Determining Food Safety Best Practices for Pecan Float Systems

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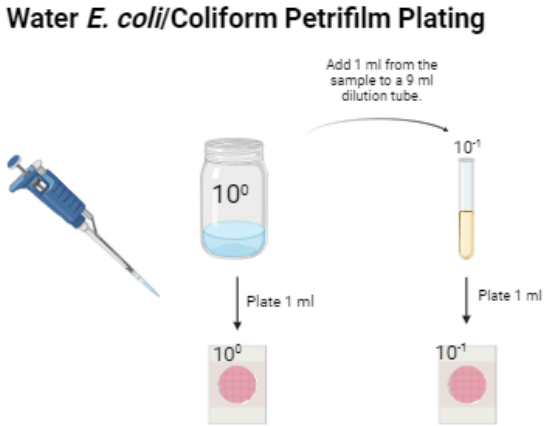
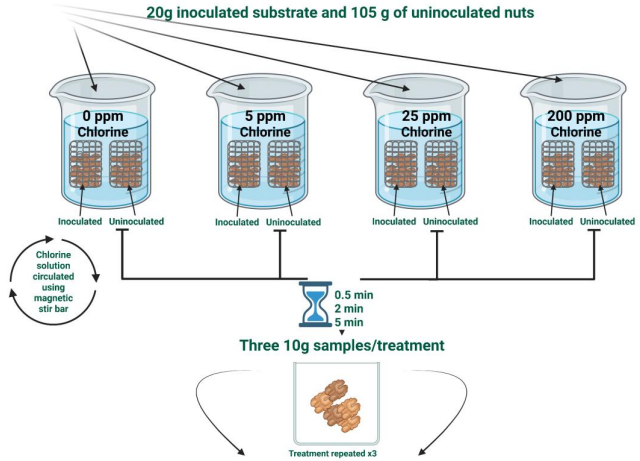
Pecan Float Systems Overview

- In order to optimize kernel yield, pecans will go through a float system to separate shells from the kernels.
- Generally chemical sanitizers are used to maintain water quality
- Sanitizer levels may be difficult to maintain as the organic load through recirculated water systems increase.
- If not properly handled, water can be a potential source of cross-contamination of foodborne pathogens in a recirculated system.

Objectives

- Evaluate the physiochemical and microbial quality of pecan float systems.
- Evaluate how interventions may impact and improve the microbial quality of the water and pecan kernels in a float system.
- Determine the effective minimum free chlorine levels that prevent the cross-contamination of *Salmonella* in a simulated pecan float system.





Float Tank Microbial and Physiochemical Quality (Methods)

Interventions

Baseline: Samples taken pre-intervention.

Intervention 1: Float tank water spiked with chlorine every 60 minutes.

Intervention 2: Peracetic acid spray bar at the end of the process.

Physiochemical Analysis

Colorimeter

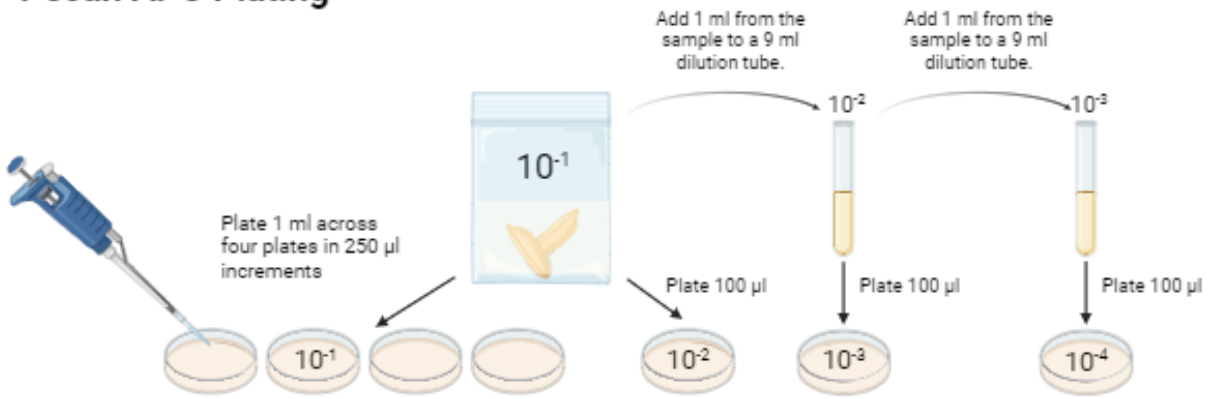
- Total Chlorine (ppm)
- Free Chlorine (ppm)
- Chemical Oxygen Demand (COD, ppm)

pH Meter

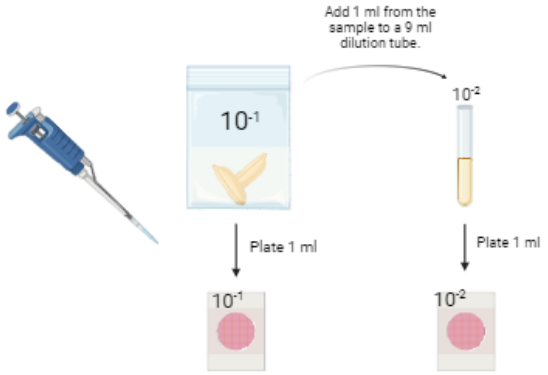
Float Tank Microbial and Physiochemical Quality (Methods)

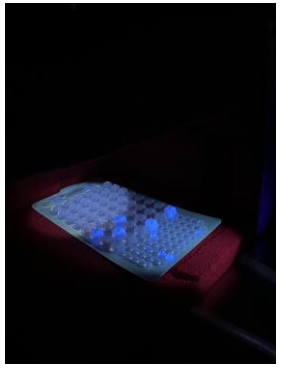
Microbial Analysis of Water and Pecan Kernels

