Good Agricultural Practices

Water Quality

Nancy C. Flores
NMSU CES Food Technology Specialist

Food Safety Begins on the Farm
Fruit and Vegetable Consumption

Between 1970 - 1997, the U.S. per capita consumption of fruits and vegetables increased 24%!

577 lbs to 718 lbs per year
Fruits and Vegetables

- Significant increases in the number of produce associated foodborne disease outbreaks in the U.S.

- Produce associated outbreaks per year more than doubled from 1973-1987 and 1988-1998
Why are Foodborne Illnesses Increasing?

- Complexities of the Food System
- Aging of the Population
- Chronic Illnesses / Compromised Immunity
- Changing Microorganisms:
  * More Virulent Strains
  * Adapting to Stresses
US Produce Outbreaks: 1990 - 1998

Salad Bar 35.4%
Fruit 20.8%
Lettuce 16.7%
Sprouts 9.4%
Cabbage 5.2%
Carrots 3.1%
Tomatoes 2.1%
Unknown/Other 7.3%

Source: CDC Foodborne outbreak surveillance system
Fruit and Vegetable Outbreaks by Origin of Produce: 1990 - 1998

- Domestic: 75.3%
- Imported: 7.5%
- Unknown: 17.2%

Source: CDC Foodborne outbreak surveillance system
Why Should We Care?

Every year foodborne illnesses result in an estimated:

- 76 million cases of foodborne illness.
- 325,000 people hospitalized for foodborne illness.
- 5,200 needless deaths each year.
- Economic losses between $10-83 billion.
Produce Associated Outbreaks Affect Business

- Strawberry industry lost an estimated $50 million in 1996 after mistakenly being indicated as the source of pathogens in an outbreak.
- Odwalla shareholder value dropped approximately 41% ($12.4 million) in six months after outbreak.
- Requirement of having third party inspections.
- Work against produce promotions campaigns.
- May result in unwanted legislation or regulation.
Produce Associated Outbreaks Affect Business

- Food retailers interested in food safety & addressing the issue because of consumers.
- Food retailers are requiring third party inspection of farms that supply produce and certification of Good Agricultural Practices.
- Growers are having to absorb the costs of these inspections.
A Little Microbiology

• In the right environment, bacteria replicate ~ every 20 minutes.
• An head of lettuce has 1 bacteria on it.
• How long will it take to multiply to 100 cells?
  140 minutes / 2 hrs & 20 min

The Infective Dose of *E. coli* O157: H7 could be as few as 10 cells.
PREVENTION is the Key to Reducing Microbial Contamination of Fresh Fruits and Vegetables
Harvest Considerations

• Ideally pick dry fruits or vegetables.
• Leave produce that has bird droppings on it.
• Clean and sanitize totes daily.
• Cool product quickly.
• Teach workers about proper handwashing and provide proper facilities.
Promote Cleanliness at U Pick

• Invite customers to wash their hands prior to entering the fields.
• Provide clean and convenient restrooms for customer use.
• Supply soap, clean water, and single-use towels for hand washing.
Review Field Management Practices to Reduce Risks

- Manure
- Water quality
- Worker and field sanitation
- Post harvest handling
- Transportation
Water Carries Pathogens

- *E. coli* 0157:H7 viewed primarily as a water-borne pathogen.
  - Many outbreaks associated with recreational water.
- *Salmonella, Giardia* and Cyclospora outbreaks on produce caused by contaminated water.
Water Management

• Know the source of the water and intended use.
• Evaluate the irrigation method.

• Test water quarterly for fecal coliforms and keep records of all water test results.

• Be active in local watershed groups.
Wash Water Quality and Its Importance to Your Operation
Why Focus on Water Disinfection?

Singular critical point capable of amplifying an error in sanitation or hygiene management during production, harvest, or postharvest.
Methods to Disinfect Water

• Methods are only affective in clear water since heavy organic or mineral content impede exposure to treatment.

• **Heat**- boil water for 1 minute minimum 10 minutes for maximum safety. Do not boil water with nitrates since boiling concentrates further.

• **Chemical**- chlorine, bromine, iodine or ozone.

• **Light**- ultraviolet radiation must be filtered and free of iron.
Chlorination of Water

Chlorination reduces transfer of contamination

- Maintain constant chlorine by monitoring. In general 100-150 ppm.
- Monitor pH of water. Optimum range 6.0-7.0
- Be conscious of the temperature of the water. High temp. results in quicker pathogen kill, but also results in rapid loss of chlorine due to gas formation.
Disinfecting Water Systems

- Disinfecting drilled or dug well:
- Chlorine bleach (household laundry) can be used after construction or repair work.
- Before chlorine application remove any water treatment devices (carbon filter, water softener, RO)
- One gallon bleach for 525 gallons water or one gal per 10 ft of 36 in diam or one gal per 350 ft of 6 in diam drilled well.
Disinfecting Water Systems

- **Disinfecting spring water:**
- Fast dissolving 65% calcium hypochlorite pellets 3 oz per 100 gal or 2 ft depth.
- Pellets must not contain algicides, chlorine stabilizers etc. which are not safe for drinking water
Disinfecting Water Systems

