

Research update: Characterization and mitigation of *Salmonella* and *Listeria* risks

Presented by:

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Objectives

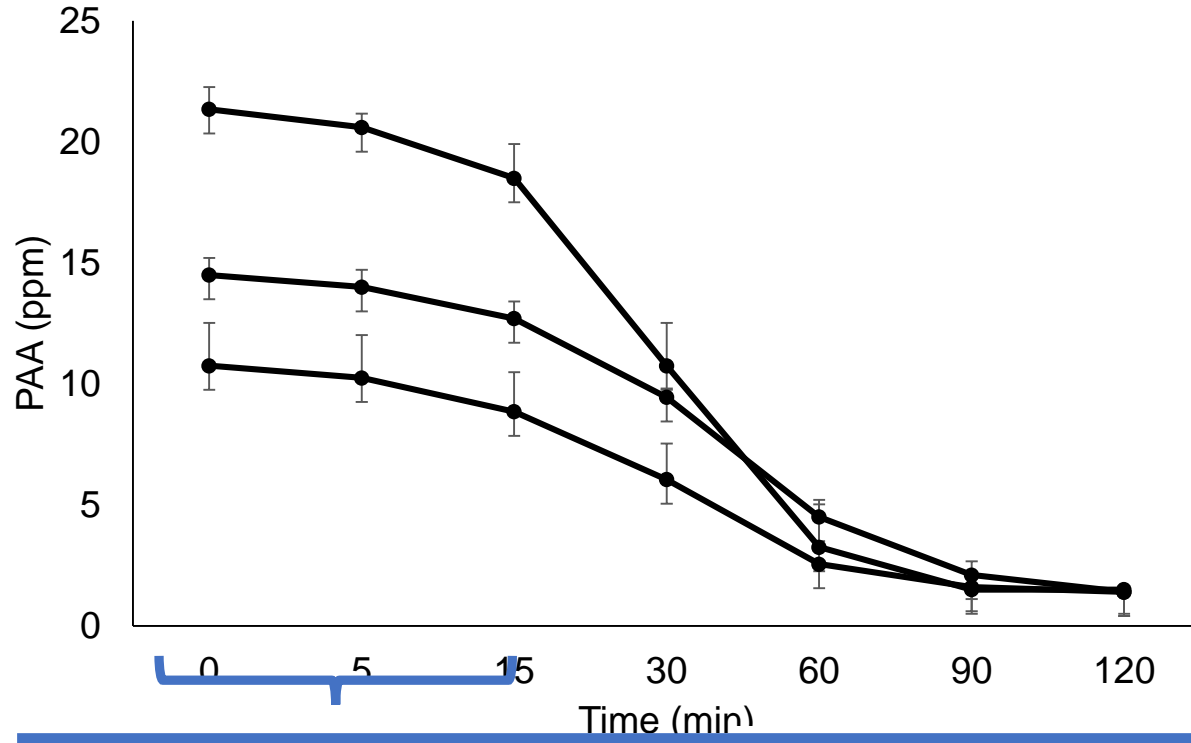
- Preventing cross contamination
 - Pathogens: *Salmonella* and *Listeria monocytogenes*
 - Citrus packinghouse systems:
 - Imazalil, soda ash, sodium bicarbonate
 - Tanks, spray, drench systems
 - Recirculated/reused
 - Compatible sanitizers:
 - Chlorine and peracetic acid
- Evaluating survival of inoculated *Salmonella*, *L. monocytogenes* on citrus fruit as a function of inoculum carrier



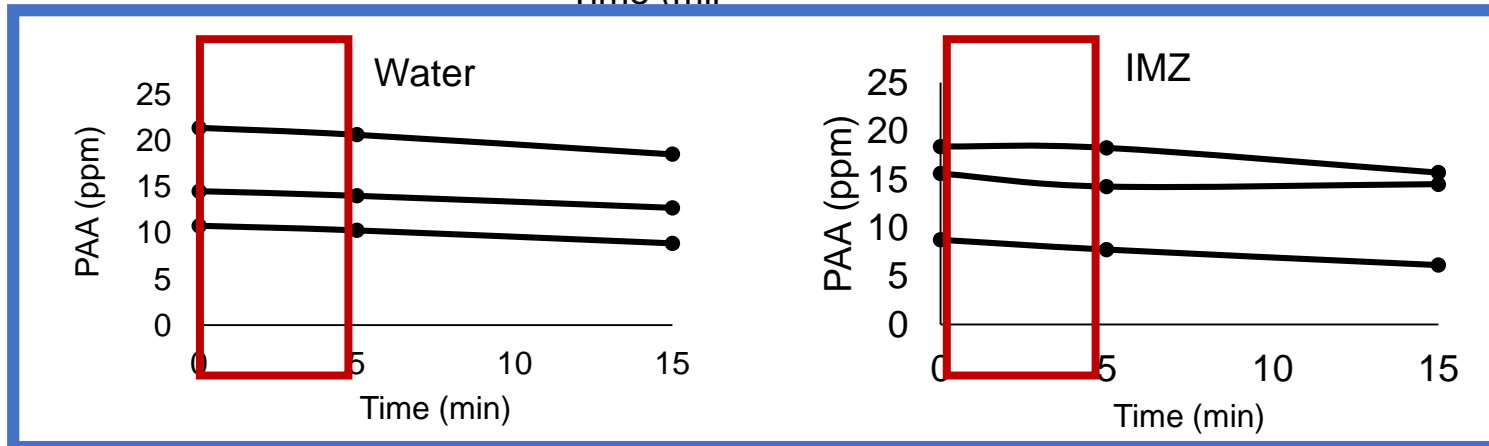
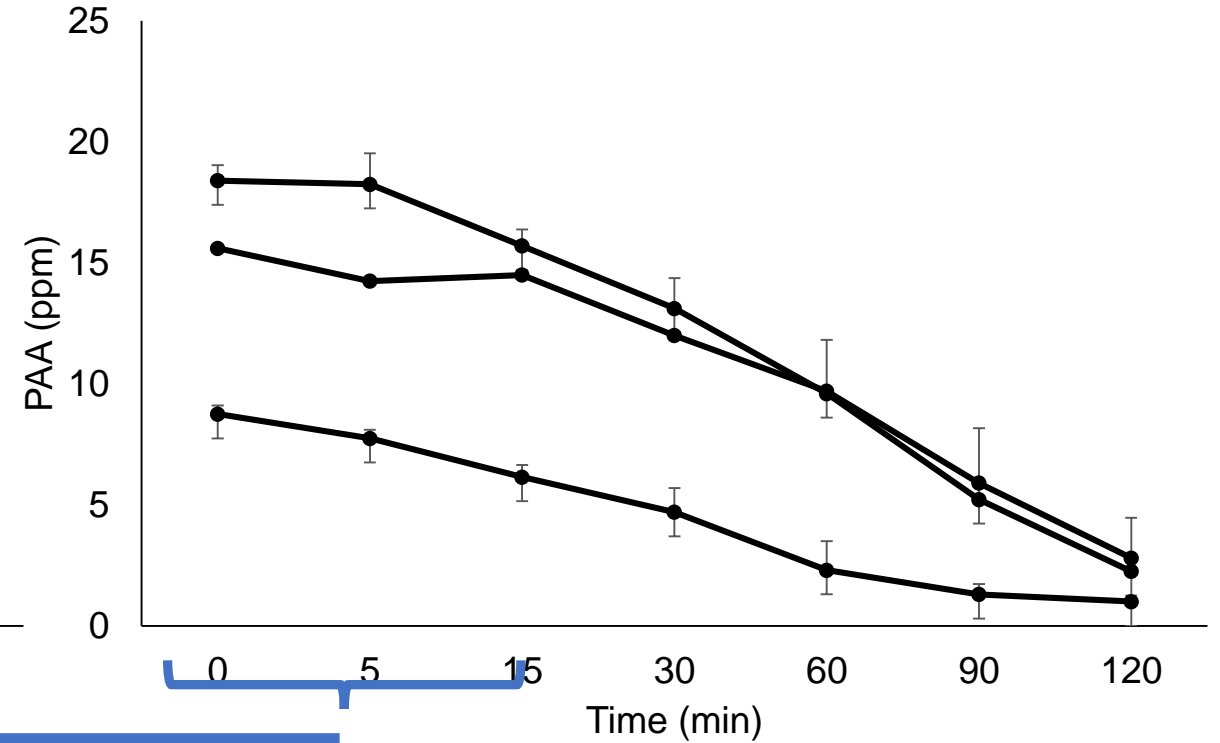
Imazalil with PAA