Pecan APC Plating

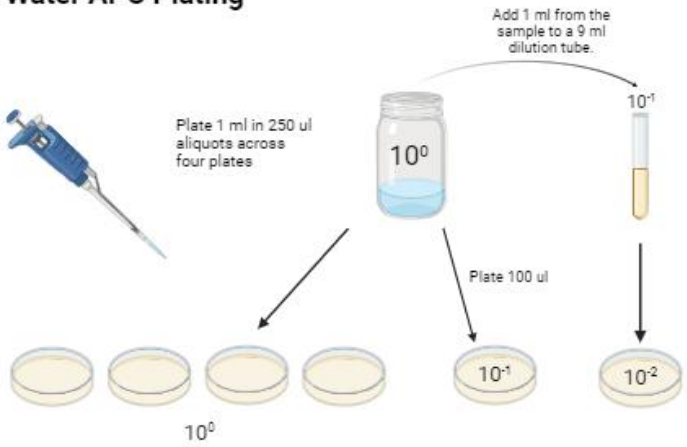


Pecan *E. coli*/Coliform Petrifilm Plating

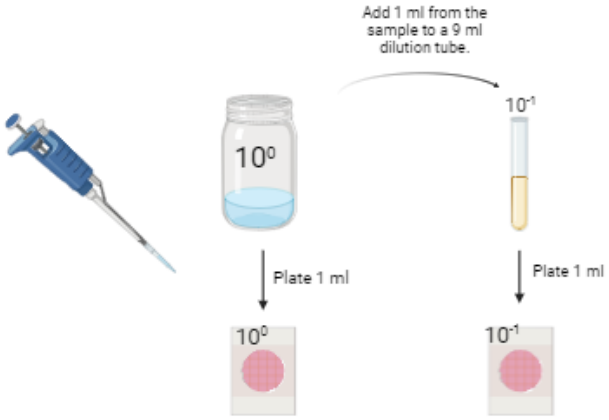




Water APC Plating



Water *E. coli*/Coliform Petrifilm Plating



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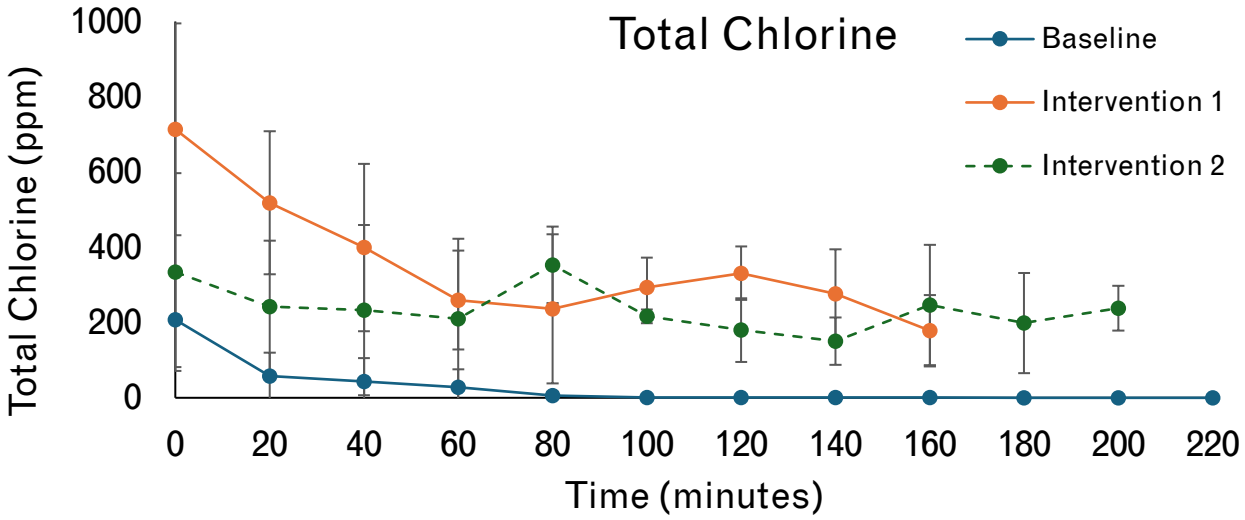
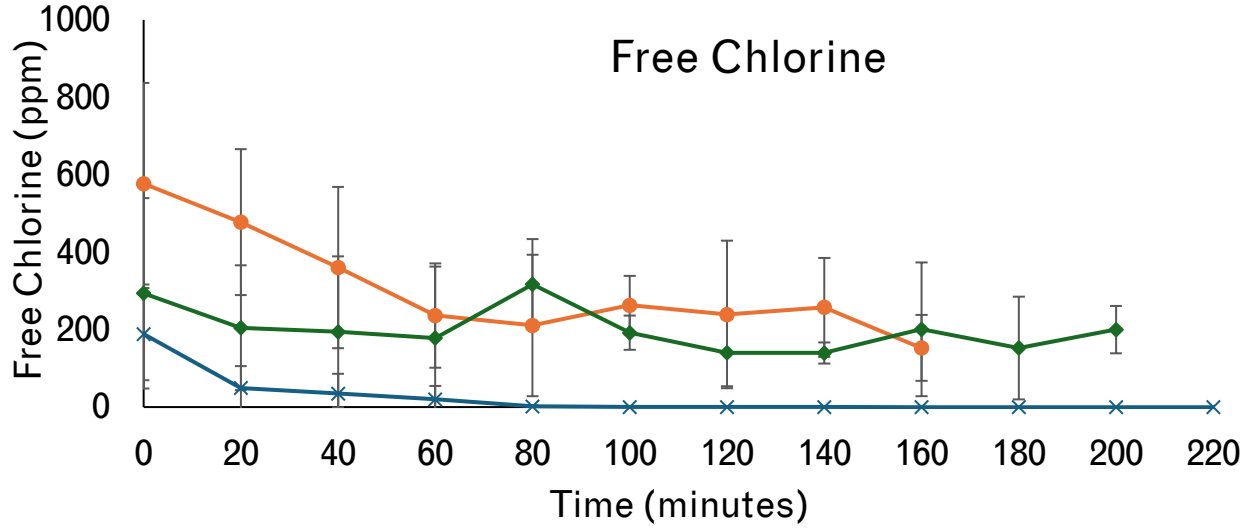
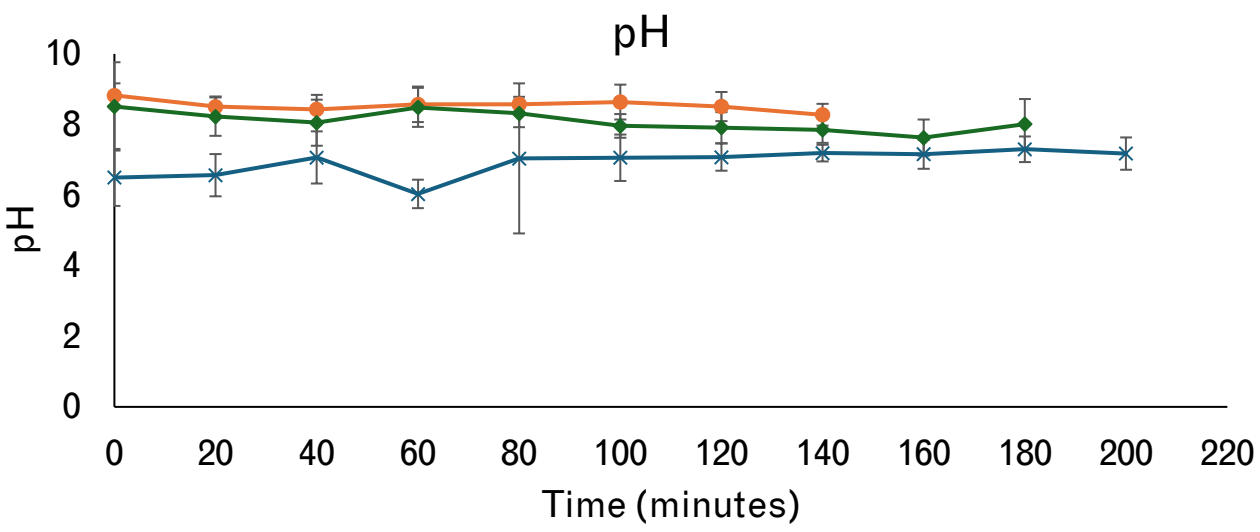
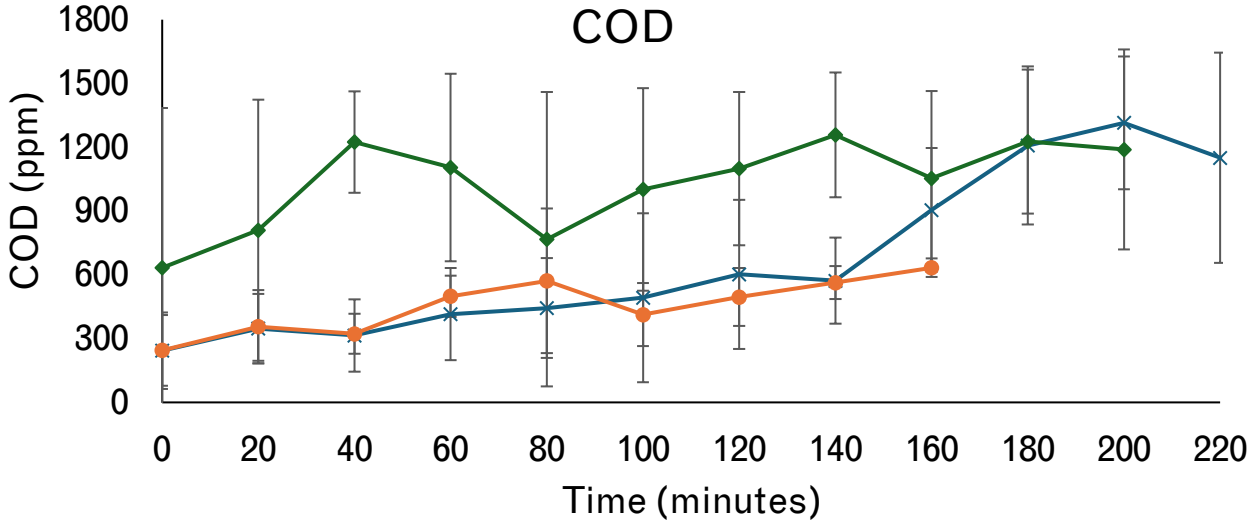
Float Tank Microbial and Physiochemical Quality (Results)

