

Efficacy of Ozone in Sanitizing Fresh Produce

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Safety of Fresh Produce

Judged by the recent disease outbreaks

- **Six month ago**

- **What do we know today?**

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FDA News

FOR IMMEDIATE RELEASE

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FDA Finalizes Report on 2006 Spinach Outbreak

The Food and Drug Administration (FDA) and California's Department of Health Services (CDHS) today released a joint report on an extensive investigation into the causes of an E.coli O157:H7 outbreak last fall that was associated with contaminated Dole brand Baby Spinach and resulted in 205 confirmed illnesses and three deaths. The inquiry was conducted by the California Food Emergency Response Team (CalFERT), a team of experts from FDA's district office in San Francisco and CDHS. They were assisted by experts from the Centers for Disease Control and Prevention (CDC) and Animal and Plant Health Inspection Service of the U.S. Department of Agriculture.

The investigators successfully identified the environmental risk factors and the areas that were most likely involved in the outbreak, but they were unable to definitely determine how the contamination originated.

"The probe was a notable effort by federal, state and local officials," said Robert E. Brackett, Ph.D., director of FDA's Center for Food Safety and Applied Nutrition. "It yielded valuable information we can use to determine how best to reduce the likelihood of similar outbreaks."

The report describes the painstaking detective work of the investigators following the first reports from CDC in September 2006 of an apparent outbreak of E.coli O157:H7 linked to the consumption of bagged spinach. The probe initially focused on the processing and packaging plant of Natural Selection Foods, LLC in San Juan Bautista, CA, where the contaminated products had been processed.

The next focus of the inquiry was the source of the spinach in 13 bags containing E.coli O157:H7 isolates that had been collected nationwide from sick customers. Using the product codes on the bags, and employing DNA

Sources of contaminants

- Water (Irrigation. Rainfall runoff.)
- Animals (farm or feral)
- Humans (Harvest. Handling, etc)
- Factory (Wash water. Package)
- Retail (Display case. Home. Cross contamination)



<http://en.wikipedia.org/wiki/Image:Runoff.jpg>



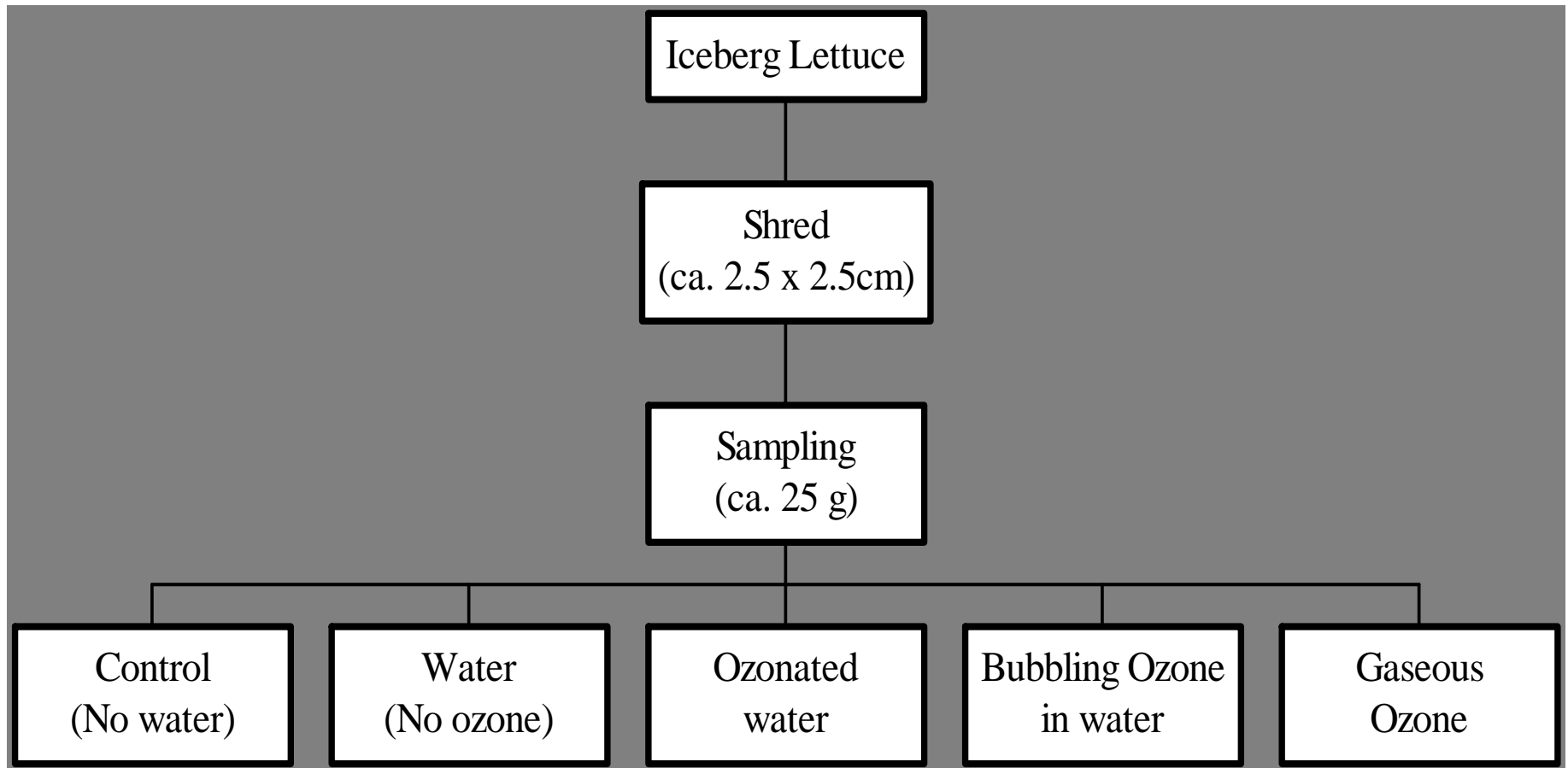
San Benito River on the Paicines Ranch: Cattle Crossing

