coli*). Five potato packinghouse operations were sampled three times each during the season. At each visit, water and potato samples were collected in triplicate during two time-points (morning and afternoon). A total of 630 samples were collected. The average population of generic *E. coli* in flume water samples (n=90) was 413 MPN/100 milliliters, while the average population of generic *E. coli* in spray bar water (n=90) was below the limit of detection (<1 MPN/100 milliliters or zero detectable generic *E. coli*). Generic *E. coli* populations were significantly higher in flume water, compared with spray bar water. The average population of generic *E. coli* on potato samples from incoming bulk bodies/before entry into flumes, in flumes, post-flume/before spray bar, spray bar, and post-spray bar/before packing was 106, 386, 251, 3 and less than 1 MPN/100 milliliters, respectively. Populations of generic *E. coli* on potatoes were significantly higher on potatoes before the spray bar, compared to on potatoes after the spray bar. Thus, water used for the final rinse in the spray bar system was effective at reducing the quantity of *E. coli* on potatoes, as generic *E. coli* populations were below the limit of detection for all potato samples tested post-spray bar/after drying/before packing.

Need / Situation

Water used in flumes and dump tanks is often re-circulated to conserve water and energy. Soil, plant matter, and disease-causing pathogens can potentially accumulate in water during bin dumping and flume recirculation. Contaminated water used in flumes and dump tanks may transmit diseases that decay the potato and adversely affect human health. Sanitizers, such as chlorine or peracetic acid, may be used to manage the risks associated with postharvest water (e.g., cross contamination). However, sanitizers are rarely used in flumes and dump tanks because of the high organic load due to potatoes being grown in the ground. Minimal published research exists on the microbial quality of water used in the postharvest handling and packing of potatoes; for example, the risk of using untreated surface water).

Good Agricultural Practices GAP

FDA FOOD SAFETY MODERNIZATION ACT

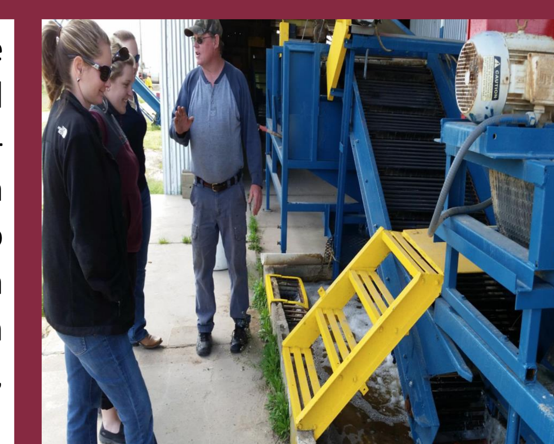
The lack of data on postharvest water in potato operations is largely a result of potatoes being classified as a low risk agricultural commodity for food safety, as they are typically not consumed raw. However, with the implementation of the Food Safety Modernization Act (FSMA) Produce Safety Rule, several Good Agricultural Practices (GAP) audit schemes are aligning with the FSMA Produce Safety Rule. The FSMA Produce Safety Rule requires water used during harvest, or postharvest activities for covered produce have zero detectable generic *E. coli*, as well as untreated surface water not be used during harvest or postharvest activities for covered produce. While potatoes are not a covered crop under the FSMA Produce Safety Rule, GAP requirements do not differentiate between covered and non-covered crops.

Thus, concerns about the water quality used during potato postharvest handling activities has come under scrutiny (due to the FSMA Produce Safety Rule and new GAP standards). The project goal was to evaluate the microbial quality of water used in potato packinghouses using generic *E. coli*. Generic *E. coli* is not a human pathogen, but used as an indicator of microbial contamination by the FSMA Produce Safety Rule and GAP (so *E. coli* was used in this study).

Methods

Study Design

Five potato packinghouse operations were sampled three times each during the season. Upon each visit, water and potato samples were collected in triplicate during two time-points (morning: between 8-11 am and afternoon: between 12-3 pm). A total of 630 samples were collected. Potato packinghouses were enrolled in the study based on willingness to participate. Information was collected on potato packinghouse handling including source of water, type of sanitizer, among other information.



Sample Collection

Water samples were collected in sterile 1 L bottles from (i) flumes used to wash initial organic material (e.g., dirt, debris) off potatoes (n=90) and (ii) spray bars used to rinse potatoes before they are dried and packed (n=90) (Fig. 1). Potato (whole) samples were collected from (i) incoming bulk bodies/before entry into flumes (n=90), (ii) flumes (n=90), (iii) post-flume/before spray bar (n=90), (iv) spray bar/during spraying (n=90), and (v) post-spray bar/after drying/before packing (n=90) (Figure 1). All water and potato samples were transported back to the laboratory on ice, and processed within 3 h (same day).

