Water in Fresh Produce, from Production to Packing

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Overview

• Production Water- irrigation, cooling, fertigation, frost protection
  • PSR agricultural water requirements through the years
  • Updates in 2017-2018
  • Looking forward
• Postharvest Water- washing, cooling, transport
  • PSR agricultural water requirements
  • Managing risk of cross-contamination during washing
  • Looking forward
Production Water Quality

Quick Overview of Agricultural Production Water

Draft Produce Safety Rule (V1)
- August 2013
  - Ground water: beginning of growing season and every 3 months
  - Surface water subject to runoff: every 7 days
  - Surface water NOT subject to runoff: monthly
  - <235 E. coli/100 mL (single sample) and <126/100 mL (5 samples rolling geometric mean)

Draft Produce Safety Rule (V2)
- September 2014
  - Moved to 126 GM & 410 STV
  - Surface water: 20 samples over 2 years
  - Ground water: 4 samples over 1 year
  - Reestablish baseline every 10 years

Final Produce Safety Rule
- November 2015
Current PSR Requirements

• All agricultural water must be safe and of adequate sanitary quality for its intended use (§ 112.41)
• Direct Application (§ 112.44)

<table>
<thead>
<tr>
<th>Geometric Mean</th>
<th>Statistical Threshold Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max 126 CFU generic <em>E. coli</em> per 100 ml</td>
<td>Max 410 CFU generic <em>E. coli</em> per 100 ml</td>
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</table>

Current Water Testing Requirements

<table>
<thead>
<tr>
<th>Untreated Surface Water (Lake, Pond, River, Canal)</th>
<th>Ground Water (Well)</th>
<th>Municipal</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Initial MWQP survey- 20 samples over 2-4 years</td>
<td>• Initial survey- 4 samples over 1 year</td>
<td>• No testing requirements</td>
</tr>
<tr>
<td>• Afterwards-5 samples per year</td>
<td>• Afterwards- 1 sample per year</td>
<td></td>
</tr>
</tbody>
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Water Tests Equivalent to 1603

• November 2017
• Equivalent testing methods to 1603
  • Membrane filtration methods:
    • mTEC agar (EPA method 1103.1, Standard methods 9213D, & ASTM 5392-9)
    • MI agar (EPA method 1604)
    • mENDO/NA-MUGagar (Standard methods 9222B followed by 9222G)
    • mColiBlue 24 agar (Hach method 10029)
  • Most probable number methods:
    • Colilert (Idexx method, using Quantitray 2000)
    • Colilert 18 (Idexx method, using Quantitray 2000)

Extended Water Compliance

• Proposed rule issued on September 13, 2017
• Concern over testing requirements

“We are proposing to extend the compliance dates to address questions about the practical implementation of compliance with certain provisions and to consider how we might further reduce the regulatory burden or increase flexibility while continuing to achieve our regulatory objectives, in keeping with the Administration's policies.”
Extended Water Compliance

<table>
<thead>
<tr>
<th>Business Size</th>
<th>Proposed Compliance Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>All other businesses (&gt;500K)</td>
<td>1/26/22</td>
</tr>
<tr>
<td>Small businesses (&gt;250K-500K)</td>
<td>1/26/23</td>
</tr>
<tr>
<td>Very small businesses (&gt;25K-250K)</td>
<td>1/26/24</td>
</tr>
</tbody>
</table>

- Largest farms will begin testing in the 2022 growing season

Romaine lettuce outbreak tied to tainted irrigation canal

Yuma Irrigation Canal Link in Deadly Romaine Lettuce E. coli Outbreak

Dirty canal water may have tainted romaine lettuce with E. coli

More than 200 were sickened and five died in this spring’s E. coli outbreak, the FDA says.
Challenges

• Irrigation water can easily become contaminated
• Presence of foodborne pathogens can present risk even when water quality criteria are within acceptable limits
• How can we mitigate risks?