<http://www.fda.gov/bbs/topics/NEWS/2007/NEW01593.html>

EFFECTIVE OZONE DELIVERY FOR DECONTAMINATION OF FRESH LETTUCE

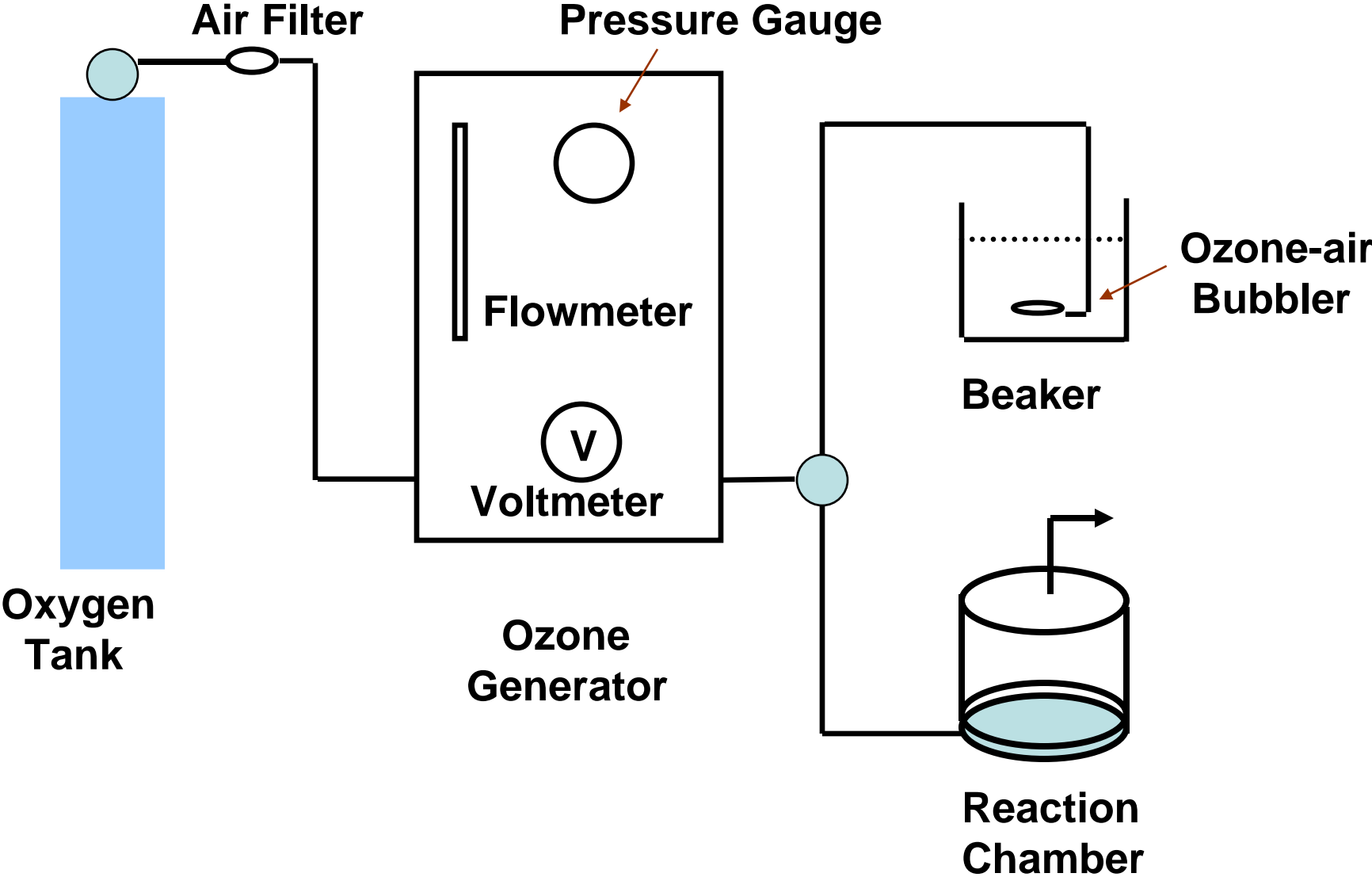
1996-1999

J.G. KIM and A. E. Yousef



Treatment of lettuce by different ozonation methods

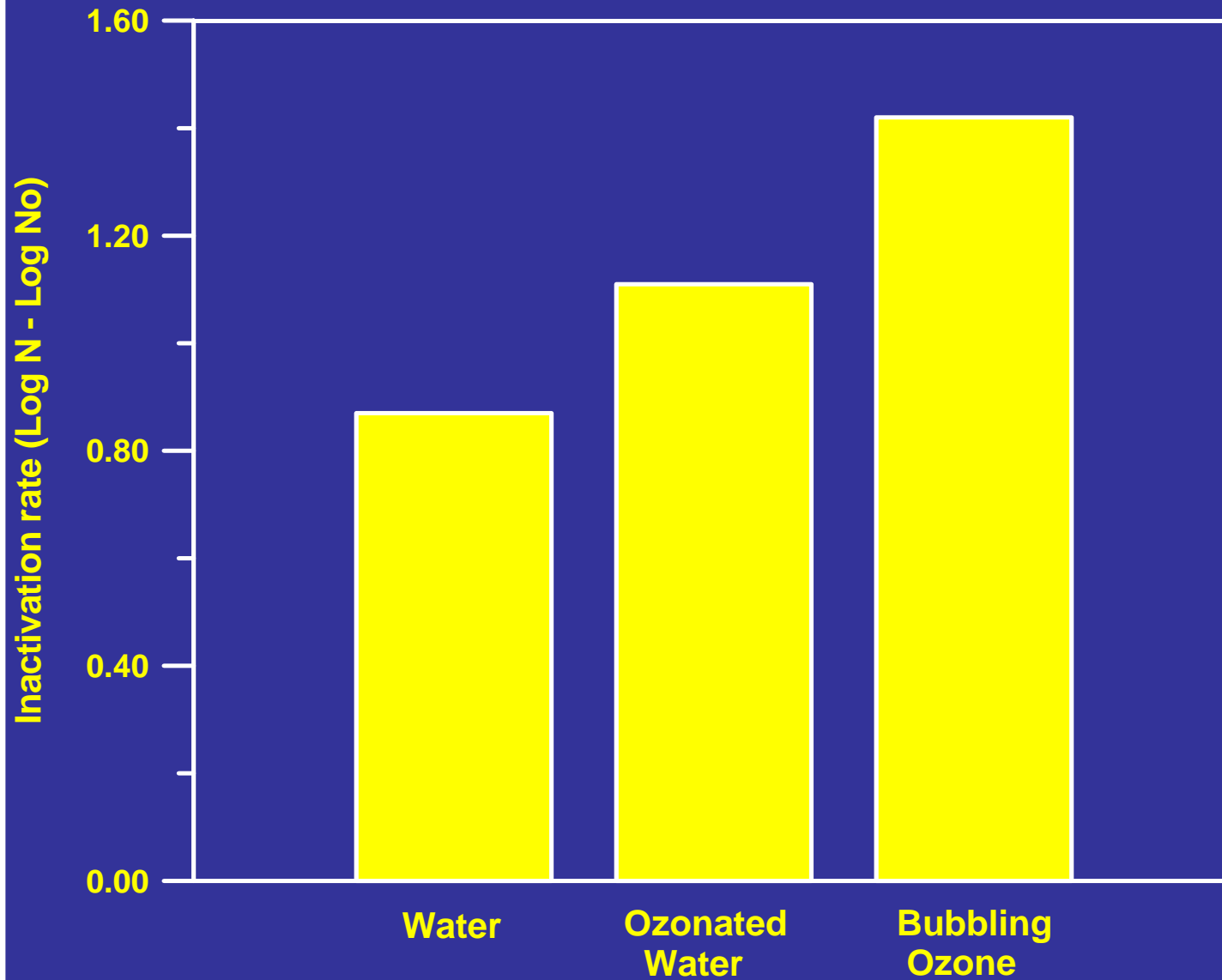
Schematic Diagram of Ozone Production



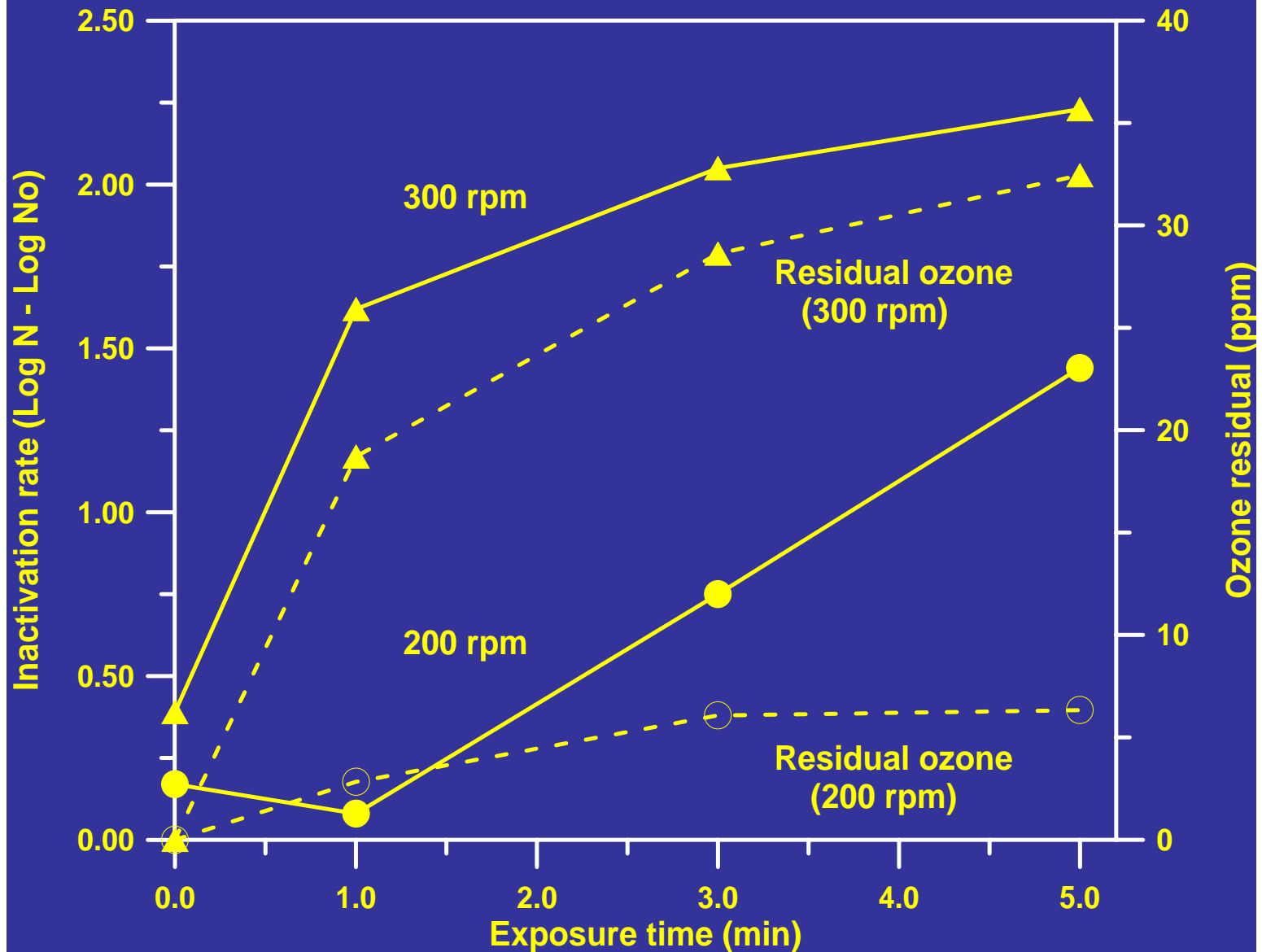
Inactivation of natural flora on lettuce by combining ozonation and delivery methods

Delivery Method	Ozonation Method		
	Water	Ozonated water	Bubbling Ozone
Low-speed Stir	0.74^a	0.98^a	1.01^{a1}
Low stir + Sonication	1.02^a	0.98^a	1.43^{b1}
Stir & Stomaching	0.84^a	1.28^a	1.93^{b2}
High-speed Stir	1.03^a	1.05^a	1.88^{b1}

Effect of ozone treatment on the inactivation of natural flora in fresh lettuce processing



Ozone inactivation of natural contaminants on lettuce at different stir speed and changes of residual ozone



CONCLUSION

- Bubbling ozone gas in water provided the best ozonation procedure for the inactivation of microorganisms on fresh lettuce.
- Inactivation of microflora on lettuce was greatest (1.88-1.93 log CFU/g) when ozone bubbling was applied during high speed stir or with stomaching.

