Solutions to brush sanitation tailored to the producer's appetite for capital investment and labor intensity

Summary

Produce brushes are essential for cleaning and polishing fruit but are difficult to clean and sanitize effectively. As brushes deteriorate with use, they become even more difficult to clean and sanitize and can harbor pathogens like *Listeria monocytogenes*. However, there is limited evidence-based guidance for when a facility should replace their brushes. This study will evaluate the effect of brush deterioration on sanitation outcomes. Sanitation outcomes will be evaluated through: (1) environmental monitoring at a collaborating apple packhouse and (2) bench-scale experimental work. The conclusions from this work will aid the industry by providing evidence to help facilities make informed decisions regarding brush bed management.

Benefits to the Industry

This work will provide evidence to the industry that supports decisions on brush replacement frequency and sanitation strategy. Replacing brushes involves tradeoffs, including cost and downtime during installation. By investigating the effect of brush deterioration on sanitation outcomes, we will provide the industry with the relevant information for optimizing priorities. These findings will additionally help the industry determine what microbial and general hygiene indicators are most effective in verifying sanitation. These indicators can be used as part of routine sanitation monitoring and as part of a strategy for evaluating when brushes should be replaced.

Objectives

1. Identify the impact of brush deterioration on pathogen retention.
2. Define deterioration markers for replacing brushes to mitigate pathogen retention.
3. Trial steam to clean and sanitize brushes of varying deterioration states.
4. Trial protocols with collaborating apple facilities and evaluate microbial outcomes.

Methods

Markers of brush deterioration and methods of assessment:
Through industry consultation, the brush attributes that deteriorate with wear were identified as: bristle tuft length and splay, bristle matting, discoloration, brush core visibility, and wax buildup. Height and splay were measured from 10 randomly identified locations. Matting, discoloration, core visibility, and wax buildup were quantified as the percentage of the brush bed with different degrees of wear.

Baseline assessment of microbial hygiene status of produce brushes in a collaborating facility:
Swab samples were collected from brushes (1) post-production prior to sanitation and (2) post-sanitation. Microbiological data for 3 hygiene indicators, Enterobacteriaceae (EB Petrifilm), total Gram negatives (CVTA), and aerobic plate count (APC Petrifilm) were collected, along with ATP data.

Results to Date

Brush bristle splay and height were measured. Less deteriorated bristles were only 1 cm wide (**Figure 1**) and had a height of almost 3 cm (**Figure 2**), while worn bristles were found to be as wide as 3 cm (**Figure 1**) and measured closer to 2 cm in height (**Figure 2**). Drying brushes were more worn in both splay and height, while wash brushes appeared to be in the best relative condition.

In initial site visits, Enterobacteriacea (EB) counts were more variable between visits and more readily reduced by sanitation compared to total plate count (TPC) and total Gram negatives (**Figures 3** and **4**). Numerically lower reductions in microbial counts were observed on wax brushes compared to wash or dry brushes.

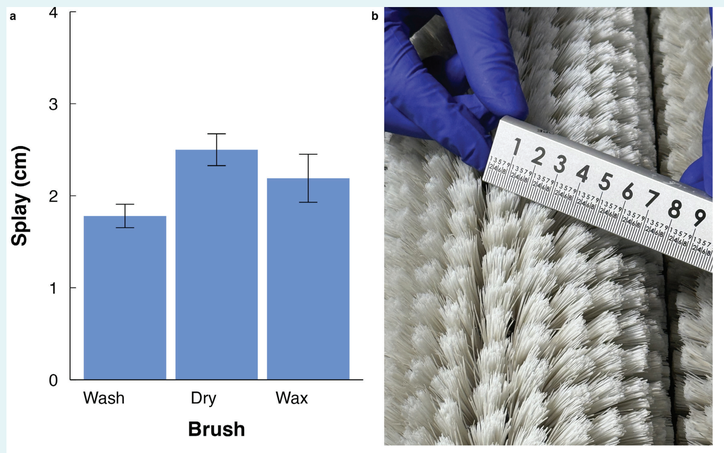

Figure 1. (a) Bristle splay (cm) for different types of brushes and (b) how measurements were taken.

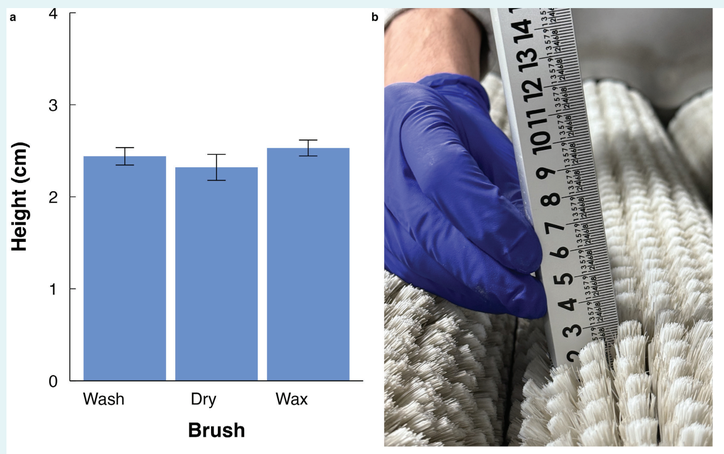

Figure 2. (a) Bristle height (cm) for different types of brushes and (b) how measurements were taken.

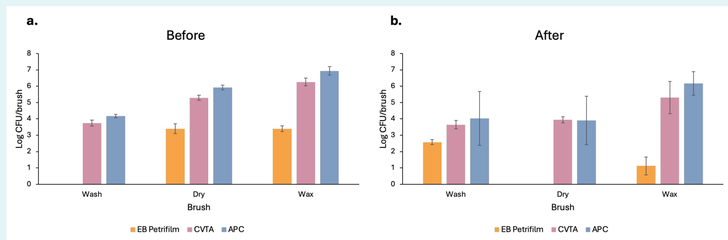

Figure 3. Enterobacteriaceae, total Gram negative (CVTA), and aerobic plate counts on different produce brushes on production line 1 post-production before sanitation (a) and post-sanitation (b).

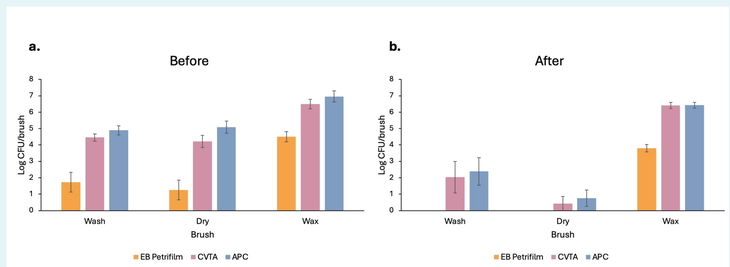

Figure 4. Enterobacteriaceae, total Gram negative (CVTA), and aerobic plate counts on different produce brushes on production line 2 post-production before sanitation (a) and post-sanitation (b).

Contact

Abby Snyder, PhD
Cornell University
abs276@cornell.edu

Authors

Lyle Massoia, Sarah Daly, Devin Daeschel, Abby Snyder, V.M. Balasubramaniam (Co-PI)

Project funding dates

January 1, 2025 – December 31, 2026

Acknowledgements

We thank our industry collaborator in New York, John Cottam at Industrial Brush Co., and our CPS advisory council.