Stability of PAA in water and Imazalil (300 ppm) at 23°C (73°F)

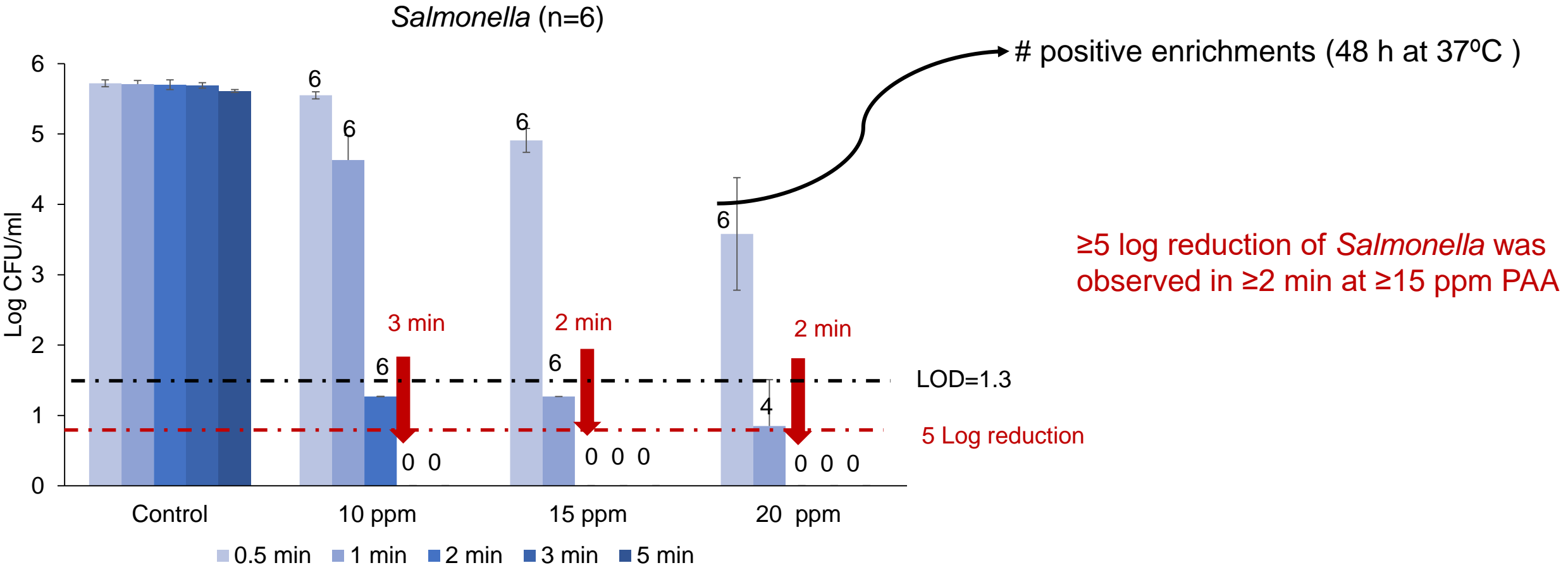
Water



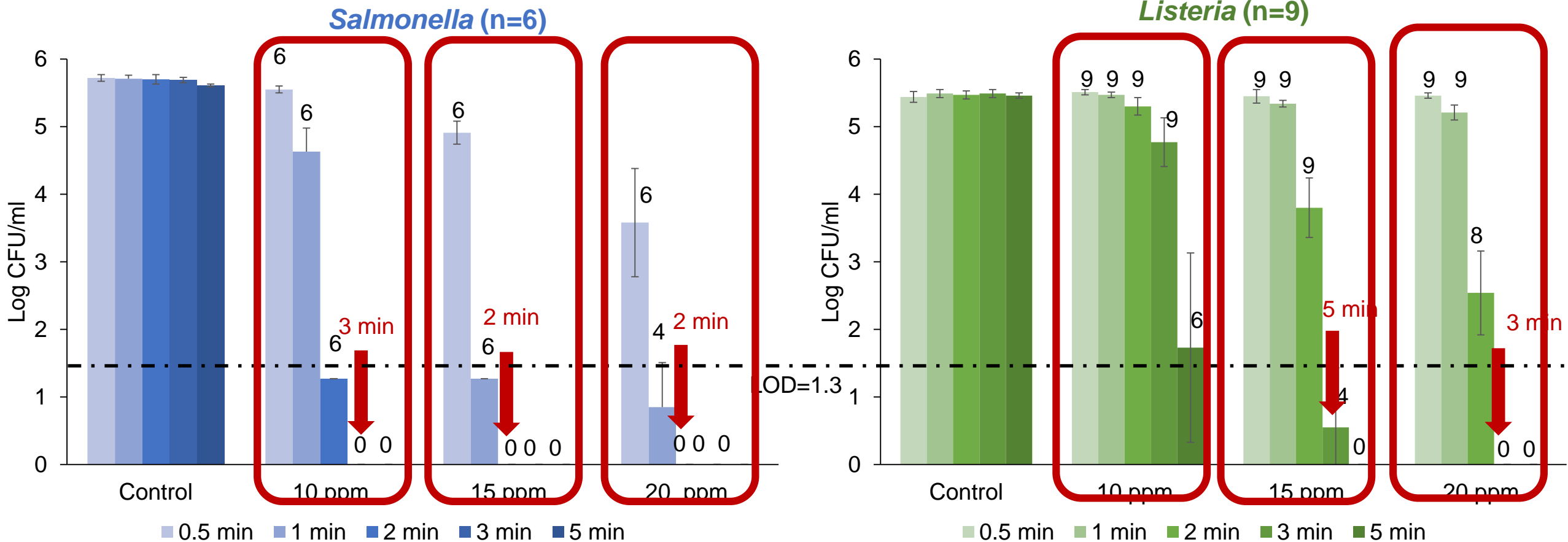
IMZ



Effect of PAA concentration (10 to 20 ppm) and exposure time (0.5 to 5 min) on the inactivation of *Salmonella* in 300 ppm imazalil at 16°C (60°F)