Figure 3. Average Total chlorine, free chlorine, pH, and COD measurements in the float system water for each intervention over the processing period (n=3)









Float Tank Microbial and Physiochemical Quality (Results)

Table 3. Average ± standard deviation APC and coliform counts of water samples taken from the float system for each intervention over the course of the processing period (n=3).

Timepoint (Minutes)	APC (log CFU or MPN/100 ml)			Coliform (log CFU or MPN/100 ml)		
	Baseline	Inter. 1	Inter. 2	Baseline	Inter. 1	Inter. 2
0	0.87±1.25	0.16±0.28	1.13±1.95	0.00±0.00	0.00±0.00	0.00±0.00
20	2.31±0.73	0.00±0.00	1.80±1.33	1.69±1.47	0.00±0.00	0.00±0.00
40	2.74±0.92	0.80±0.73	1.98±1.53	1.56±0.77	0.00±0.00	0.00±0.00
60	2.97±0.88	0.98±0.84	2.20±1.73	1.88±1.45	0.00±0.00	0.00±0.00
80	3.32±1.39	1.52±2.38	0.72±0.66	2.10±1.88	0.00±0.00	0.00±0.00
100	3.43±1.49	0.36±0.32	1.41±0.21	2.74±1.93	0.00±0.00	0.00±0.00
120	4.24±0.78	0.00±0.00	1.59±0.37	3.75±0.93	0.00±0.00	0.00±0.00
140	3.41±2.09	0.53±0.46	1.57±0.75	3.68±0.99	0.00±0.00	0.00±0.00
160	4.12±0.89	1.55±1.39	1.44±1.30	3.40±0.43	0.00±0.00	0.00±0.00
180	4.52±1.19	NA	1.24±1.13	3.83±1.01	NA	0.00±0.00
200	4.53±1.32	NA	1.33±0.42	3.68±1.19	NA	0.00±0.00
220	4.51±0.42	NA	NA	3.23±0.64	NA	NA

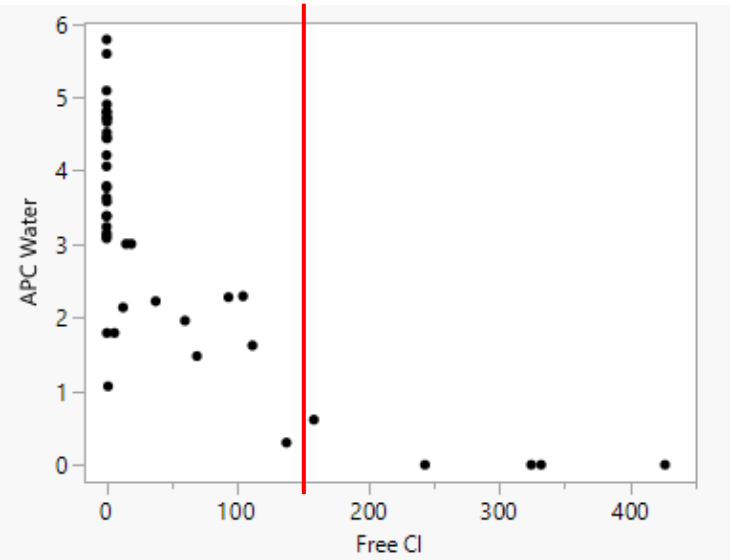
Float Tank Microbial and Physiochemical Quality (Results)

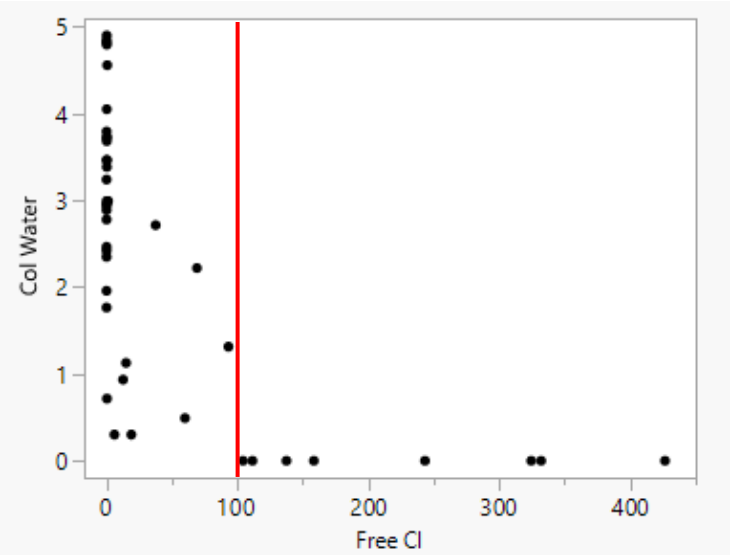
Table 4. Pearson correlation table of the physiochemical and microbial water quality parameters of the pecan float tank water ($p<0.05$)

