

## Farmers' Market Food Safety

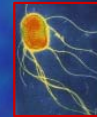
## Discussion Topics

- Food Microbiology Overview
- Acidified Foods
- Hazards of Fresh Fruits and Vegetables

## Food Microbiology Overview

## Food Microorganisms

- Bacteria
- Yeast
- Mold
- Viruses
- Parasites
  - Pathogens – any microorganism that causes disease in humans



## Microorganism transfer

- Soil and Water
- Plants and animals
- Raw to processed food / cross contamination
- Person to Food
- Person to Person

## Microbial Growth

- Moisture
- Food source
- Time
- Temperature
- Oxygen
- pH
- Light

## Microbial Growth

- Reproduce by dividing
- Every 20 to 30 minutes
- Generation time

## Bacterial Multiplication

| ■ Time | Numbers   |
|--------|-----------|
| ■ 0    | 1         |
| ■ 20   | 2         |
| ■ 40   | 4         |
| ■ 80   | 16        |
| ■ 160  | 256       |
| ■ 420  | 2,097,152 |

## Foodborne Illness

- An illness or disease transmitted to people through food products that results from ingesting foods which contain pathogens, their toxins or poisonous chemicals

## Foodborne Illness

- Food will not look, taste or smell bad
- Pathogenic organisms or toxins present in food
  - Food allows growth
  - Temperature allows growth
  - Time to grow and produce toxin
  - Food must be eaten

## Food Preservation

- Physical treatments
  - Inhibit by Dehydration, Cold storage & Chemical
  - Destroy by Heating & Radiation
  - Reduce by Washing
  - Remove by Filtration

## Water activity ( $A_w$ )

- Measure of available water
  - Ranges from 0 to 1.0
- Inhibits growth
  - Bacteria <0.91
  - Yeast <0.87
  - Molds <0.80

## How to lower water activity

- Bacteria
  - 5-15% Salt
  - 50% Sugar
- Mold and Yeast
  - 15% Salt
  - 50% Sugar for Yeast
  - 65-70% Sugar for Mold

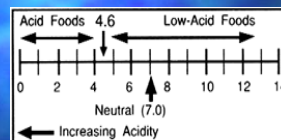
## Temperature

- Keep food out of the temperature danger zone (40-140°F)
- Keep cold things cold <40°F
- Keep hot things hot > 140°F

## Oxygen

- Vary in the amount needed
  - Aerobic – need air
  - Anaerobic – no air
  - Microaerophilic – little air
- MAP & Vacuum Packaging
  - Control the air in the package

## Clarification of Acidity (pH)



## Determination of pH

- Measured using colorimetric or electrometric methods

## Buffering Capacity

- Ability of Food to Resist Changes in pH
- Varies from food to food
  - Proteins have high buffering capacity

## Acidified Foods

## Acidified Foods

- Fermented Foods Preserved by Lactic Acid Bacteria
  - Yogurt, Sauerkraut
- Preservation by Addition of Acid to Low Acid Ingredient

## FDA Definition

- Low Acid Food to Which Acid or Acid Food is Added to Produce a Final pH of 4.6 or Less
- $A_w > 0.85$
- Every component must have a pH of  $< 4.6$  within 24 hrs

## Scheduled Process

- High Acid Foods ( $\text{pH} < 4.6$ ) do not require high temperatures
  - Boiling water may be sufficient
  - Low pH prevents outgrowth of spores

## Scheduled Process

- Hot-Fill-Hold
  - Hot Product sealed into container. Held and cooled.
- Atmospheric
  - Product put into container. Closed and pasteurized.