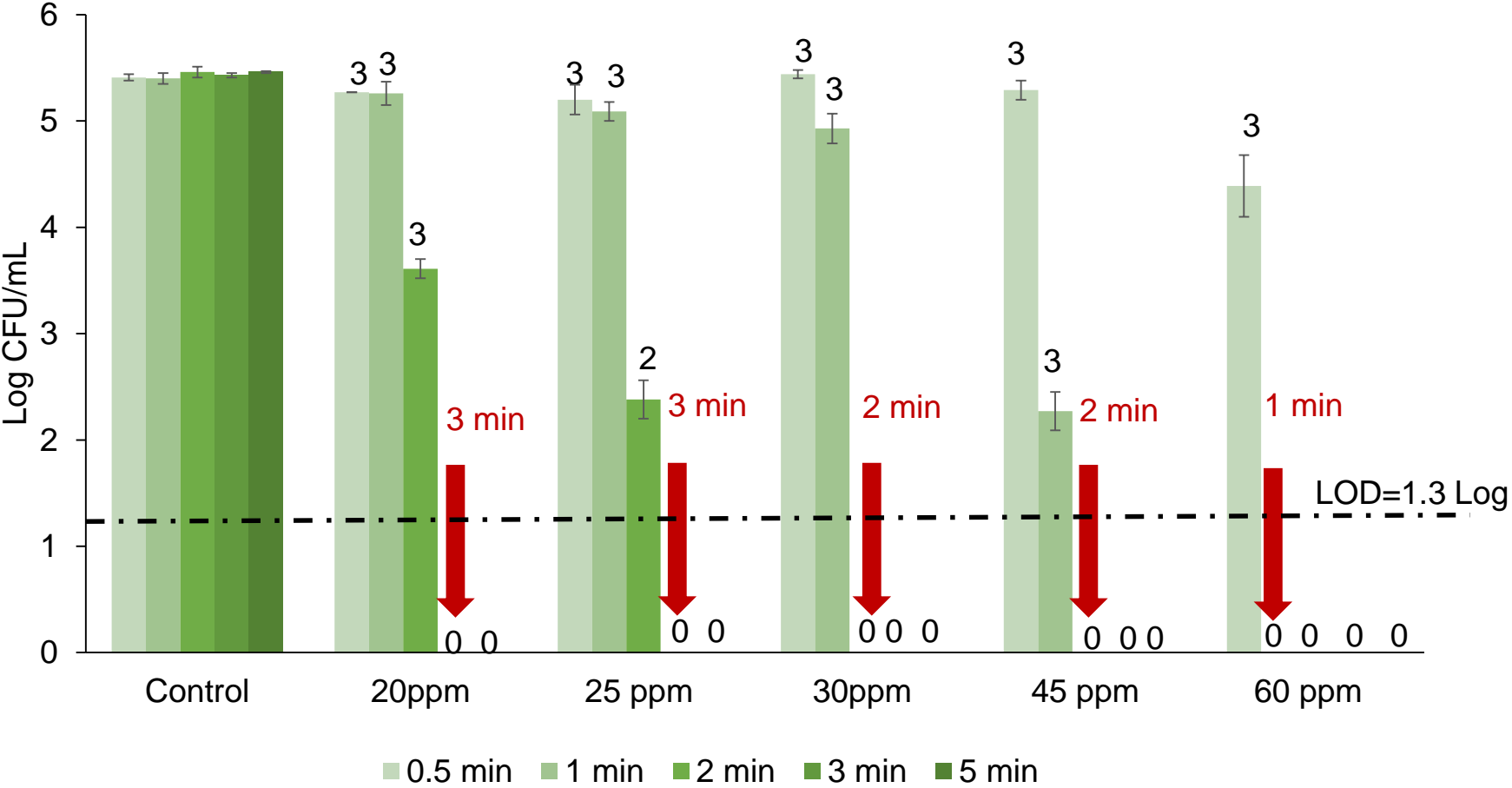
Effect of PAA concentration (10 to 20 ppm) and exposure time (0.5 to 5 min) on the inactivation of *Salmonella* and *Listeria* in 300 ppm imazalil at 16°C (60°F)



≥5 log reduction of *Salmonella* in ≥2 min at ≥15 ppm PAA

≥5 log reduction of *Listeria* in ≥3 min at ≥20 ppm PAA

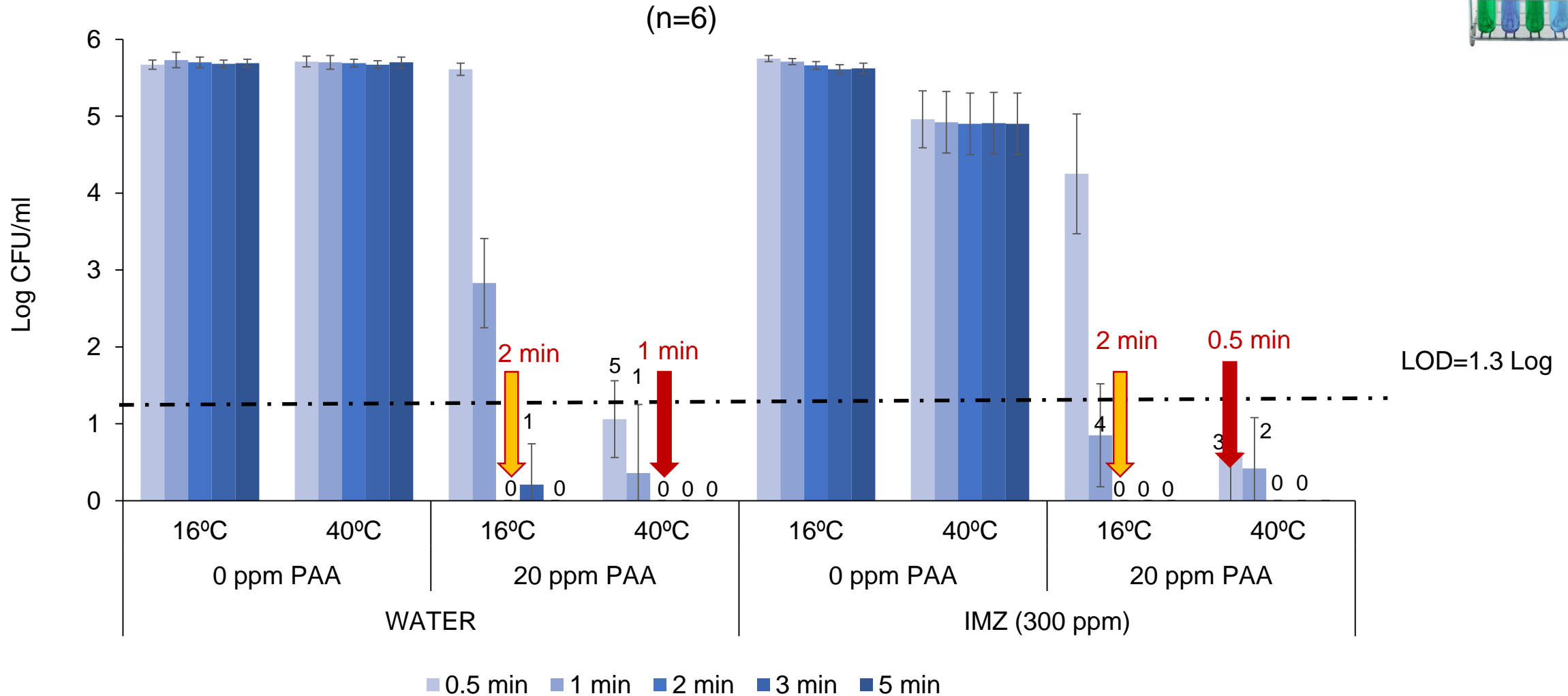
Effect of PAA concentration (20 to 60 ppm) and exposure time (0 to 5 min) on the inactivation of *Listeria* in 300 ppm imazalil at 16°C (60°F) (n=3)