	APC	Col	Tot Cl 2	Free Cl 2	pH	COD
APC	1.000	0.808	-0.783	-0.767	-0.611	0.307
Col	0.808	1.000	-0.596	-0.573	-0.509	0.001
Tot Cl 2	-0.783	-0.596	1.000	0.984	0.752	-0.312
Free Cl 2	-0.767	-0.573	0.984	1.000	0.744	-0.330
pH	-0.611	-0.509	0.752	0.744	1.000	-0.181
COD	0.307	0.001	-0.312	-0.330	-0.181	1.000

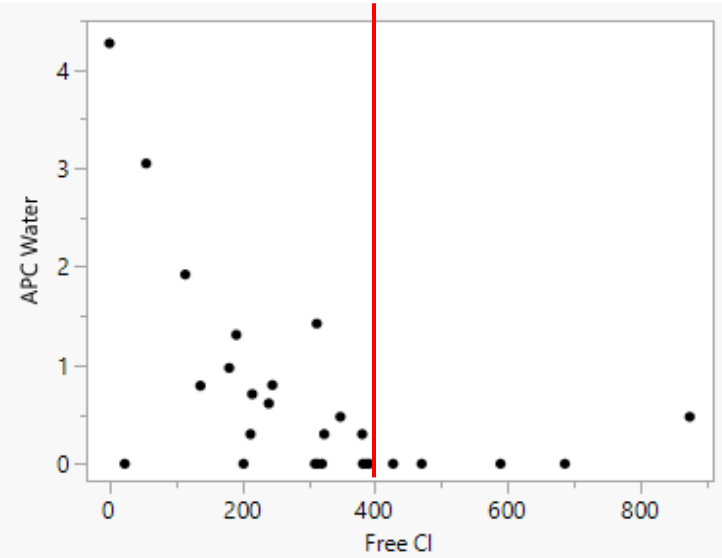
Float Tank Microbial and Physiochemical Quality (Results)