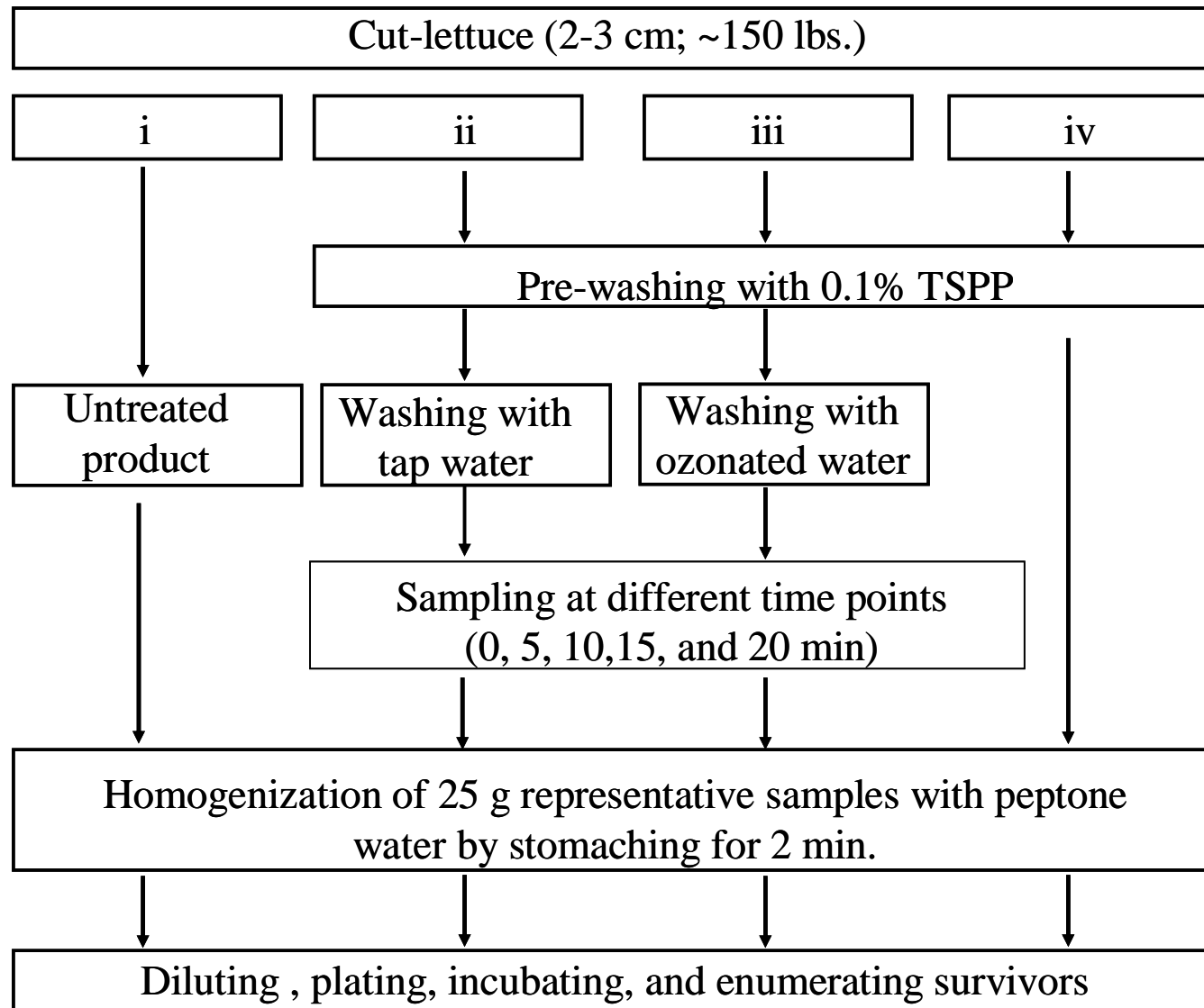
Conclusion (continued)

