

Evaluating food safety challenges of blueberry harvesting



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Summary

As a "superfood" with many health benefits, fresh blueberries (Figure 1), like any other fresh fruits and vegetables, can be a potential vehicle for transmitting gastrointestinal diseases and pose a risk to public health. Industry cleaning and sanitation practices directly affect the hygiene status of harvest containers and equipment, and subsequently the microbial quality of the harvested blueberries. The ultimate goal of this research project is to evaluate the food safety challenges of blueberry harvesting by identifying best industry practices in the cleaning and sanitization of harvesting containers and equipment.

Objectives

1. Collect information about cleaning and sanitation practices for harvest containers and mechanical harvesters among blueberry growers/packers through an anonymous survey in several U.S. states.
2. Validate the efficacies of selected key cleaning and sanitation practices in decontaminating harvest containers and mechanical harvesters in the fields and/or packing facilities.
3. Evaluate, in a laboratory setting, whether identified key industry cleaning/sanitizing practices can effectively remove microbial buildups and biofilm mass on materials used to manufacture harvest containers and mechanical harvesters.
4. Transfer the knowledge gained from the project to berry growers/packers and promote better industry practices for broad adoption.

Methods

- A practice survey questionnaire was posted on a Google site. The survey link was emailed to blueberry growers/packers by project collaborators in several U.S. states.
- The hygiene condition of blueberry harvester containers and picking buckets was evaluated in the 2020 harvest season.
- Coupons of different colored high-density polyethylene (HDPE), the material used to manufacture blueberry harvest containers and picking buckets, were tested for their ability in supporting bacterial accumulation and biofilm formation.
- The efficacies of cleaning/sanitizing treatments (with water, chlorine, or dish soap; with soaking or no soaking; with simulated manual washing or machine washing) in removing biofilms on selected coupon materials were determined.

Results to Date

- To date, 71 participants from 13 different U.S. states responded to the survey questions (Figure 2). Survey results have been analyzed and Excel or Upset graphs have been generated.
- Cleaned harvest containers (buckets, lugs, or flats) surveyed in the study had significantly ($P < 0.05$) lower total aerobes and yeast and mold counts than the used but not yet cleaned harvest containers (Table 1, Table 2).
- The color of HPDE coupons did not significantly ($P > 0.05$) affect the amount of biofilm accumulated (results not shown).
- Cleaning/sanitizing treatment efficacy experiments on HDPE coupons showed that:
 - Coupons soaked in water or cleaner/sanitizer solutions at room temperature for 1 h had less biofilm mass than unsoaked coupons
 - Simulated manual washing with agitation (220 rpm, 1 min) removed less biofilm mass than machine wash with bench-top wash machine (100 rpm, 1 min)

Benefits to the Industry

The information generated by this project will be useful to blueberry growers/packers, and perhaps other fresh produce growers/packers, to improve their cleaning and sanitation practices and produce safer products for consumers. Strong consumer confidence in safe food products will likely further boost industry revenues.



Figure 1. Highbush blueberries.

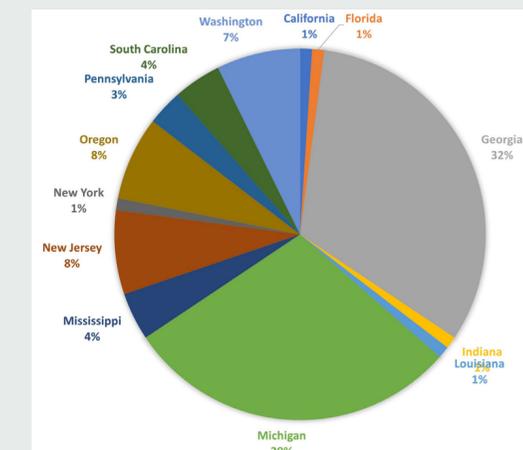


Figure 2. Geographic distribution of the blueberry grower/packer survey respondents.

Table 1. Mean populations of total aerobes, yeasts and molds, and coliforms from swab samples collected from harvest containers (buckets and lugs) during two visits to individual fresh blueberry facilities in Georgia.

Facility	Sample	Log CFU/cm ²		
		Total aerobes	Total yeast and molds	Total coliforms
Facility	GA-I (n=60)	2.39 ^A	2.56 ^A	0.17 ^A
	GA-II (n=100)	1.40 ^B	1.57 ^B	0.14 ^A
Container	CH (n=40)	1.02 ^C	0.67 ^C	0.12 ^A
	CL (n=40)	1.88 ^B	1.80 ^B	0.24 ^A
	UH (n=40)	1.76 ^B	2.67 ^A	0.10 ^A
	UL (n=40)	2.42 ^A	2.62 ^A	0.15 ^A
Visit	1 (n=80)	2.20 ^A	2.14 ^A	0.22 ^A
	2 (n=80)	1.34 ^B	1.74 ^B	0.08 ^A

Within columns, different letters indicate statistical difference at a 95% confidence interval. CH: cleaned hand-picking bucket; UH: used, not yet cleaned hand-picking bucket. CL: cleaned berry lug; UL: used, not yet cleaned berry lug.

Table 2. Mean populations of total aerobes, yeasts and molds, and coliforms from swab samples collected from harvest containers (buckets and flats) during two visits to individual fresh blueberry facilities in Oregon.

Facility	Sample	Log CFU/cm ²		
		Total aerobes	Total yeast and molds	Total coliforms
Facility	OR-I (n=80)	1.91 ^A	2.19 ^A	0.09 ^A
	OR-II (n=80)	1.26 ^B	1.88 ^B	0.07 ^A
Container	CF (n=40)	1.28 ^C	1.42 ^C	0.06 ^B
	CH (n=40)	1.53 ^B	1.17 ^D	0.04 ^B
	UF (n=40)	1.33 ^{BC}	2.50 ^B	ND
	UH (n=40)	2.21 ^A	3.04 ^A	0.21 ^A
Visit	1 (n=80)	1.80 ^A	2.25 ^A	0.09 ^A
	2 (n=80)	1.38 ^B	1.82 ^B	0.07 ^A

Means of same variables followed by different letters are significantly different ($P < 0.05$). CF: cleaned flat; UF: used, not yet cleaned flat. CH: cleaned hand-picking bucket; UH: used, not yet cleaned hand-picking bucket. ND: not detected; detection limit < 0.06 log CFU/cm².