Wash Water Sanitation and Validation

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Wash water management: state of the art

Presented by:
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WHY DO WE WASH FRESH PRODUCE?

• Cosmetic improvement
• To remove undesirable substances
  • Latex, soil, stems, leaves, etc.
• To reduce the initial microbial load
• To make it safer? Maybe not.
What Do We Mean By “Wash”?  

- For purposes of this discussion, washing is any process that allows water to contact fruits, vegetables or nuts.
  - Dump tanks
  - Flumes
  - Spray bars
  - Huller/shellers
  - Water-based quarantine processes
  - Wiping with a wet rag, heaven forbid!
How Does Washing Affect Safety?

• “Washing fresh produce is not an opportunity to clean it...it is an opportunity to contaminate it!”

• Water is an excellent medium for dispersing and spreading microorganisms.

• One contaminated fruit or vegetable can transfer millions of bacteria or viruses to water, which can then contaminate entire lots of the produce being washed.
Why Is This A Problem?

• Because once we contaminate fresh produce, we cannot thoroughly decontaminate it except by cooking it.
• That is fine for potatoes and artichokes, but less desirable for lettuce and many other products.
You Mean We Can’t Decontaminate It With Chlorine, Ozone, Irradiation, PAA Or Anything Else?

• That is exactly what I mean!
Washing Does Not Decontaminate Produce

Tomatoes Washed with Chlorinated Water

Some Surfaces May Attract Bacteria

- Lettuce
  - *E. coli* O157:H7 found in cut edges and stomata (Seo and Frank, 1999)
  - *L. monocytogenes* and *Salmonella* attach to cut edges (Takeuchi et al., 2000)
Water Infiltration to Produce May Be Significant During Postharvest Handling

Fruit pulp must be < 10F (6°C) warmer than water temperature to prevent infiltration.

Microbes in water

Adequate water sanitation will prevent problems.
WASHING DOES NOT REMOVE ALL CONTAMINANTS

Unwashed *E. coli* on lettuce

Washed *E. coli* 100 ppm Hypochlorite

Post-washed *E. coli*

Lopez-Galvez, F., et al., Cross-contamination of fresh-cut lettuce after a short-term exposure during prewashing..., Food Microbiology (2009),
Washing Cannot Reliably Decontaminate Produce

– If produce gets contaminated it’s very hard to decontaminate.
  • The surface is complex and hard to clean.
  • Pathogens can adhere strongly.
  • We cannot know if the washing was effective.
  • There may be internal contamination.

– If the surface is damaged, microbial growth can proceed rapidly.
I’m glad that you asked!

WE USE THEM TO PREVENT CROSS CONTAMINATION!!!

Notice the word “PREVENT.”

Wash water sanitizers can prevent contamination, they cannot reverse contamination. This is a key “Take Home Lesson.”
What Is The Best Water Sanitizer To Prevent Cross Contamination?

• Sodium/calcium hypochlorite?
• Peroxyacetic acid?
• Ozone?
• Chlorine dioxide?
• Electrified salts?
• Organic acids?

• THE BEST SANITIZER IS THE ONE THAT WORKS FOR YOUR PRODUCT UNDER YOUR CONDITIONS!
How Do I Know Which Sanitizer Works Best In My System?

- Validation
- Verification
- Critical Control Point
- Operational Set Point
Validation

• Validation is the process of demonstrating that the system as designed can adequately control identified hazards to produce a safe, unadulterated product. There are two distinct elements to validation:

• 1) The scientific or technical support for the system design
• 2) The initial practical in-plant demonstration proving the system can perform as expected (execution)
Validation

• In short, validation is demonstrating that your process is capable of accomplishing what you expect it to do.

• In the case of water sanitation, validation involves demonstrating that your sanitizer, in your system, under your conditions, can effectively prevent cross contamination by microorganisms.
Fig. 3. Evaluation of cross-contamination between inoculated and uninoculated freshcut lettuce using contaminated water. *Escherichia coli* counts of unwashed and washed uninoculated fresh-cut lettuce using tap water, chlorine (40 mg/l), Tsunami (500 mg/l), Citrox (5,000 mg/l) and Purac (20,000 mg/l) previously contaminated by immersion of inoculated lettuce. Bars represent the average of at least three values and error bars represent standard deviation.

Verification

• Verification refers to ongoing measurements and controls to assure that the system is being managed according to the validated plan and so is under control at all times.
Critical Control Point

• Critical control point, or CCP, in a HACCP plan is a point in a process that can be measured and controlled, and when controlled within specified limits (critical limits) can significantly reduce or eliminate a significant hazard.

• Wash water sanitizer performance will probably be a CCP in your HACCP plan.

• If you do not have a HACCP plan, control of wash water sanitizer is still critical!
Operational Set Point

• You may have specified critical limits in your HACCP or other food safety plan.
• During operation it is prudent to provide some margin above or below those critical limits to ensure that you are never outside the critical limits.
• For example, if your plan specifies a critical limit of 10ppm free chlorine, you may want to always operate above 12ppm. That would then be your operational set point.
Multiple Variables

• In order to manage your water sanitation system, you need to understand the system.

• There may be several variables that affect the performance of your sanitizer.
  – If you do not understand those variables and how they relate to each other, you will not understand how to properly manage the system.

• Let’s look at chlorine, or sodium hypochlorite, in water.
Chlorine In Water…What Happens?

• Sodium hypochlorite, NaOCl, initially separates into two fractions.
  – HOCl, or hypochlorous acid, is an effective sanitizer.
  – OCl⁻, or hypochlorite ion, is ~80 times less effective than hypochlorous acid.
  – Together these are called “free chlorine”.

• The relative amounts of each is a function of water pH.
HOCl is the active biocide
Forms Of Chlorine In Water

• NH₂Cl, NHCl₂, NCl₃, etc. = Chloramines

• Organic chlorine compounds such as chloroform

• These are called **Combined Chlorine**

• These forms are not bactericidal
Forms Of Chlorine In Water

• Free Chlorine + Combined Chlorine = Total Chlorine

• Of all of the forms of chlorine in water, hypochlorous acid is the effective sanitizer.
FROM: Breakpoint Chlorination during Produce Wash Control of Chlorine Concentration during Simulated Produce Wash Operations through Breakpoint Chlorination, Bin Zhou$^{1,2}$, et al.

SLIDE REDACTED AT REQUEST OF AUTHOR
ONE LAST POINT

• Washing in clean water, without any sanitizer, will generally provide a 1-2 log reduction of bacteria on the surface of fresh fruits or vegetables.

• This means that 90-99% of the bacteria will come off in the first wash water.

• So it is the first wash, the first dump tank, the first flume where effective water sanitation is most important!
ANY QUESTIONS?

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