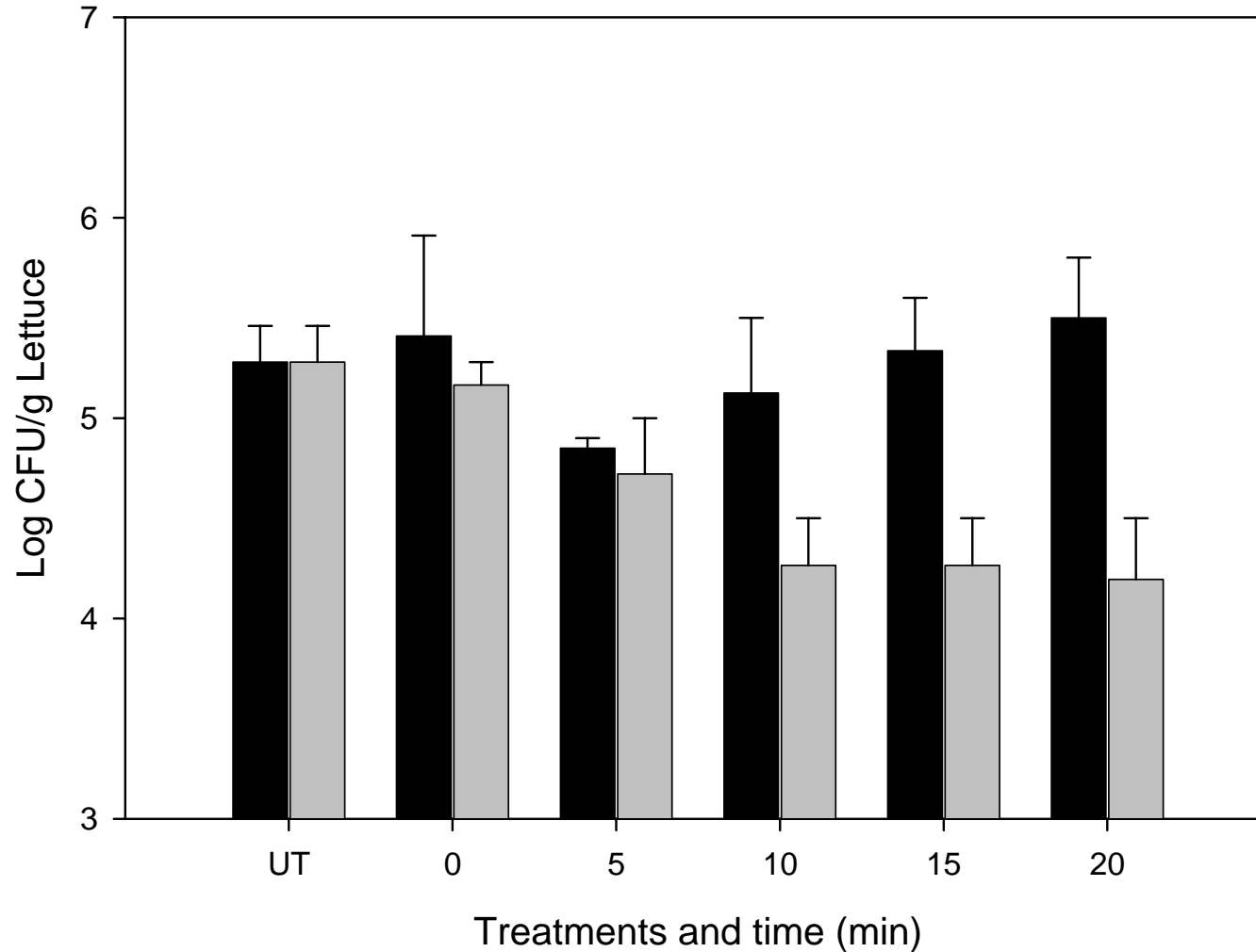
- Inactivation rate of microorganisms is closely related to residual ozone in the treated mixture.
- For greater inactivation by gaseous ozone, reactor design needs to be improved.