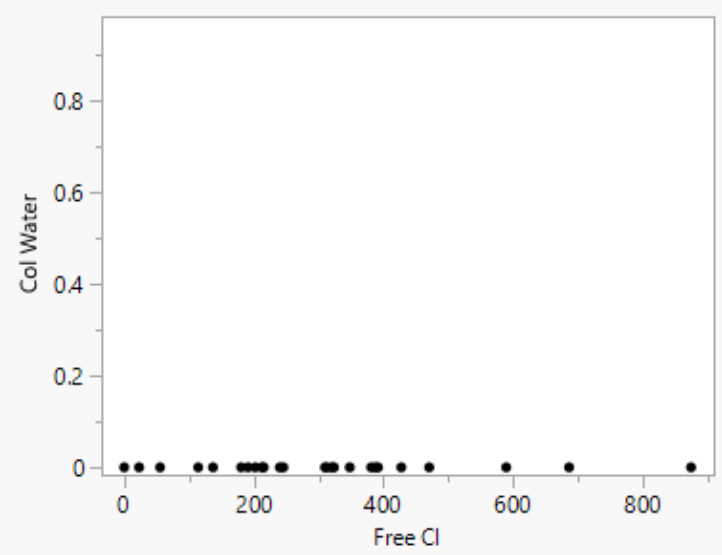
Baseline



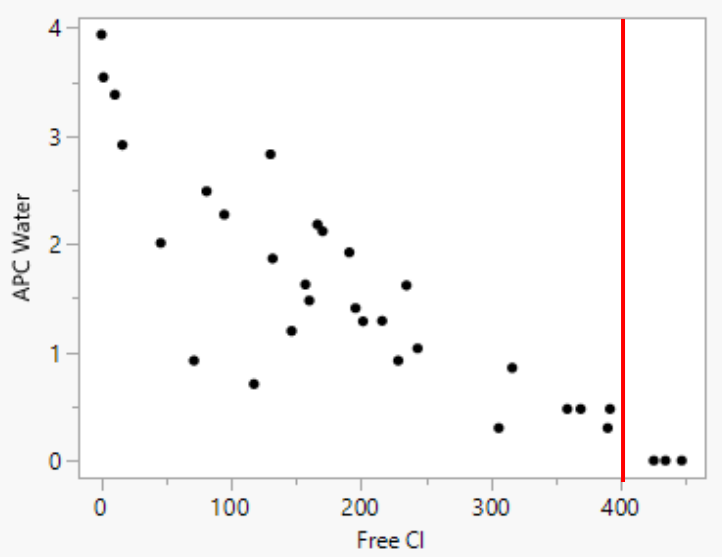


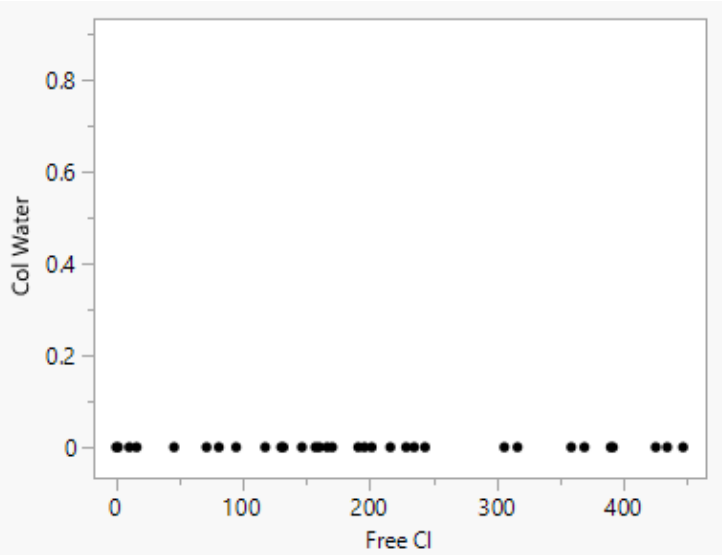
Intervention 1



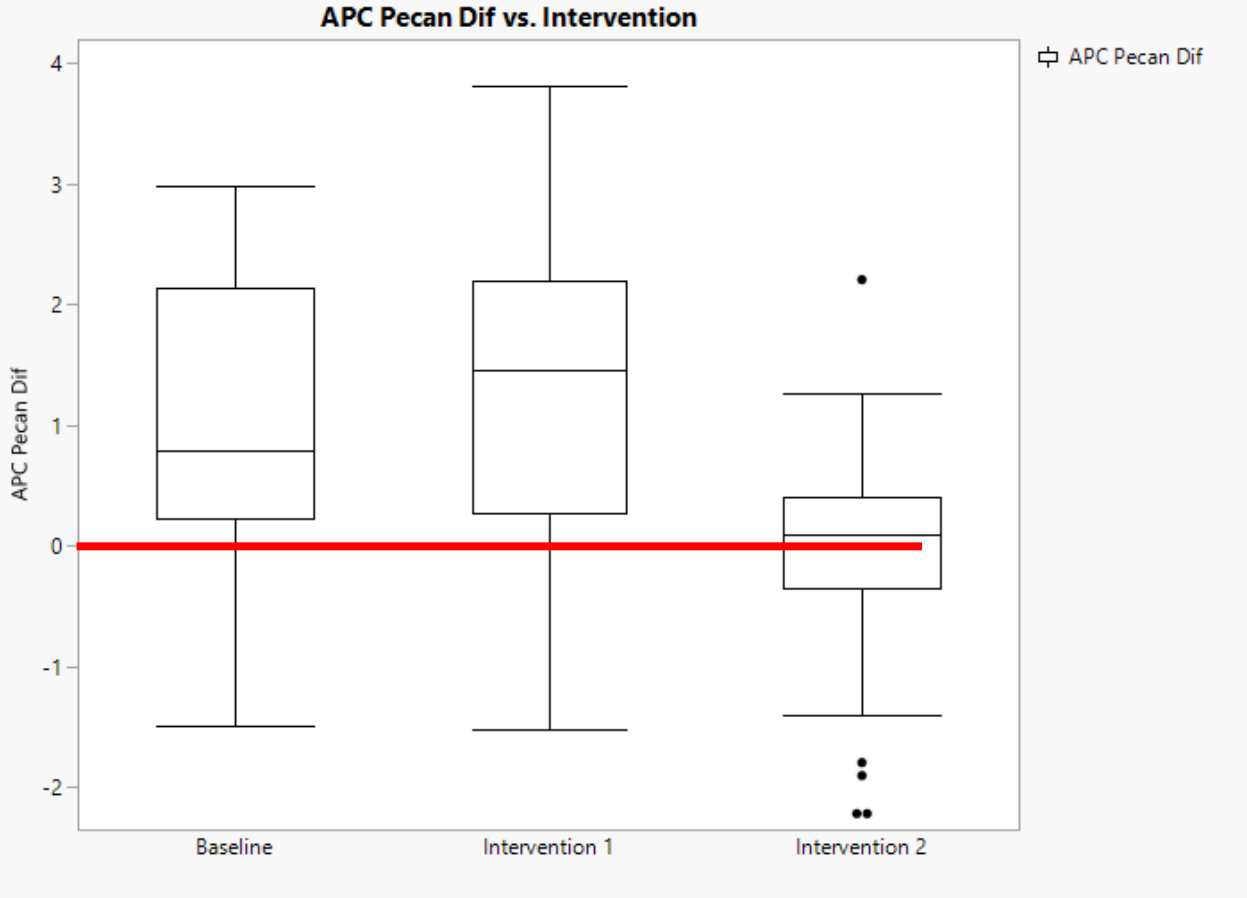


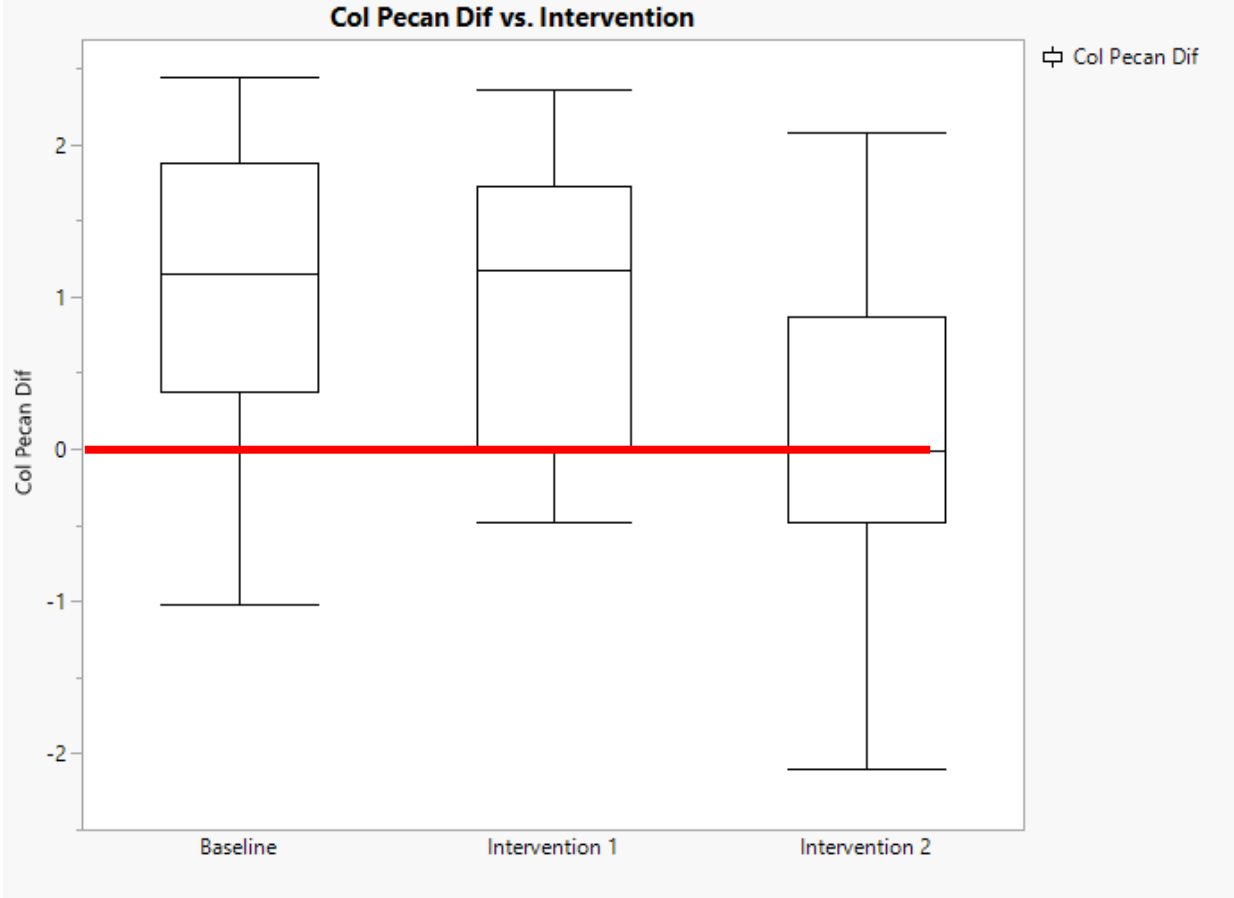
Intervention 2



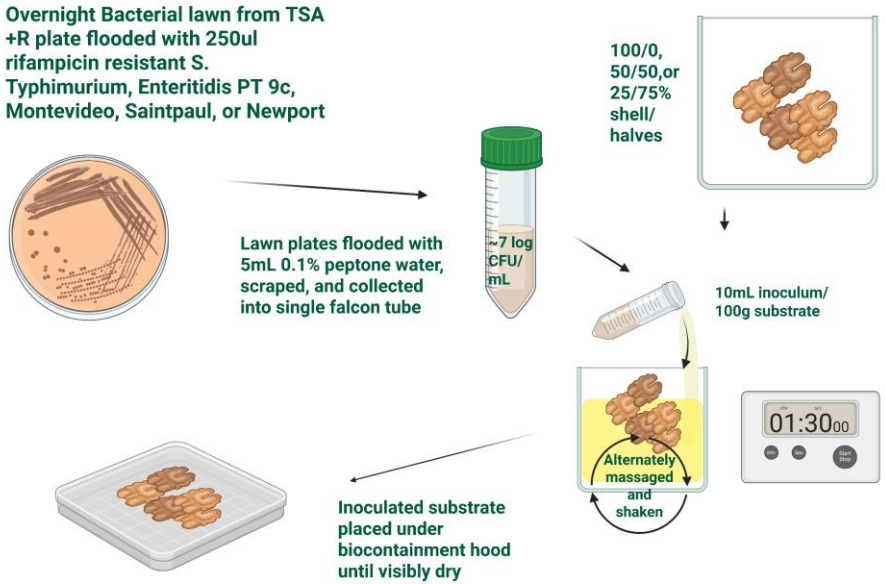