PAA (ppm)	pH	
	IMZ (300 ppm)	Water
0	8.22	8.3
20	7	7.18
25	6.89	6.95
30	6.62	6.74
45	6.45	6.50
60	6.07	6.05

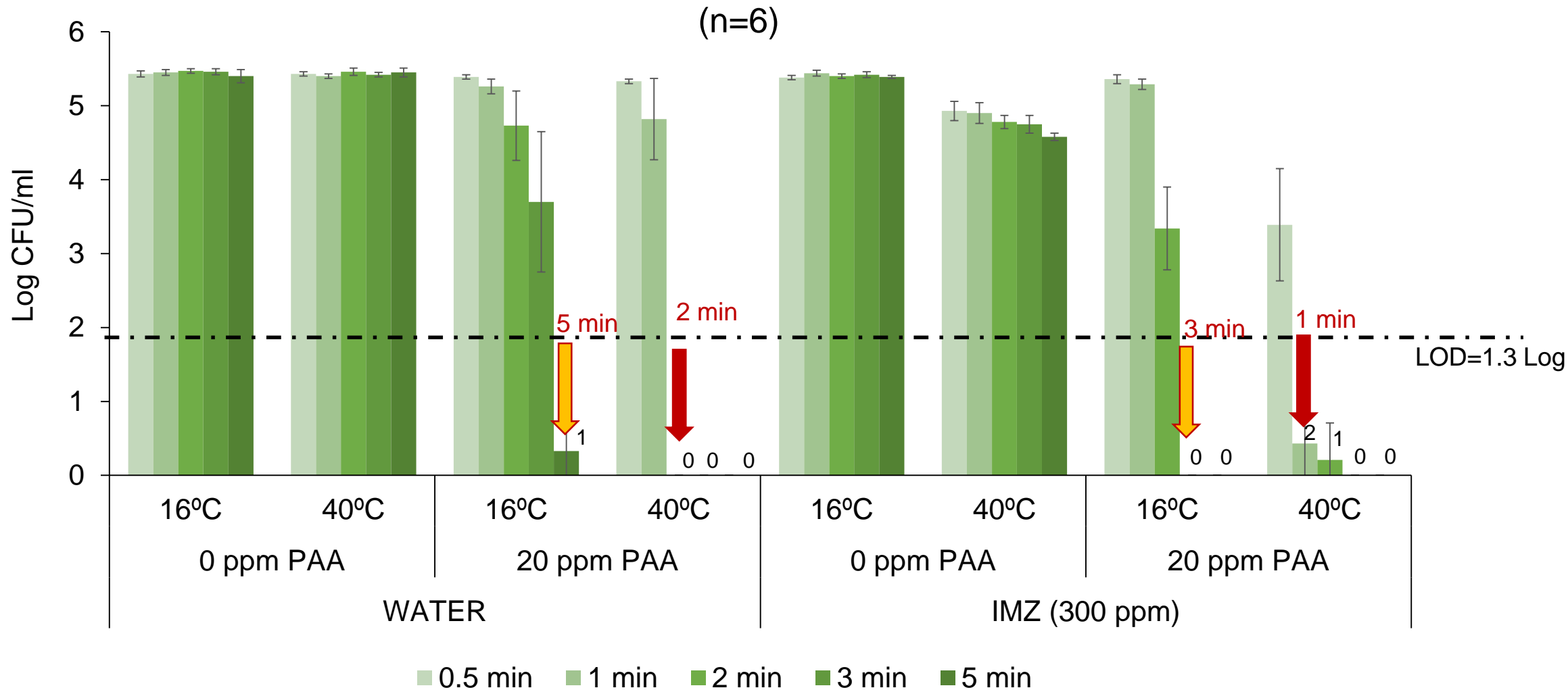
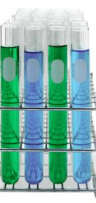
a ≥5 log reduction of *Listeria* in IMZ was observed in ≥3 min at 20 and 25 ppm PAA or ≥2 min at 30 and 45 ppm or 1 min at 60 ppm

Effect of temperature 16 vs 40°C (60 vs 104°F) on the inactivation of *Salmonella* with or without imazalil (300 pp) or PAA (20 ppm)