Ozone-based produce washer

Location: OSU, 032 Howlett Hall, Pathogenic Pilot Plant





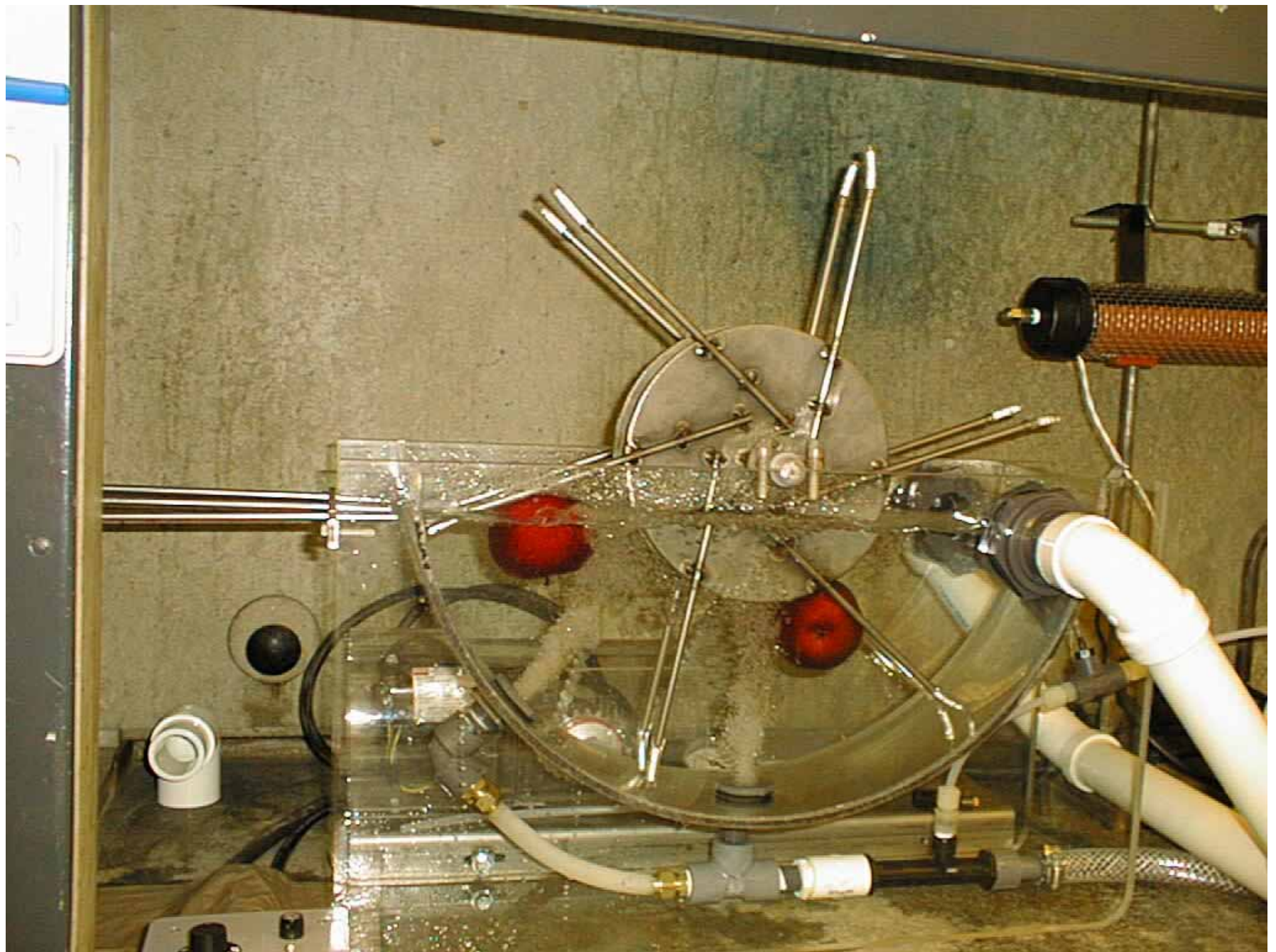
Counts of natural mesophilic contaminants of cut-lettuce when treated first with 0.1% TSP water and followed by ozone (Gray) or water wash (Black).
UT: untreated samples, counts at 0 min represent the samples washed with 0.1% TSP.