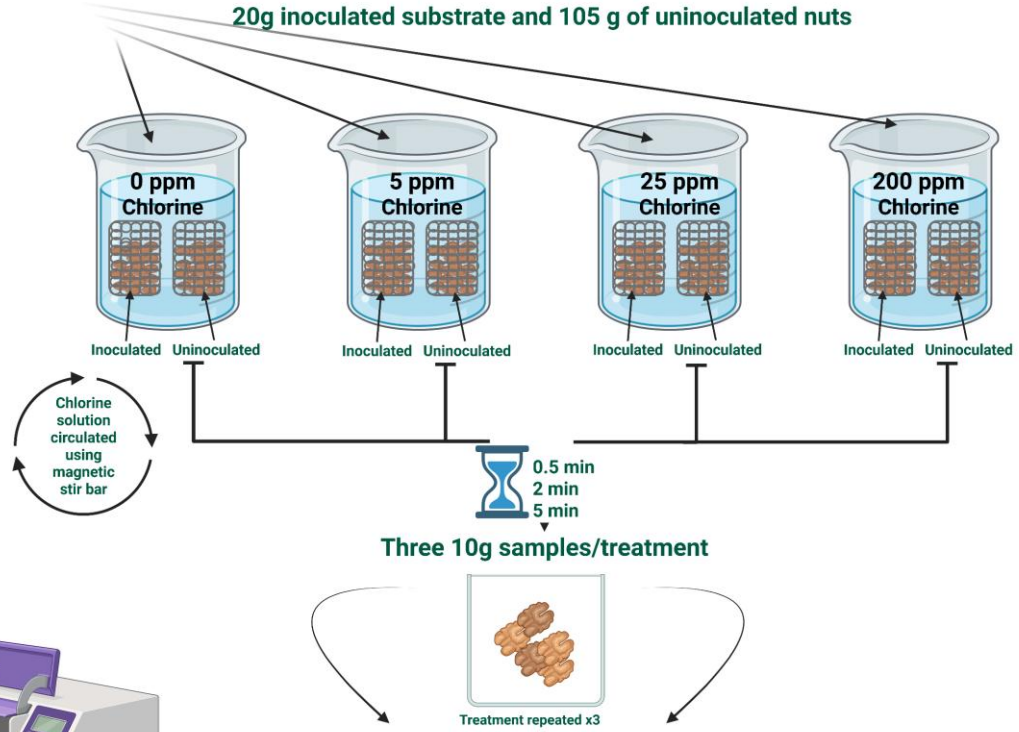
Float Tank Microbial and Physiochemical Quality (Results)

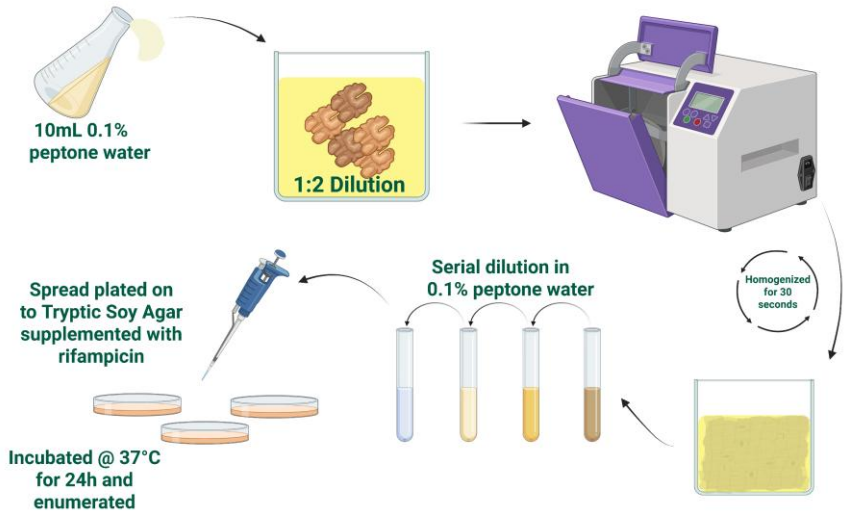




Minimum Chlorine Level to Prevent Cross-Contamination (Methods)







Data was analyzed by General Linear Model and Tukey's HSD ($P \leq 0.05$).