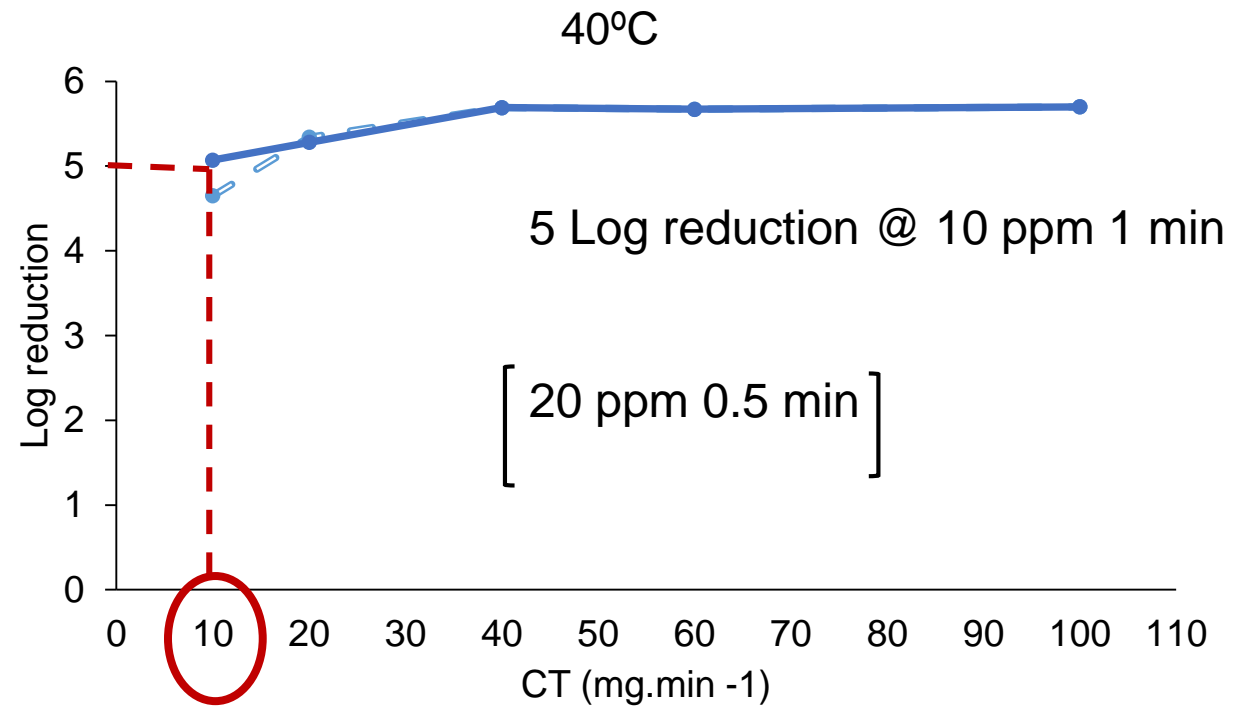
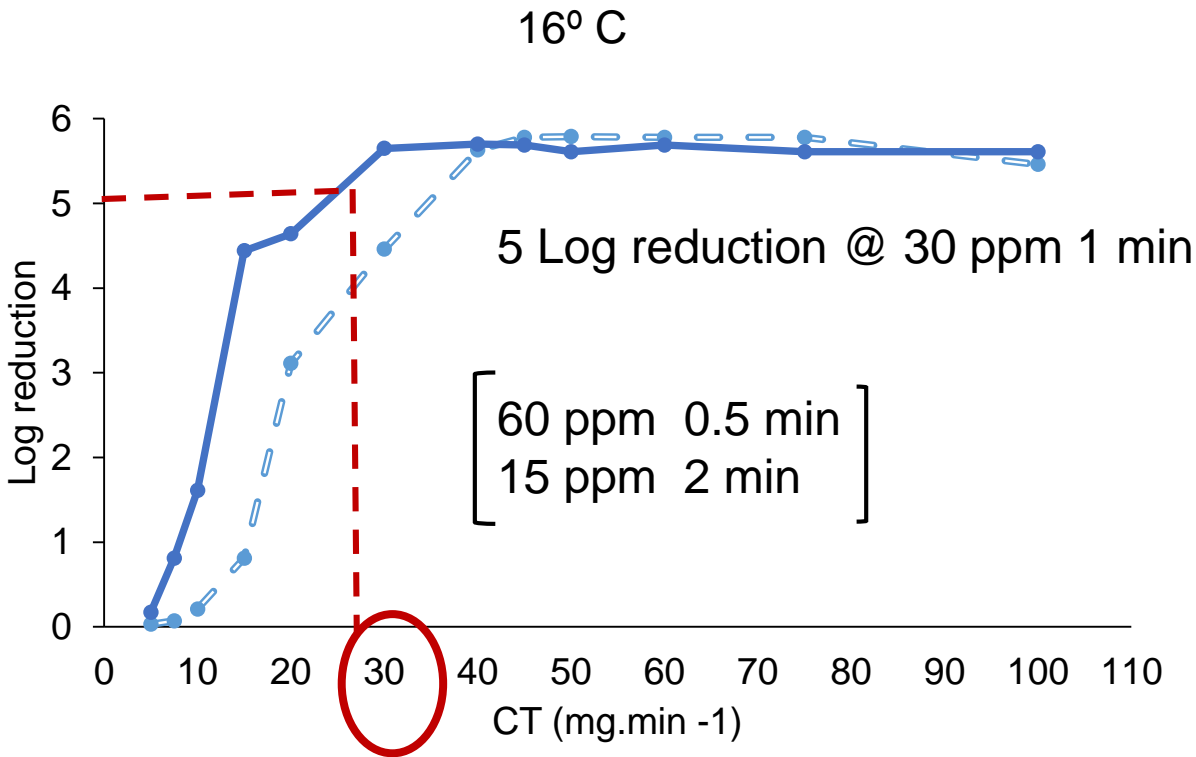
Greater survival of *Salmonella* was observed at 16°C compared to 40°C.
 At 40°C ≥5 log reductions of *Salmonella* was observed within 0.5 min exposure of IMZ with 20 ppm PAA

Effect of temperature 16 vs 40°C (60 vs 104°F) on the inactivation of *Listeria* with or without imazalil (300 pp) or PAA (20 ppm)



Greater survival of *Listeria* was observed at 16°C compared to 40°C.
 At 40°C ≥5 log reductions of *Listeria* was observed within 1 min exposure of IMZ with 20 ppm PAA

Log reduction of *Salmonella* as a function of minimum effective dose of PAA at 16 and 40°C (60 and 104°F)

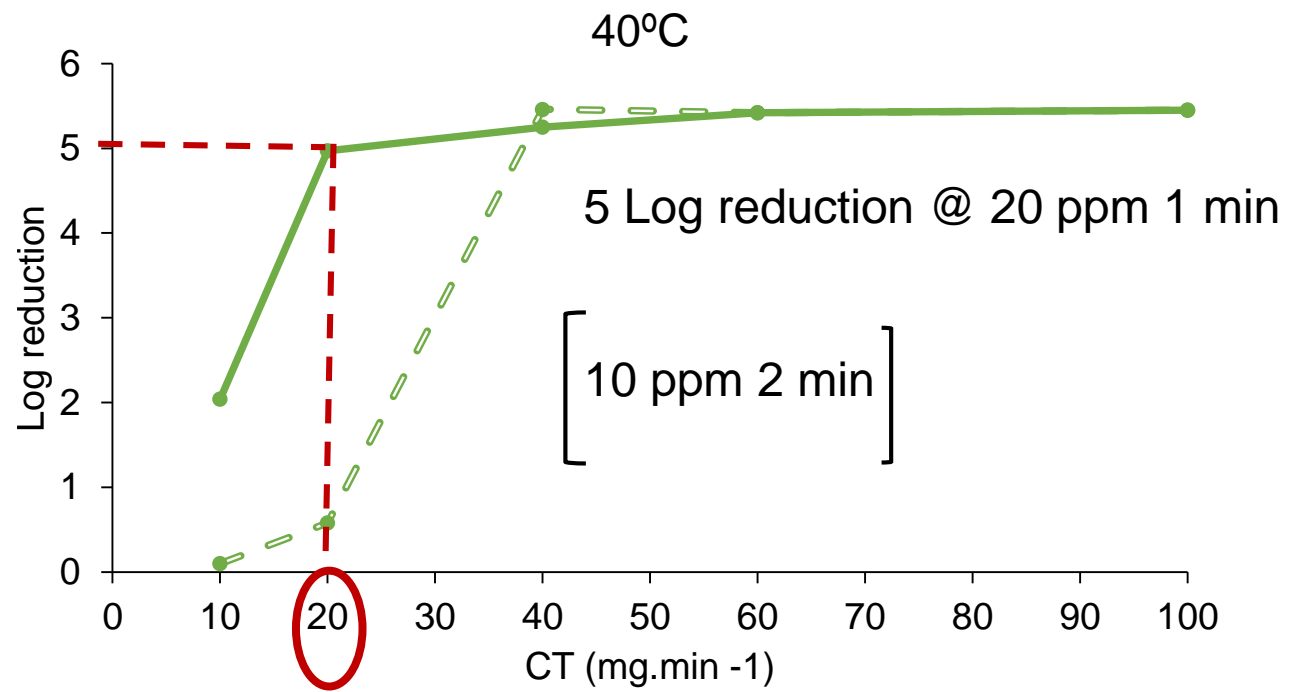
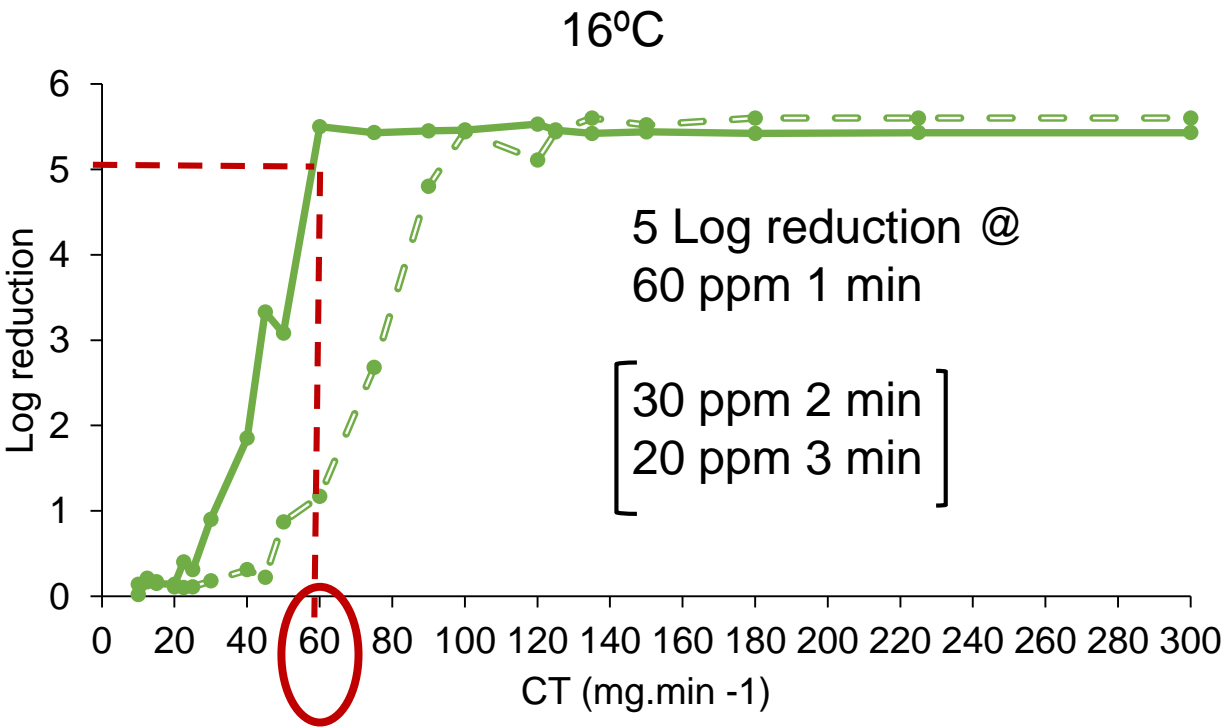