Fruits

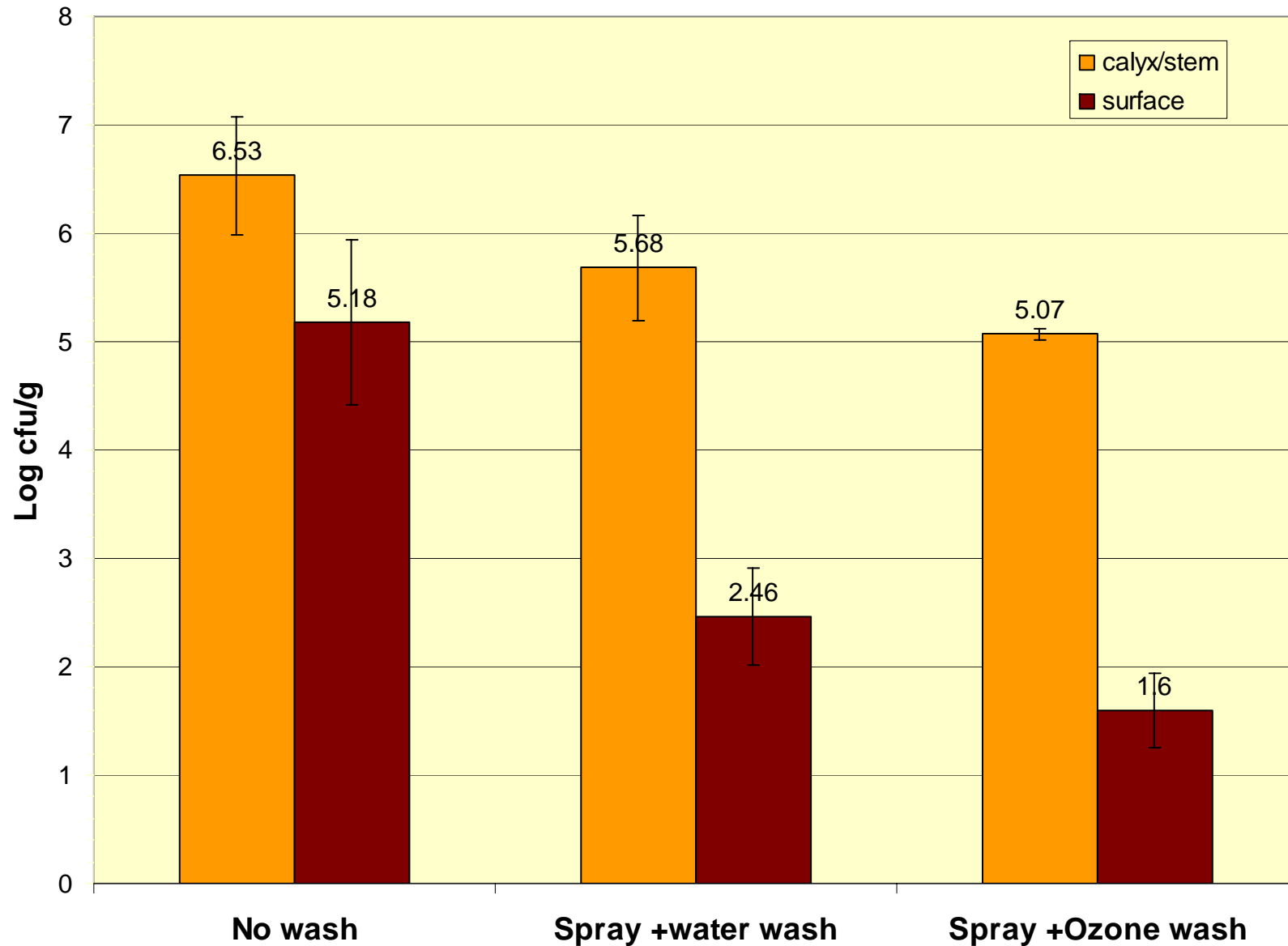
Table 3. Decontamination of apples inoculated with *E. coli* (Strain K12) with sanitizing washes applied in a flat-bed brush washer ^a

Wash treatment	Temp. °C	<i>E. coli</i> log(CFU/g) ^b		
		Before dump tank	After dump tank	After brush water
Water	20	5.49 ± 0.09	4.92 ± 0.37	4.81 ± 0.26
	50	5.40 ± 0.09	5.04 ± 0.16	4.59 ± 0.08
200 ppm Cl ₂	20	5.87 ± 0.07	5.45 ± 0.05	5.64 ± 0.23
8 % Na ₃ PO ₄	20	5.49 ± 0.09	5.02 ± 0.43	4.98 ± 0.02
	50	5.49 ± 0.09	5.02 ± 0.08	4.75 ± 0.45
1 % acidic deterg. ^c	50	5.87 ± 0.07	5.49 ± 0.03	5.42 ± 0.50
5 % H ₂ O ₂	20	5.87 ± 0.07	5.46 ± 0.40	5.27 ± 0.09
	50	5.87 ± 0.07	5.54 ± 0.31	5.49 ± 0.10

Saper, J. 2001. Food Technol. Biotechnol. 39 (4) 305–311



Efficacy of a spray step on the calyx/ stem to enhance ozone inactivation of *Escherichia coli* O157: H7



Sanitizing fresh-cut produce: the challenge

- Reduce the load substantially

Problems

- How is “substantially” measured?
- Aggressive treatments hurt produce

- Keep survivors in check

Problems

- Refrigeration is not enough
- Residual antimicrobial is a risk

- Internalization!!!