## Required Regulation-FDA

- Register and File a Process
  - heat, pH control, sugar, salt, preservative
- Adhere to Filed Process
- Provide Process and pH Records

## Regulations-Acidified Foods

- USDA
  - 9 CFR, Part 318 (381)
- FDA
  - 21 CFR Part 114, Part 110 and 108.25



## Hazards of Fresh Fruits and Vegetables

## Fruit and Vegetable Trends

(1987 - Present)

- Important component of U.S. Diet
- Federal initiatives
  - U.S. Dietary Guidelines
  - Food Guide Pyramid
  - Healthy People 2002
  - Nat. Cancer Inst. - Five a Day Program
- 24% Increase in consumption

## Fruit and Vegetable Trends

(1987 - Present)

- Growers response
  - Wider variety of traditional and new produce
  - Global production and distribution
    - Food from 130 countries over the world
    - Provides year-round availability
  - Innovative packaging
  - Improved marketing merchandising

## Fruit and Vegetable Trends

(1987 - Present)

- Increase in Foodborne Illness associated with produce
- The number of people affected more than doubled
- A variety of fruits and vegetables were involved
- 75% related to domestically grown
- Most outbreaks were caused by bacteria

## Fruit and Vegetable Trends

(1987 - Present)

- *Salmonella* sp. and *E.coli* O157:H7 caused most outbreaks
  - Poor agricultural practices
  - Poor hygiene of workers
- Other causative agents
  - Cryptosporidium and Cyclospora parasites
  - Hepatitis A and Norwalk viruses

## Causes for Increases in Illness

- Changes in social demography
  - Increase in elderly, immuno-compromised & those suffering from chronic diseases
  - Pregnant women and young at high risk
- Changes in food system
  - National and international scale
  - Expose more consumers
  - Harder to trace an outbreak

## Causes for Increases in Illness

- Changing consumer preferences
  - Increased popularity in salad bars
  - Increase in meals eaten outside the home
  - Increases the risk of produce contamination
    - Poor handling and preparation practices
    - No heat treatment to kill pathogens
    - Long storage periods at improper temperatures may allow microbes present to survive and grow

Increases the risk of foodborne illness

## Causes for Increases in Illness

- Genetic changes in microorganisms
  - Adaptation to stresses in the environment
    - Grow where they once could not survive
    - *Yersinia enterocolitica* and *Listeria monocytogenes* are capable of growing slowly at refrigerator temperatures
  - Some bacteria can cause serious human illness when only small numbers of cells are ingested
    - *E. coli* O157:H7 and *Salmonella enteritidis*

## Increase in Outbreaks

- Reduces consumer confidence
- Can cause financial losses
- Respond with third party inspections to verify that produce is being grown, harvested and packaged using good agricultural and management practices (GAP & GMP)

## Farm Strategy Focus

- Difficult to completely sanitize produce once contamination has occurred
- Reduce risks by:
  - Preventing contamination before it happens

## Basic Principles

- Prevention of microbial contamination of fresh produce
- Accountability throughout all levels of agricultural from growing to packing and transportation

## Record Keeping

- All farm operations that deal with food safety
  - Manure use
  - Water test results
  - Worker training programs
- Facilitates audits
- Shows growers commitment
- Eases trace backs for contamination or proof that contamination did not occur on the farm

## Sources of on-farm contamination

- Soil
- Irrigation water
- Animal manure
- Wild and domestic animals
- Inadequate field worker hygiene
- Harvesting equipment
- Transport containers (field to packing)

## Sources of on-farm contamination

- Wash and rinse water
- Unsanitary handling during sorting and packaging
- Equipment used to soak, pack or cut produce
- Ice
- Cooling units (hydrocoolers)

## Sources of on-farm contamination

- Transport vehicles
- Improper storage conditions (temperature)
- Improper packaging
- Cross contamination in storage, display and preparation

## Site Selection

- Historical use of the land
  - No industrial dumping
  - When has animal waste or biosolids been applied
- Upstream from animal containments
- Identify upstream uses of surface water
  - No runoff from contaminated water or livestock waste

## Manure Management

- Improperly aged or treated manure can contribute to risk of foodborne illness
- Pathogens can survive in manure for 3 months or more
- Concerns:
  - Fecal material may come in contact with produce
  - Water may splash pathogens in the manure onto produce

## Manure Handling

- Proper and thorough composting
- Incorporation into soil before planting
- Apply manure in the fall
- Avoid top dressing
- DO NOT harvest until after 120 days
- Document rates, dates and location of manure application