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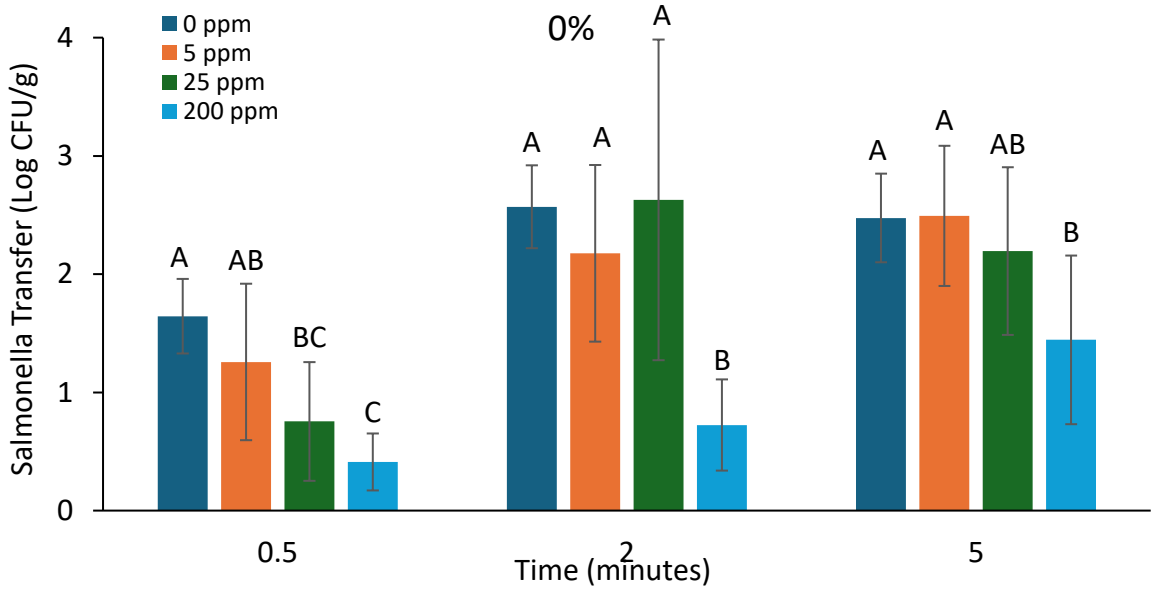
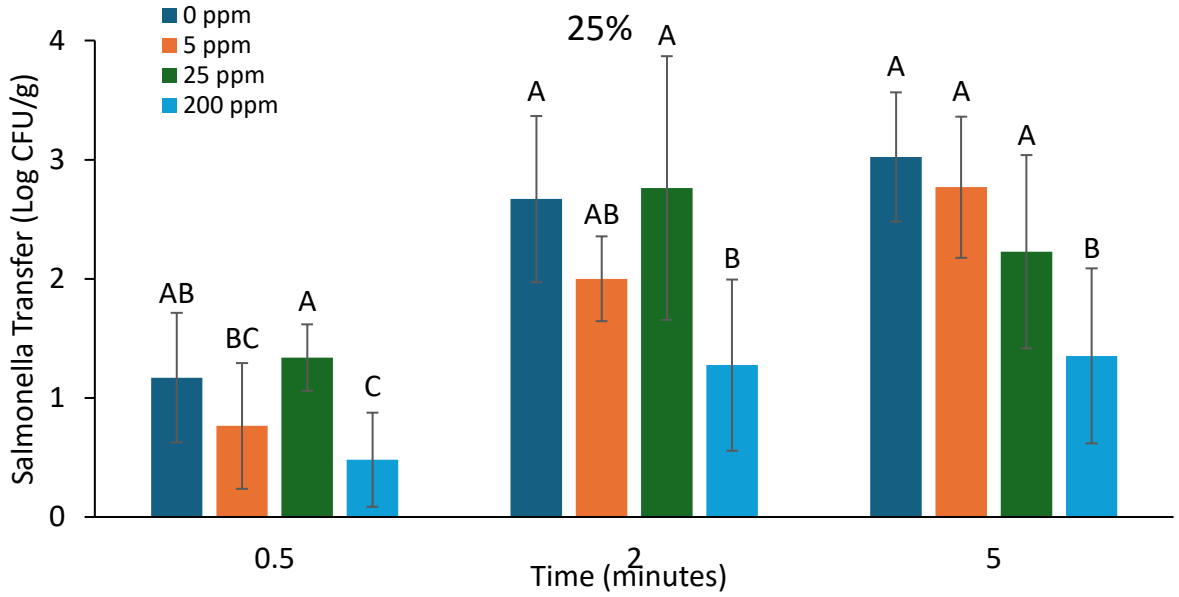
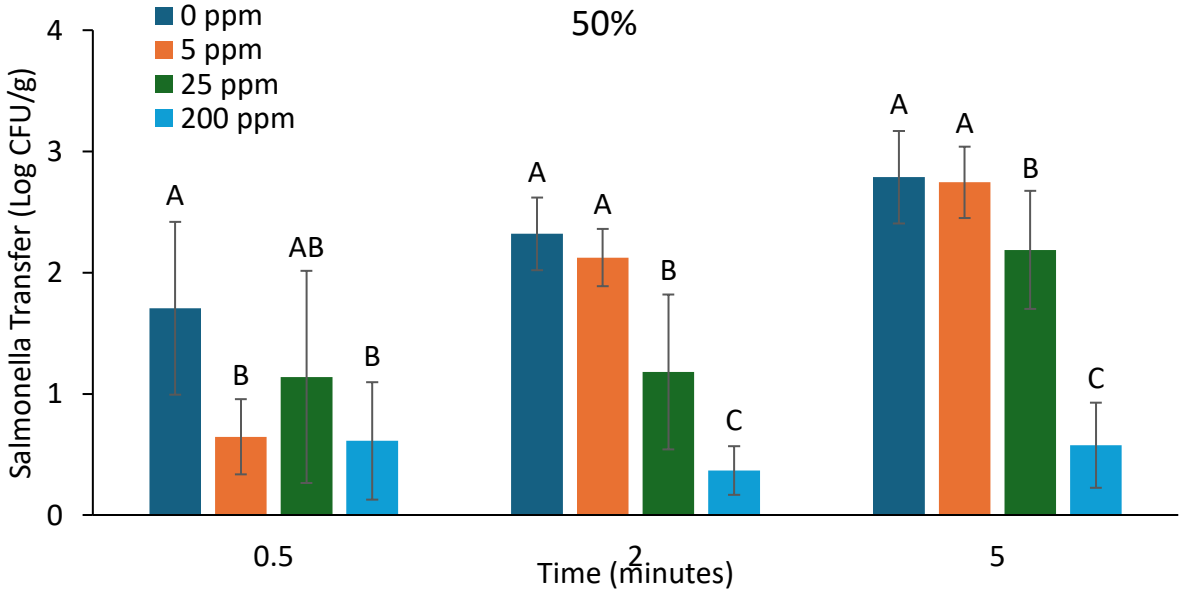
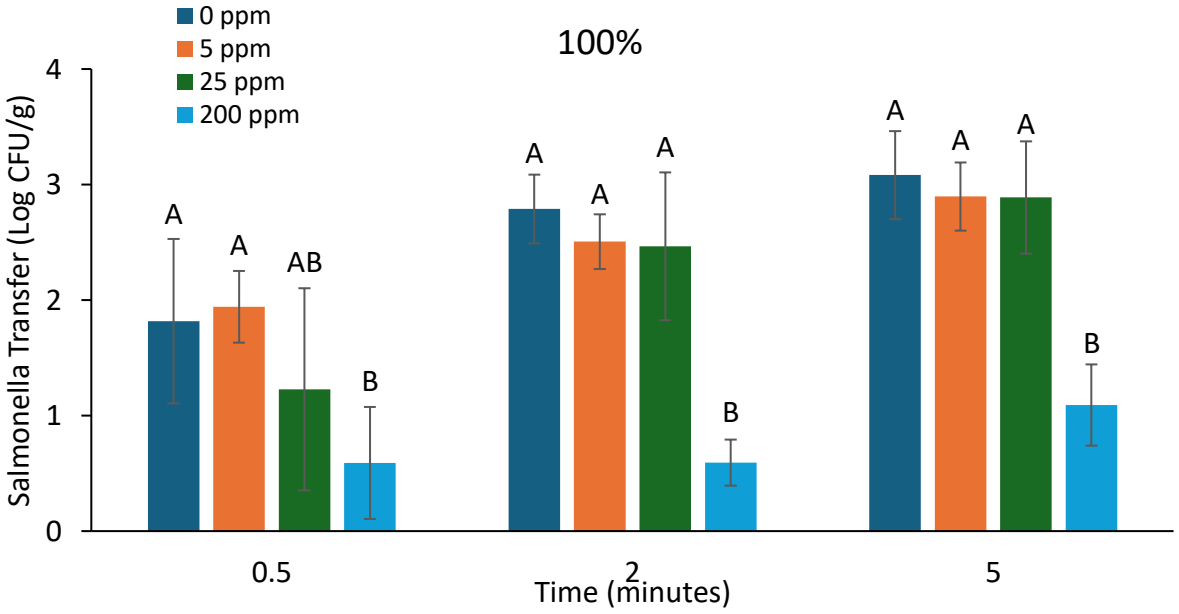
Minimum Chlorine Level to Prevent Cross-Contamination (Results)