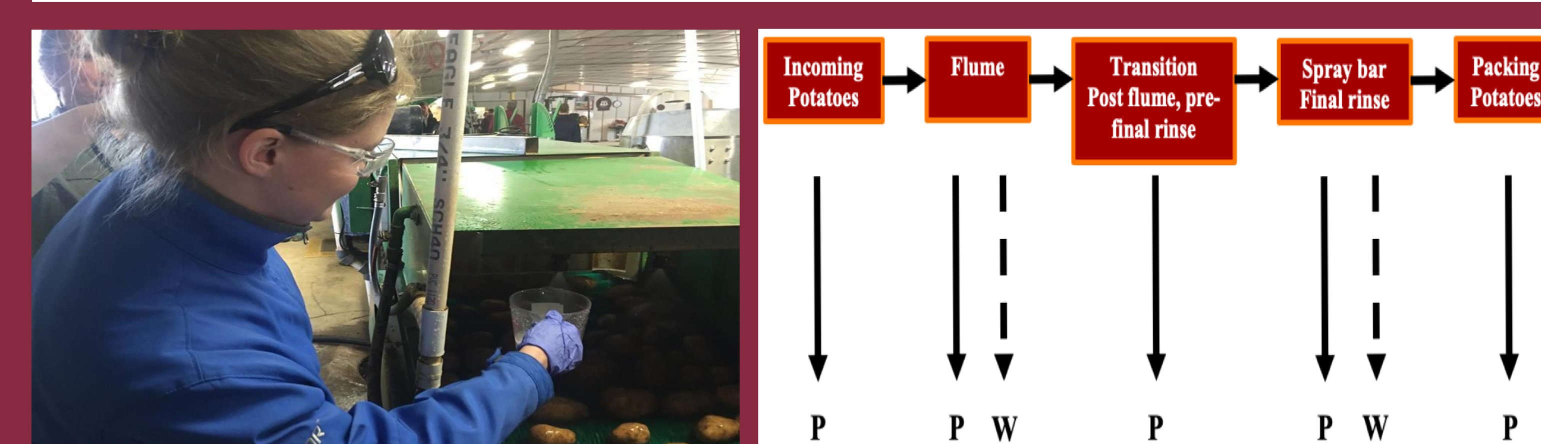
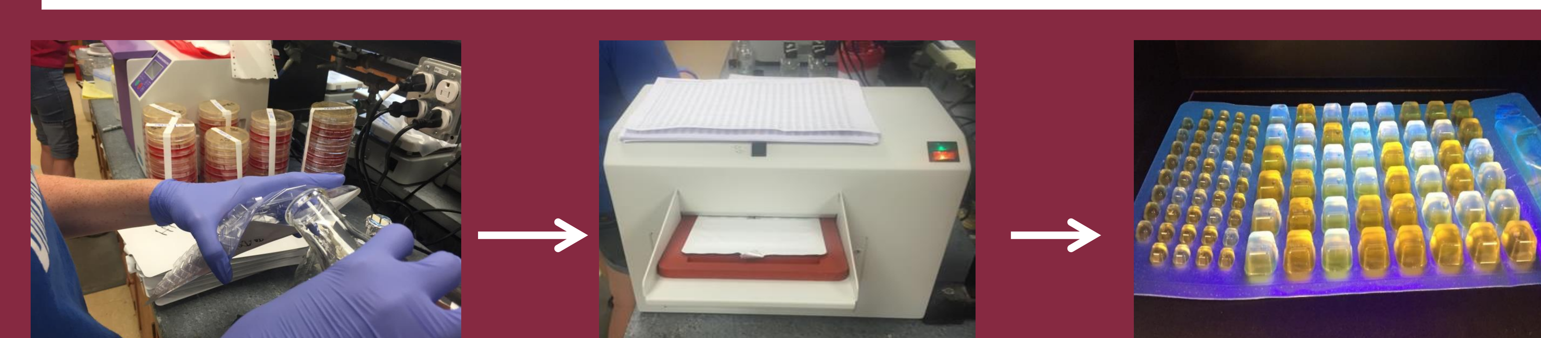


Figure 1. Sample collection points in a potato packinghouse. Researchers collected water (labeled as W) and potato (labeled as P) samples at each step shown in the diagram.

Sample Processing

Samples were enumerated for generic *E. coli* (most probably number: MPN) using the IDEXX Colilert-18 and Quanti-Tray/2000 (standard method 9223B). Yellow wells represent coliforms and fluorescent wells represent generic *E. coli* per 100 mL.



Statistics

An analysis of variance and Tukey's multiple comparison test was performed to determine differences between mean values of sampling locations; as well as a t-test to determine differences between sampling visit and time-point mean values. $P \leq 0.05$ was significant.