- Once the well is re-capped open one faucet at a time throughout the house.
- Run water until a strong chlorine odor is detected then turn the tap off.
- Chlorinate system for about 12 hours. Drain highly chlorinated water unto a driveway or bushy area.
- Sample water for bacterial counts 2-3 days after chlorine odor has disappeared.
Emergency Disinfection

- Mix water and chlorine completely
- Let stand for 2 to 3 hours
- Store in clean sealed container and protect from recontamination
- Turbid or cloudy water should be boiled for 5 minutes before consumed.
### Emergency Disinfection

#### Chlorine Dosage

<table>
<thead>
<tr>
<th>Water volume</th>
<th>Liquid bleach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gal</td>
<td>5 drop</td>
</tr>
<tr>
<td>10 gal</td>
<td>½ teaspoon</td>
</tr>
<tr>
<td>50 gal</td>
<td>2 teaspoon</td>
</tr>
<tr>
<td>100 gal</td>
<td>1 tablespoon</td>
</tr>
<tr>
<td>1000 gal</td>
<td>¾ cup</td>
</tr>
</tbody>
</table>
Calculate water volume

- **Box Volume in gallons** = 7.5 x L x H x W
- L = length     H = height     W = width
- 7.5 x 6 x 3 x 2 = 270 gals
  ➔ 3 tablespoons bleach for disinfection
- **Cylinder Volume** = 6 x (Diam)^2 x Height
- 6 x 4^2 x 5 = 480 gal ➔ 5 tablespoons bleach
Postharvest Water Quality

- Evaluate your operation and identify the risks that exist.
- Develop a system to reduce the risks that is effective and economically reasonable for your operation.
- Monitor the effectiveness. This is paramount to developing an effective and successful system.
Beyond Chlorine

• There are other water disinfectants available.

• If you choose a new product, make sure it is effective and be aware of how to properly handle, mix, and store the material.

• Seek out additional information.

For example: *Introduction to ORP as a Standard of Postharvest Water Disinfection Monitoring*, Trevor Suslow, UC Davis.
Wash Water Quality

• Use potable water for all produce washing, cooling, dipping, icing, and processing.

• Avoid water temperatures in dump tanks that are more than 10°F cooler than produce.
Bacteria can enter the stem scar with improper handling or wash water management.

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

Postharvest water disinfection is an important preventive practice, even for an acid vegetable like tomatoes. Historically thought to be safe, outbreaks in 1990, 1993, and 1999 were caused by Salmonella spp.
WHERE TO GO FOR ASSISTANCE AND SERVICES

General Questions, Information, and Water Testing
NMED Ground Water Quality Bureau
Harold Runnels Bldg.
1190 St. Francis Dr.
Santa Fe, NM 87502
(505) 827-2886

Public Water Supply System Information
NMED Drinking Water Bureau
525 Camino de los Marquez
Suite 4
Santa Fe, NM 87502
(505) 827-7536

Lead-Poisoning Prevention
NM Dept. of Health
Harold Runnels Bldg., Rm. N-1350
1190 St. Francis Dr.
Santa Fe, NM 87502
(505) 827-0006

Water Treatment
Farm Labor/Harvester
Sanitary Facilities & Personal Hygiene
Fresh Produce Growers and Packers ARE Food Handlers !!!
Proper Facilities, Education, and Training, Training, Training
What is Proper Handwashing?
Proper Handwashing

- Reduces infection 35 to 50%
- Reduces GI-illness up to 80%
Farm Worker Hygiene

• Teach workers about food safety and their role in preventing microbial contamination of fresh fruits and vegetables.

• Provide clean restrooms with soap, clean water, and single-use towels.

• Enforce proper use of facilities.
Risk Evaluation No-Brainers
Field Sanitation

Preventing Contamination and Reducing Microbial Risks
Harvest Sanitation

• Clean and sanitize storage facilities prior to harvest.

• Clean and sanitize harvest bins daily.

• Avoid standing in harvest bins.

• Clean and sanitize packing area, equipment, and floors daily.
Extruded or Collapsible Plastic Bins Are Used from Harvest to Distribution
Growers Are Innovating Their Own On-Farm Sanitation Routines
Develop a System for Maintaining Carton and Tote Sanitation
Packing House Sanitation

• Proper sorting and culling of produce.

• Detectable Free Chlorine in Wash Waters.

• Enforce Good Worker Hygiene.

• Exclude all animals from Packing House, especially insects, birds and rodents.

• Clean and Sanitize Equipment.
Transportation and Distribution
Cleanliness and Sanitation

- Pre-clean and Pre-rinse
Protecting Produce on the Move

- Inspect trucks prior to loading to insure cleanliness and proper refrigeration.
- Identify prior loads hauled in the truck. Trucks that have hauled raw animal products should be avoided due to the risk of cross contamination.
- Document truck temperature, cleanliness, and state of product at time of shipment.
Farm Food Safety Plan Describes:

- Manure storage and handling
- Animal exclusion (domestic & wild)
- Irrigation and drainage management
- Harvest and post harvest handling
- Employee training program
- Restroom & hand washing facilities
- Crisis management strategy

Record It or Regret It!
If you did not RECORD IT, you did not do it.

• Record keeping allows you to keep track of farming operations and worker training.

• Record keeping documents your activities should this information ever be required.
Good Agricultural Practices for Managing Food Safety Risks Continue to Evolve

As new research becomes available, recommended practices may change.
The End

Food Safety Begins on the Farm