

# Good Agricultural Practices

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## Water Quality

**Nancy C. Flores**

**NMSU CES Food Technology Specialist**



# Fruit and Vegetable Consumption

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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

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- **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**



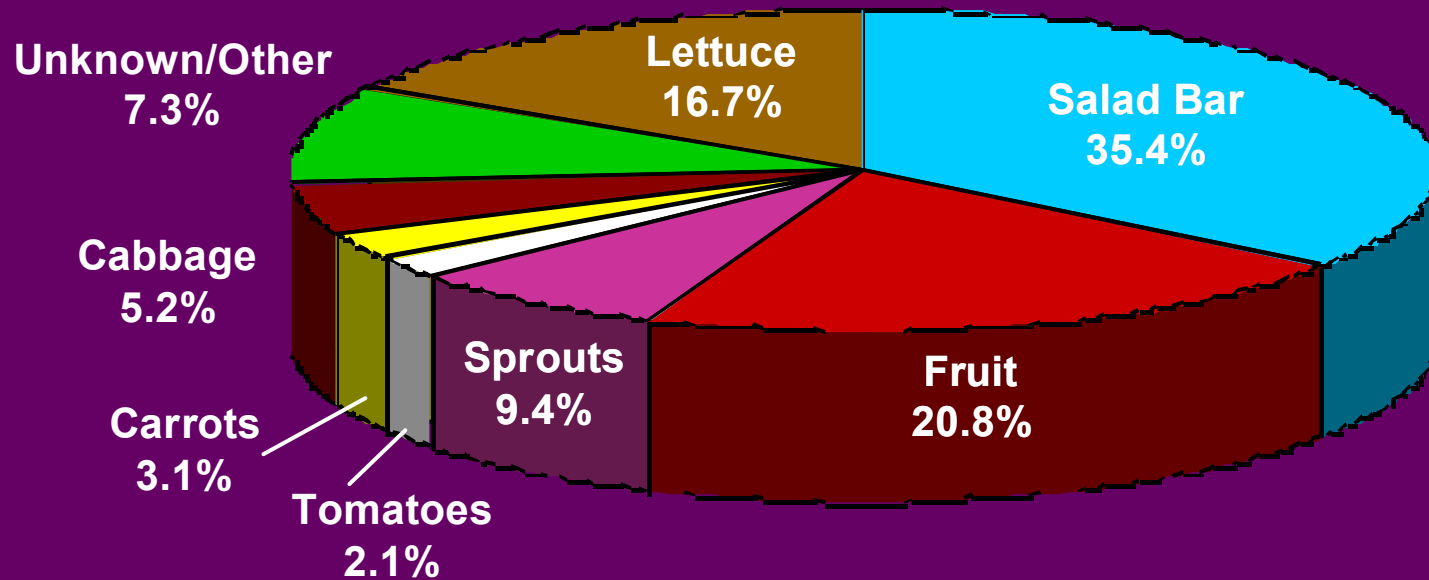
# Why are Foodborne Illnesses Increasing?

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- **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

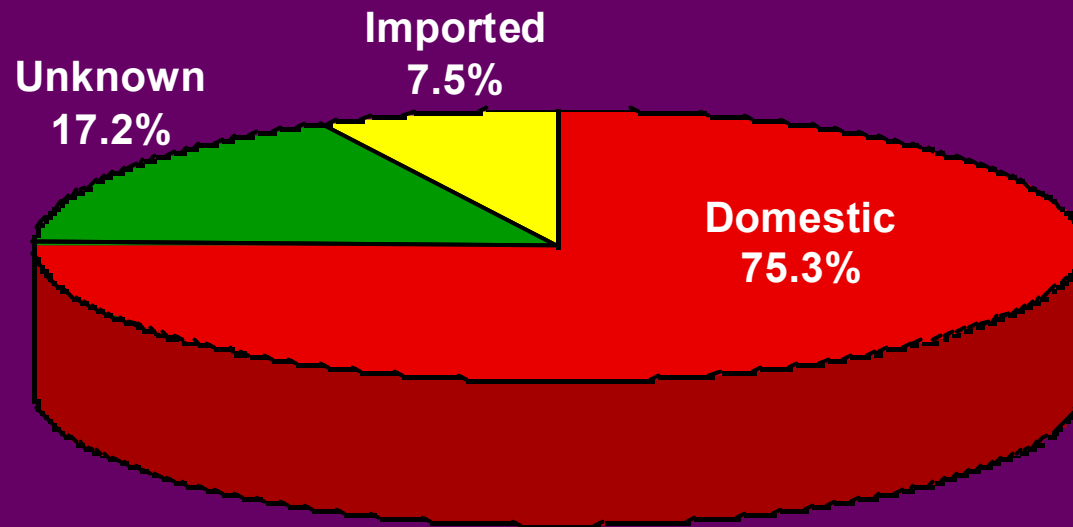


Source: CDC Foodborne outbreak surveillance system



# Fruit and Vegetable Outbreaks by Origin of Produce: 1990 - 1998

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Source: CDC Foodborne outbreak surveillance system

# Why Should We Care?

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**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**

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- **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**

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- **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

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- 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.**



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# **PREVENTION is the Key to Reducing Microbial Contamination of Fresh Fruits and Vegetables**

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# Harvest Considerations

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- 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

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- **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

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



# Water Carries Pathogens

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- *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

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- **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.**



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# Wash Water Quality and Its Importance to Your Operation

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# Why Focus on Water Disinfection?