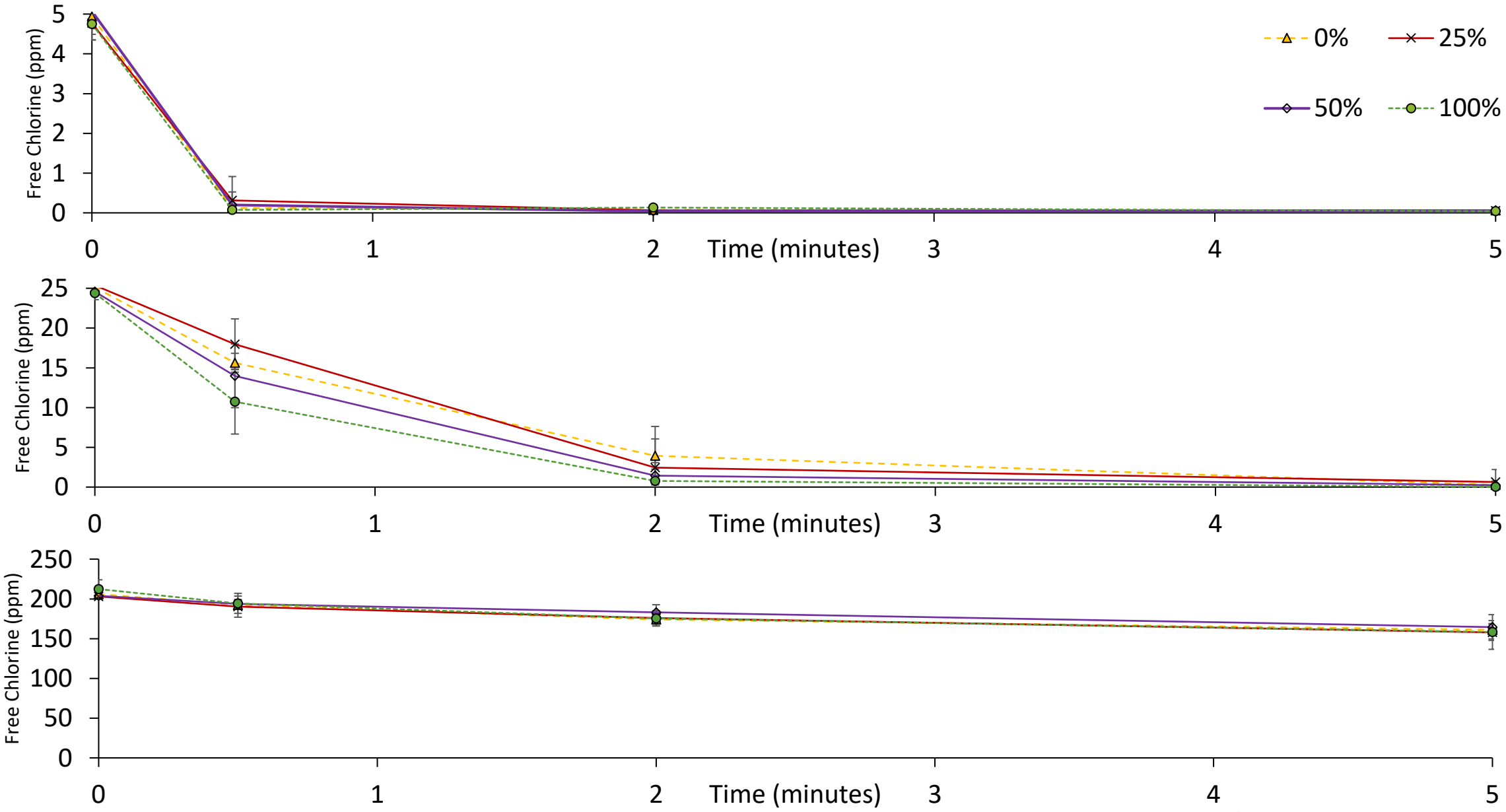


Minimum Chlorine Level to Prevent Cross-Contamination (Results)

Table 1. *Salmonella* transfer to uninoculated pecan samples in a simulated float tank at 0, 5, 25, and 200 ppm free chlorine levels at 0.5, 2, and 5 minutes with 0, 25, 50, and 100% inoculated kernel-shell ratio.

Time	0 ppm A				5 ppm A				25 ppm B				200 ppm C			
(minutes)	0%	25%	50%	100%	0%	25%	50%	100%	0%	25%	50%	100%	0%	25%	50%	100%
0.5 A	(4/9)	(4/9)	(7/9)	(6/9)	(5/9)	(3/9)	(4/9)	(7/9)	(0/9)	(4/9)	(4/9)	(4/9)	(0/9)	(3/9)	(4/9)	(2/9)
2 B	(9/9)	(9/9)	(9/9)	(9/9)	(9/9)	(8/9)	(8/9)	(9/9)	(7/9)	(8/9)	(5/9)	(8/9)	(8/9)	(9/9)	(4/9)	(0/9)
5 B	(9/9)	(9/9)	(9/9)	(9/9)	(8/9)	(8/9)	(9/9)	(9/9)	(4/9)	(9/9)	(9/9)	(8/9)	(4/9)	(1/9)	(4/9)	(2/9)

Minimum Chlorine Level to Prevent Cross-Contamination (Results)



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Key Takeaways

- Once free chlorine levels were below 200 ppm aerobic plate counts (microbial load) increased and once below 100 ppm coliform counts (indicator organisms) increased in the float water.
- Intervention 1 (chlorine spike every 60 minutes) improved the microbial quality of the water and eliminated the coliforms in the float water.
- Intervention 2 (peracetic spray bar at the end of the system) significantly improved the microbial quality of the pecans after going through the float system.
- Increased time in the float system significantly impacted the transfer of *Salmonella* to the kernels, except for the 200 ppm free chlorine treatment
- Free chlorine levels around 200 ppm free chlorine were most effective at preventing cross-contamination of *Salmonella*.

Future Research

- Optimize in-line pulsed light treatments to maximize reductions.
- Determine optimal hot water sanitation parameters to achieve a 5-log reduction while maintaining quality and improve shelling.
- Evaluate the antimicrobial properties of coatings and modified packaging.
- Investigate the effectiveness of gas treatments on foodborne pathogens while maintaining quality.
  - Ozone
  - Chlorine Dioxide
- Evaluate promising end of process pathogen treatments.
  - E-Beam/Irradiation
  - Pulsed Electric Field
- Determine controls and best practices to reduce contamination along the supply chain.

Questions

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Acknowledgements

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