● Water

● IMZ (300 ppm)

CT= Antimicrobial concentration (ppm) X Contact time (min)

Log reduction of *Listeria* as a function of minimum effective dose of PAA at 16 and 40°C (60 and 104°F)



○ Water ● IMZ (300 ppm)

Minimum effective dose of PAA to achieve ≥ 5 log reduction of *Salmonella* and *Listeria* in water and imazalil (300 ppm) at 16°C and 40°C in the absence of organic matter



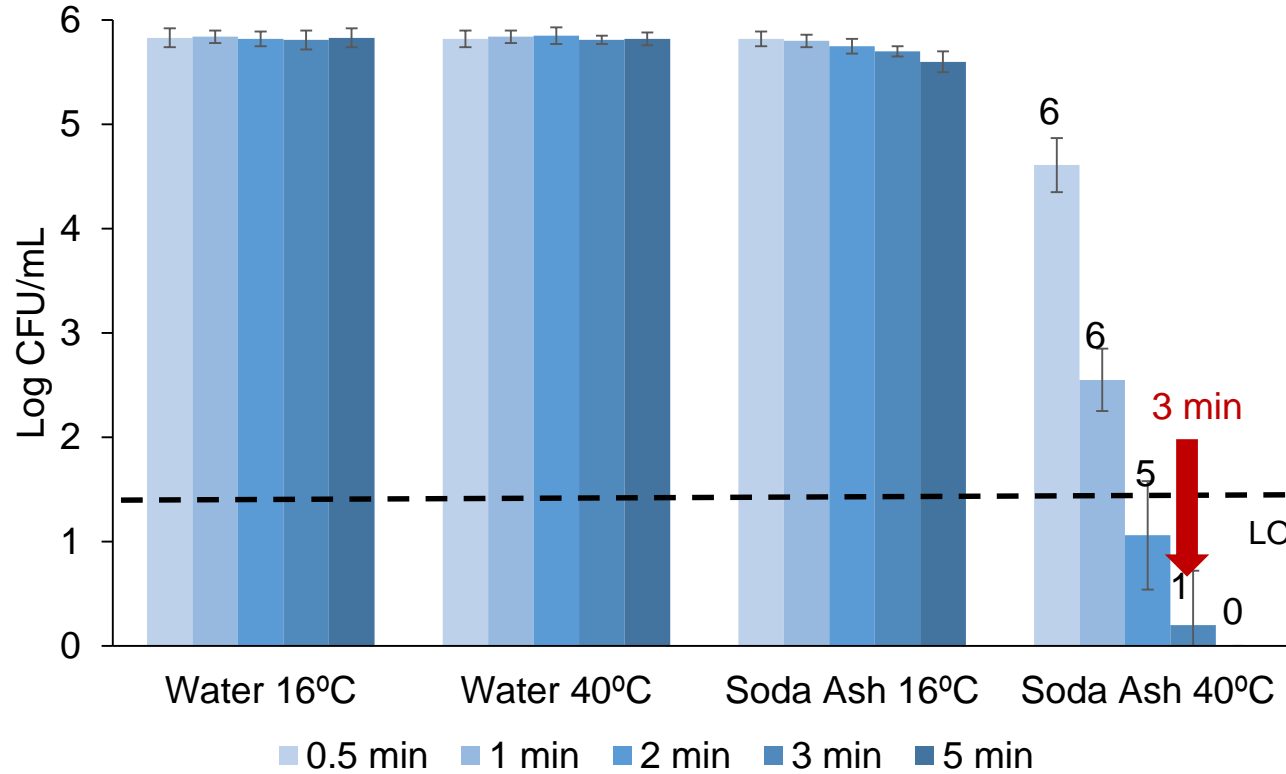
Solution	Temperature (°C)	CT value ≥ 5 log reduction (mg.min ⁻¹)	
		<i>Salmonella</i>	<i>Listeria</i>
Water	16	40	95
	40	20	40
Imazalil (300 ppm)	16	30	60
	40	10	20