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**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

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## 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

| Water volume | Liquid bleach |
|--------------|---------------|
| 1 gal        | 5 drop        |
| 10 gal       | 1/2 teaspoon  |
| 50 gal       | 2 teaspoon    |
| 100 gal      | 1 tablespoon  |
| 1000 gal     | 3/4 cup       |



# Calculate water volume

- **Box Volume in gallons** =  $7.5 \times L \times H \times W$
- L= length      H= height      W= width
- $7.5 \times 6 \times 3 \times 2 = 270$  gals
- 3 tablespoons bleach for disinfection
- **Cylinder Volume** =  $6 \times (\text{Diam})^2 \times \text{Height}$
- $6 \times 4^2 \times 5 = 480$  gal → 5 tablespoons bleach



# Postharvest Water Quality

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- **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

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- **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

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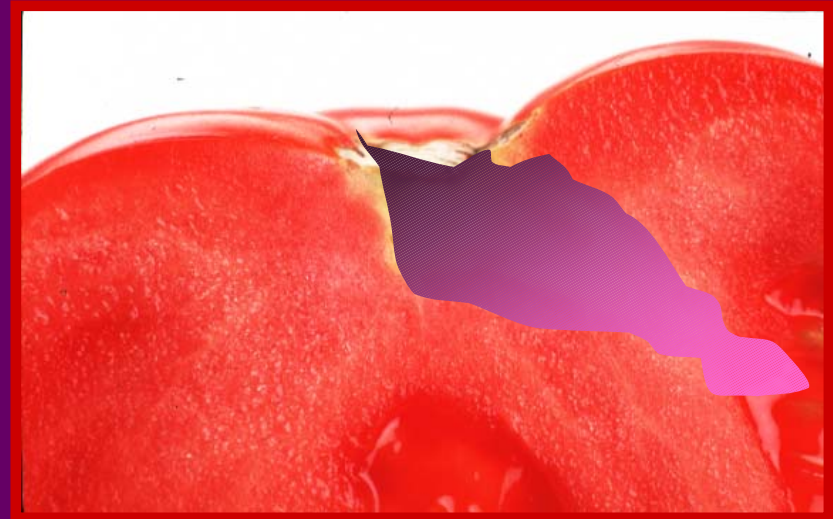


- Use potable water for all produce washing, cooling, dipping, icing, and processing.
- Avoid water temperatures in dump tanks that are more than 10°F cooler than produce.

# Bacteria can enter the stem scar with improper handling or wash water management

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**Fruit pulp must be  $< 10^{\circ}\text{F}$  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

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**Fresh Produce Growers  
and Packers  
ARE Food Handlers !!!**

# Proper Facilities, Education, and Training, Training, Training



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# What is Proper Handwashing?

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## ***Proper Handwashing***

- Reduces infection 35 to 50%
- Reduces GI-illness up to 80%



# Farm Worker Hygiene

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- **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

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**Preventing Contamination and  
Reducing Microbial Risks**



# Harvest Sanitation

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- Clean and sanitize storage facilities prior to harvest.



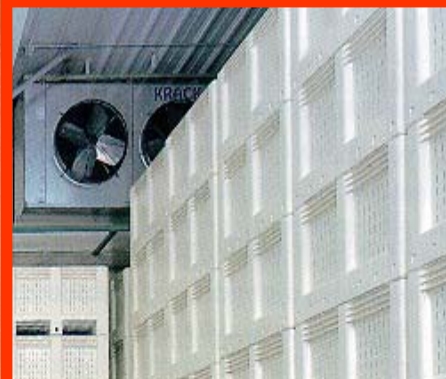
- Clean and sanitize harvest bins daily.



- 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

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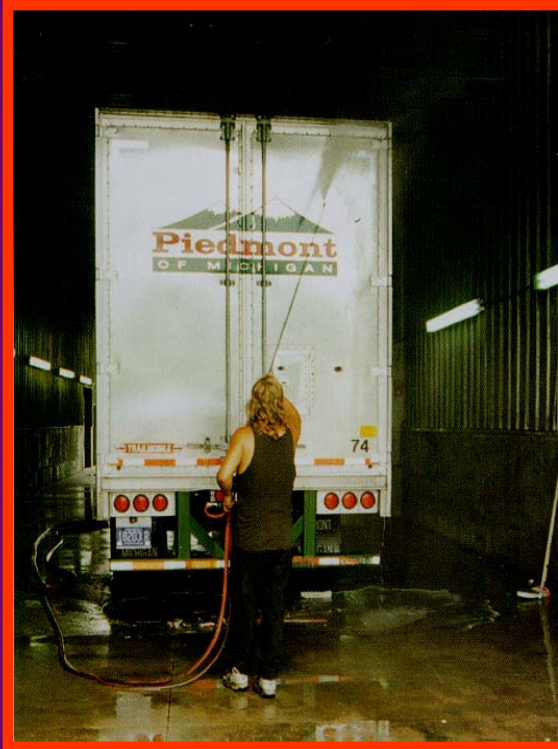
- **Proper sorting and culling of produce.**
- **Detectable Free Chlorine in Wash Waters.**
- **Enforce Good Worker Hygiene.**
- **Exclude all animals from Packing House, especially insects, birds and rodents.**
- **Clean and Sanitize Equipment.**



# Transportation and Distribution Cleanliness and Sanitation

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## ❖ Pre-clean and Pre-rinse



# Protecting Produce on the Move

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- **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:

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- **Manure storage and handling**
- **Animal exclusion (domestic & wild)**
- **Irrigation and drainage management**

**Record It or Regret It !**

- **Harvest and post harvest handling**
- **Employee training program**
- **Restroom & hand washing facilities**
- **Crisis management strategy**



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**If you did not RECORD IT,  
you did not do it.**

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- **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

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**As new research  
becomes available,  
recommended practices  
may change.**

# The End