Water Treatment

• More growers are interested in treating their water to mitigate risk
• Treat and deliver water so that it is consistently safe and of adequate sanitary quality for its intended use (21CFR112.43)
• You must monitor any treatment of agricultural water at a frequency adequate to ensure that the treated water is consistently safe and of adequate sanitary quality
How can I treat water?

- EPA-registered antimicrobial devices
  - UV light
  - Ozone generator
  - Water filter
- EPA-registered antimicrobial pesticides
  - Chlorine (e.g. calcium hypochlorite)
  - Peroxyacetic acid

Challenges

- No sanitizers currently labeled for efficacy against indicator organisms or foodborne pathogens when applied in production systems
- Need for training so that growers can implement systems effectively and adhere to the regulation
Looking Forward- Production Water

- Keep an eye out for changes to water testing requirements for production agricultural water as FDA revisits this aspect of the PSR
- Water treatment may be one means growers go about reducing risks posed by production water
  - Will there be movement in labeling of chemicals (e.g. chlorine, PAA) for treating indicators or pertinent foodborne pathogens

Postharvest Water Quality
Water Quality

- FSMA Requirements § 112.44(a):
  - Any postharvest water must not have any detectable generic *E. coli* per 100 ml
  - You must establish a water change schedule for recirculated water
  - You must visually monitor water for buildup of organic material
  - Other factors such as water hardness also impact antimicrobial activity

Current Water Testing Requirements

**Ground Water (Well)**
- Initial survey- 4 samples over 1 year
- Afterwards- 1 sample per year

**Municipal**
- No testing requirements
Acceptance of Presence/Absence Tests

The following presence/absence methods are scientifically valid:

• TECTATM EC/TC medium and the TECTATM Instrument: A Presence/Absence Method for the Simultaneous Detection of Total Coliforms and *Escherichia coli* (*E. coli*) in Drinking Water. (2014).
• Modified ColitagTM Test Method for the Simultaneous Detection of *E. coli* and other Total Coliforms in Water. ATP D05-0035. (2009).
• IDEXX Colilert Test Kit
• IDEXX Colilert-18 Test Kit
• IDEXX Colisure Test Kit
• E*Colite Bag or Vial Test for Total Coliforms and *E. coli* in Potable Water. Charm Sciences, Inc.
• 101298 Readycult Coliforms 100. EMD Millipore (division of Merck KGaA, Darmstadt, Germany).

Processing Water

Single pass system

Multi-pass system
Processing Water

What is the goal of processing water sanitation?
Most important parameters
- Resistant to organic matter
- Strong oxidation capacity
- No cytotoxic damage

Processing Water Sanitation
- Chlorine
- Peracid
- Ozone
- Chlorine dioxide

• Salmonella inoculated on snacking peppers and washed for 2 min in
  - water
  - 200 ppm free chlorine
  - 200 ppm free chlorine subsequently mixed with 1% snacking peppers
Processing Water

- Uninoculated “follower” peppers
- Transfer coefficients
  - Water - 3.63%
  - Chlorine - <0.00%
  - Chlorine + OL – 14.45%

Processing Water

- Similar trends in remaining processing water

Dunn, Harness et al
Eye on Postharvest Washing

• Regardless of antimicrobial used, do you have any data to support a lower limit to prevent cross-contamination?
• How have you established change-overs for recirculating systems?
• What monitoring tools do you use to check for antimicrobial concentration and are they accurate?

Processing Water

• Always include sanitizer in tanks, flume, or batch where cross-contamination risk is high
• Improved sanitation in single-pass systems
• Understand factors that impact activity and manage appropriately
• Work to established critical limits for minimum concentrations of sanitizers based upon scientific data
Upcoming Training Opportunities

• Food Microbiology 101
• Environmental Monitoring for Packinghouses
• Agricultural Water Treatment for Production Water
• HACCP for Packinghouses
• Produce Safety Alliance Grower Training

Thank you!

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