Soda Ash

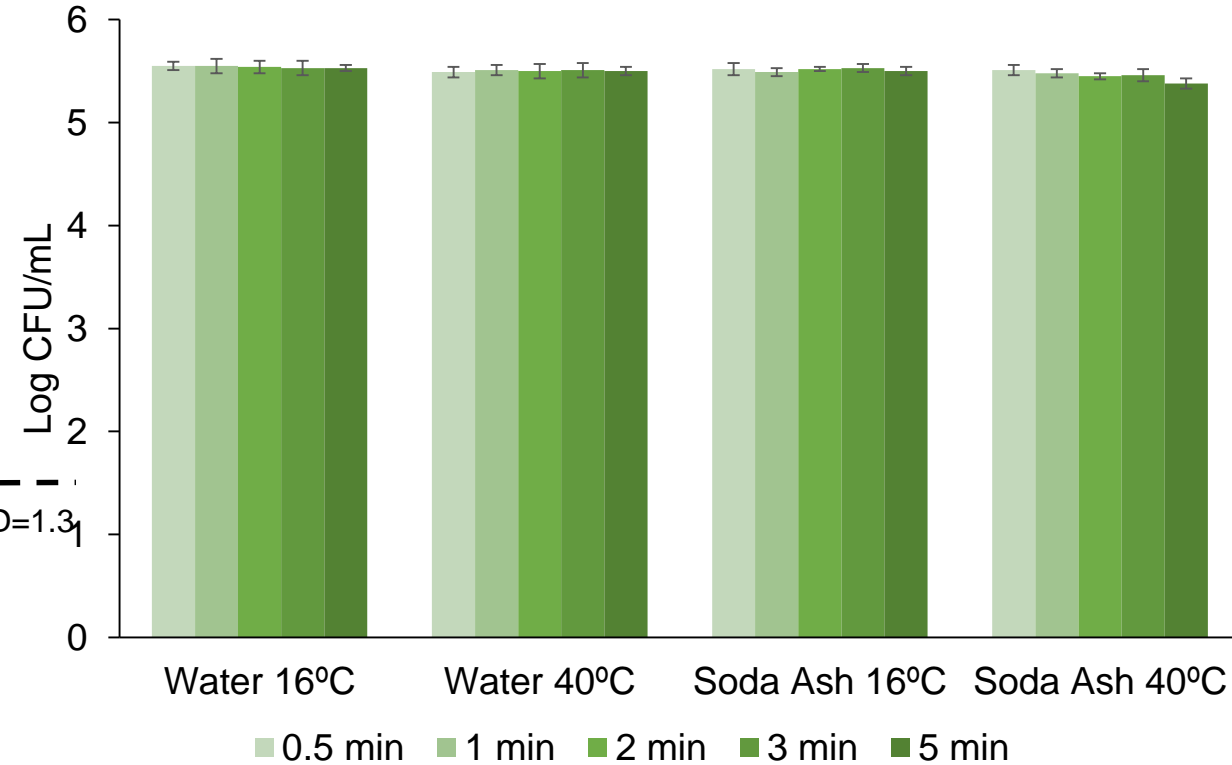
Survival of *Salmonella* and *Listeria* in water and 3% soda ash at 16 and 40°C (60 and 104°F)



Salmonella (n=6)



Listeria (n=6)

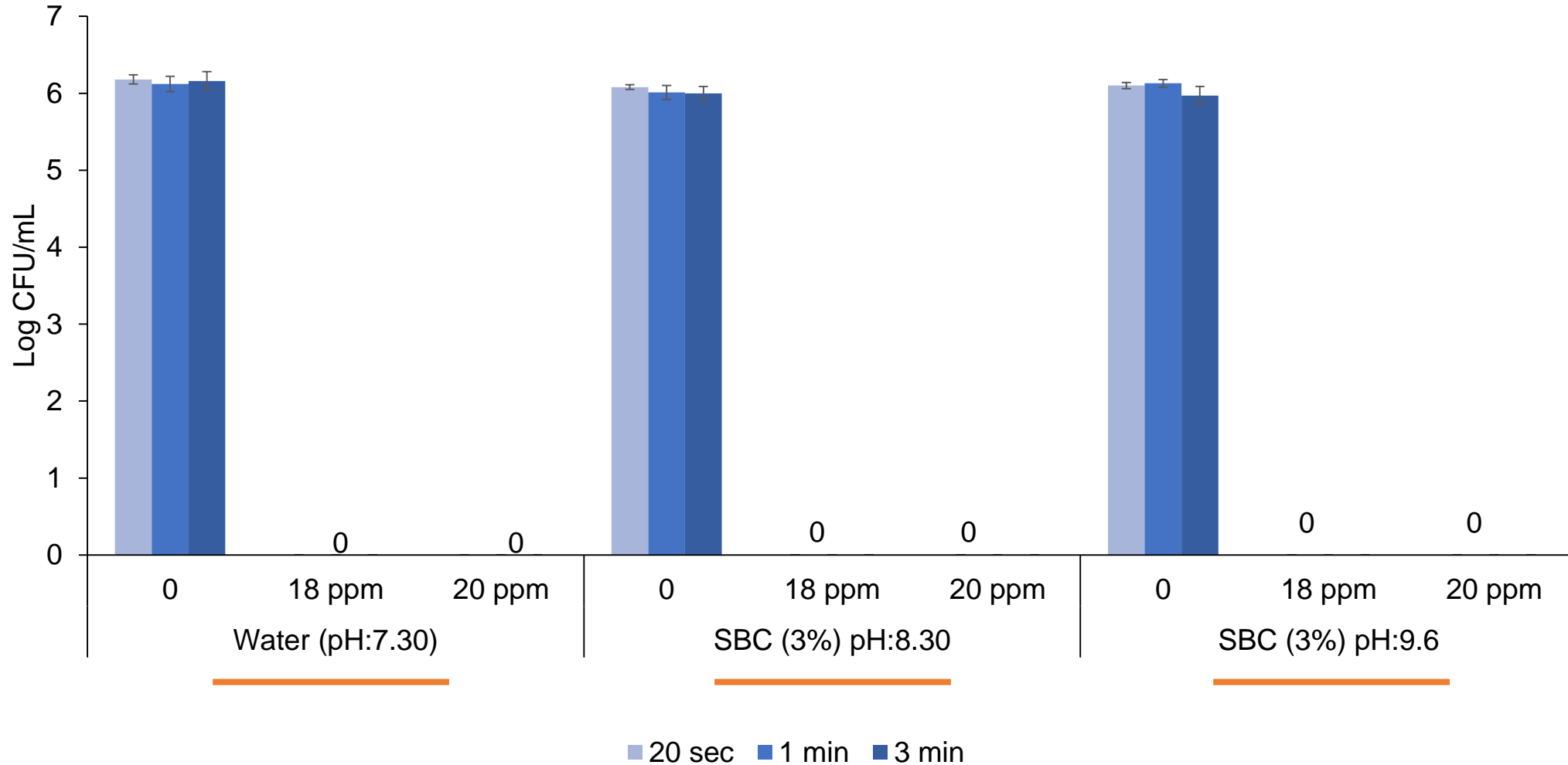
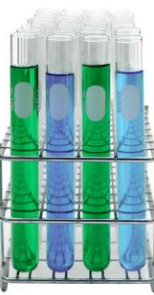


Water pH=7.90
Soda ash pH=11.30

3% soda ash was not effective in reduction of *Listeria* population at 16°C and 40°C.
3% soda ash was not effective in reduction of *Salmonella* population at 16°C, while at 40°C a ≥ 5 log reduction of *Salmonella* was observed in ≥ 3 min.