Results

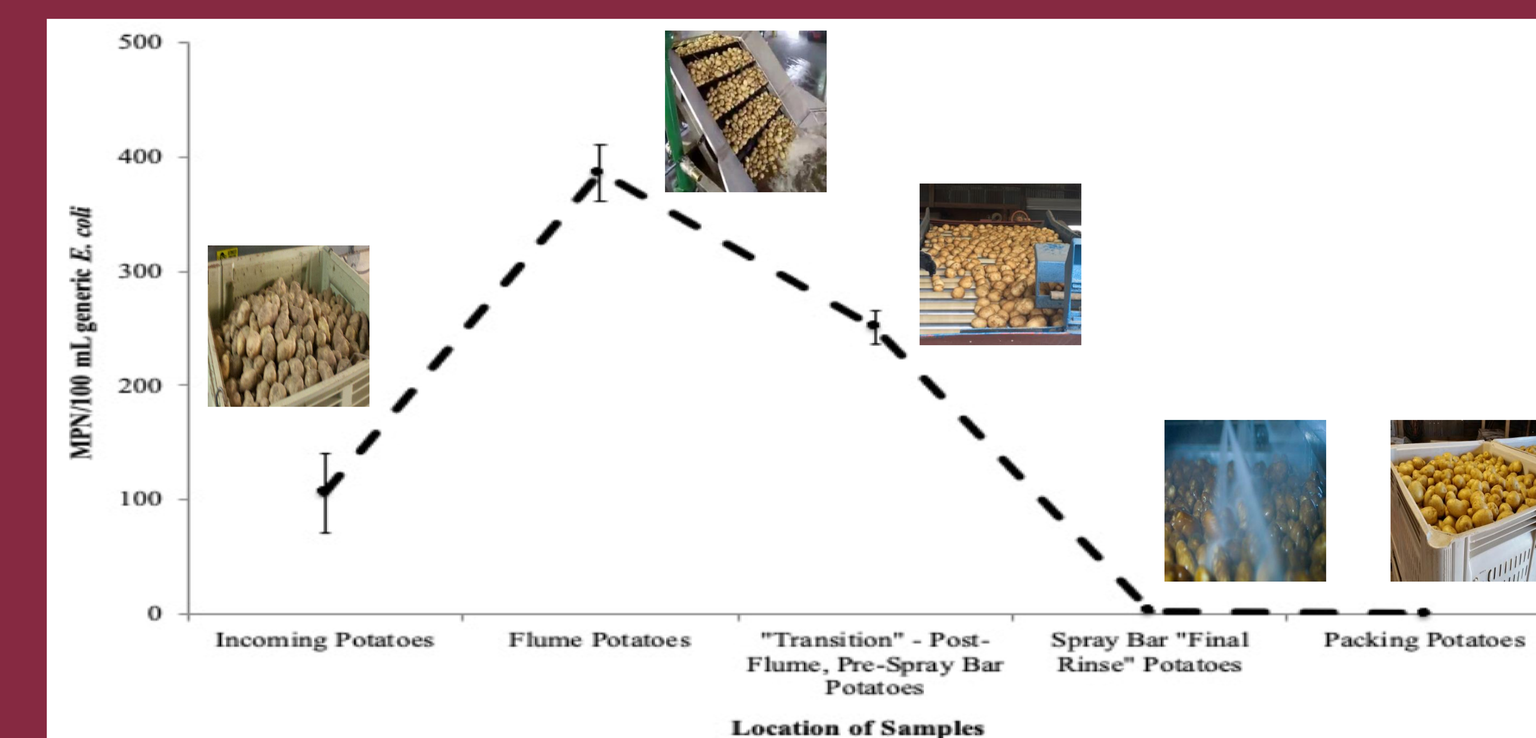


Figure 2. Average generic *E. coli* (MPN/100 mL) population with standard deviation in potato samples from incoming bulk bodies/before entry into flumes, flumes, post-flume/before spray bar, spray bar, and post-spray bar/before packing (n=90 each).

- No significant difference was observed in generic *E. coli* populations between the two-time points sampled (morning: between 8-11 am and afternoon: between 12-3 pm) for water or potato samples. No significant difference was observed in generic *E. coli* populations between any of the sample collection visits. Data was combined to strengthen analyses.
- The average population of generic *E. coli* on potato samples from incoming bulk bodies/before entry into flumes, flumes, post-flume/before spray bar, spray bar, and post-spray bar/before packing was 106, 386, 251, 3 and <1 MPN/100 mL, respectively (Fig. 2).
- Populations of generic *E. coli* on potatoes were significantly higher on incoming potatoes, potatoes from the flume, and potatoes post-flume, compared to potatoes from the spray bar and potatoes post-spray bar/after drying/before packing (Fig. 2).
- Water used for the final rinse in the spray bar system was effective at reducing the quantity of generic *E. coli* on potatoes, as generic *E. coli* populations were below the limit of detection for all potato samples tested post-spray bar/after drying/before packing (Fig. 2).
- The average population of generic *E. coli* in flume water samples (n=90) was 413 MPN/100 mL, while the average population of generic *E. coli* in spray bar water (n=90) was below the limit of detection in all samples (<1 MPN/100 mL or zero detectable generic *E. coli*).
- Generic *E. coli* populations were significantly higher in flume water, compared to spray bar water.

Conclusions

The National Potato Council's *Commodity-Specific Food Safety Guidance for the Production, Harvest, Storage, and Packing of Potatoes*, state "if water is used to flume and wash potatoes that are destined for fresh market, a final rinse with water that meets the US EPA's microbial standards for potable water should be applied to potatoes". Our data show populations of generic *E. coli* on potato samples are significantly lower after the final rinse, compared to before the final rinse. Therefore, findings support the National Potato Council's best management practices.

VIRGINIA TECH

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