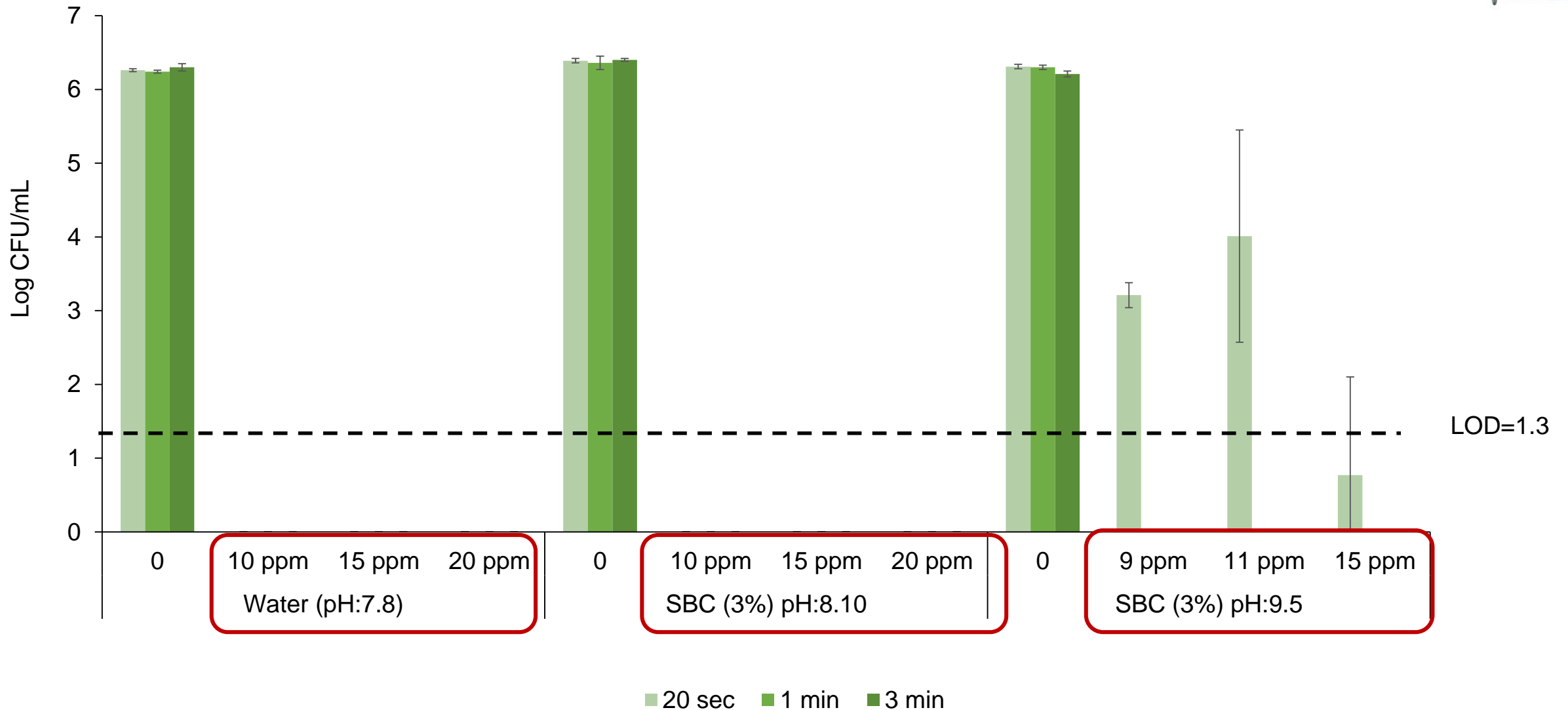
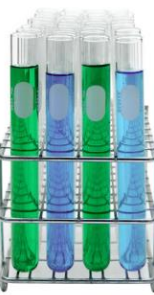
SBC with chlorine

Effect of free chlorine and exposure time on the inactivation of *Salmonella* in 3% SBC at 23°C (73°F) (in the absence of organic matter)



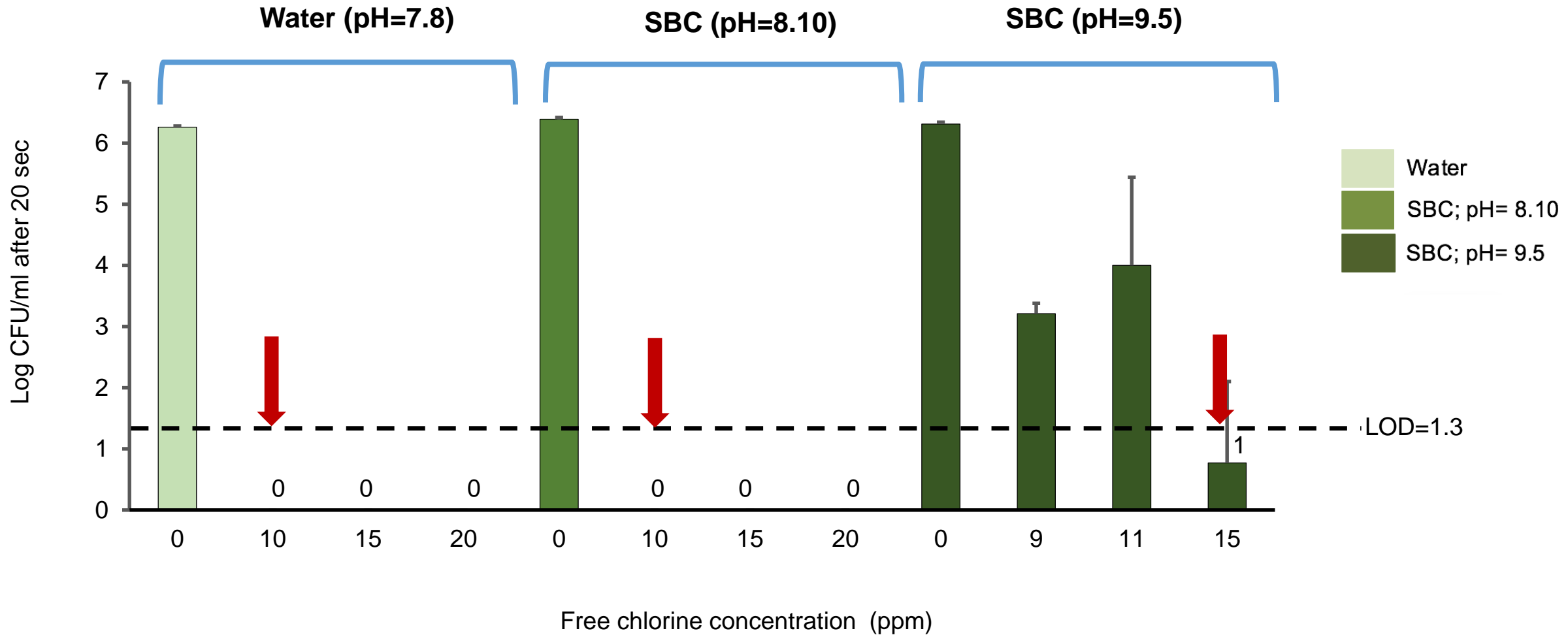
Salmonella were reduced 6 log CFU/ml after 20 seconds of exposure to ≥ 18 ppm free chlorine in 3% SBC at pH 8.3 and 9.6

Effect of free chlorine and exposure time on the inactivation of *Listeria* in 3% SBC at 16°C (60°F) (in the absence of organic matter)



consistent dose of chlorine; different free chlorine

Survival of *Listeria* after 20 sec exposure of chlorine at 16°C (n=3)



Summary (no organic matter)

IMZ+ PAA

- *Listeria* was more resistant than *Salmonella*
- ≥ 5 log reduction of *Salmonella*: ≥ 2 min at ≥ 15 ppm PAA at 16°C ; CT=30 ($\text{mg}\cdot\text{min}^{-1}$)
- ≥ 5 log reduction of *Listeria*: ≥ 3 min at ≥ 20 ppm PAA 16°C ; CT= 60 ($\text{mg}\cdot\text{min}^{-1}$)
- At 40°C , minimum effective dose of PAA to achieve ≥ 5 log reduction of *Listeria and Salmonella* reduced to the CT of **10** and **20** $\text{mg}\cdot\text{min}^{-1}$, respectively.

3% Soda ash

- No reduction of *Listeria* at 16°C or 40°C after 5 min
- No reduction of *Salmonella* at 16°C after 5 min
- ≥ 5 log reduction of *Salmonella* in ≥ 3 min at 40°C

3% SBC+ Chlorine

- ≥ 5 log reduction of *Listeria and Salmonella*: 18 ppm free chlorine in 20 sec at pH 8 and 9.5