## Water

- Where ever water comes into contact with fresh produce, its quality dictates the potential for pathogen contamination
  - Irrigation (Surface water)
    - Testing
  - Processing (Well/Municipal)
    - Chlorine added

## Irrigation Method

- Drip irrigation recommended
  - Minimizes risk of crop contamination
- Overhead irrigation
  - Use potable water
  - Examine source of surface water
- Keep records of application methods, rates and dates

## Worker Health and Hygiene

- Train to follow good hygienic practices
  - Proper handwashing
  - Proper use of toilet facilities
- Signs and symptoms of infectious diseases
  - No direct contact with produce
- Protection for cuts or lesions
- Proper glove use
- Provide proper attire

## Cleaning and Sanitizing procedures

- Rinse surfaces if noticeably soiled
- Wash with warm soapy water
- Rinse with clean water
  - Detergent must be rinsed off because it can reduce the effectiveness of the sanitizer
- Sanitize with proper strength solutions or water greater than 170°F

## Correct Concentrations of Various Sanitizers

| Chlorine   | Iodine      | Quarternary Ammonia |
|------------|-------------|---------------------|
| 50-100 ppm | 12.5-25 ppm | 100-200 ppm         |

ppm = parts per million  
Use test strips to determine the proper strength  
Each type of sanitizer requires its own test strip  
Obtain from local supplier



## Harvest Considerations

- Clean & Sanitize harvest containers
  - High pressure wash, rinse and sanitize
  - Cover clean bins if not used immediately
  - DO NOT allow people to stand in bins during harvest
  - Remove field soil from outside of bins before moving to packing areas
- Worker Hygiene and Training as before

## Harvest Considerations

- U-Pick Customer Hygiene
  - Provide well-maintained toilet facilities
  - Provide hand wash stations near restrooms
  - Invite customers to wash hands before entering the picking areas
  - Provide large hand washing posters

## Storage Facility Sanitation

- Wash, rinse and sanitize storage facilities, equipment and food contact surfaces before harvesting and storing crops
  - Thoroughly clean before sanitization
  - Dirt and organic matter make sanitizers ineffective
  - Use approved products to sanitize food contact surfaces
- Ensure refrigeration equipment is working properly
  - Measure and record temperatures at least once a week

## Cider and Juice Production

- DO NOT use drops – they may have come in contact with animal feces on the ground
- DO NOT use decayed or wormy fruit
- Wash fruit with clean water or approved sanitizers, using brushes carefully
- DO NOT allow pets in orchard, grove or field and attempt to exclude wild animals
- Strongly consider pasteurizing juice and cider

## Postharvest Handling

- Enforce good worker hygiene
- Clean and sanitize packing area and lines daily
- Maintain clean wash water
- Cool product quickly and maintain cold chain
- Sanitize trucks before loading
- Keep animals out of packinghouse and storage facilities

## Packing Facility

- Ensure that contaminated water and livestock waste cannot enter packinghouse via runoff or drift
- DO NOT wear field clothes (shoes/boots) in packinghouse
- Enforce good worker hygiene
- Clean all containers before use and discard damaged ones
- Store clean empty containers to protect from contamination
- Wash, rinse and sanitize packing areas and floor at end of each day.

## Packing Facility

- Take care not to contaminate fresh produce that is washed, cooled or packaged
- Establish and maintain a pest control program
  - Maintain a pest control log
- Block access of pests into enclosed facilities

## Washing Operations

- Use chlorinated water (at appropriate level) or other registered disinfectants to wash produce
- Change water regularly – monitor the chlorine activity
- Keep water no cooler than 10°F lower than produce
  - Colder could draw pathogens into produce
- Wash, rinse, and sanitize the packing line belts, conveyors and food contact surfaces at the end of each day to avoid buildup

## Chlorine levels for specific commodities

- General 50-500 ppm
- Apples 100-150 ppm
- Asparagus 125-250 ppm
- Cantaloupe, honeydew 100-150 ppm
- Lettuce, cabbage, leafy greens 100-150 ppm
- Tomatoes, potatoes, peppers 200-350 ppm

ppm = parts per million total (drainable) chlorine

## Guide to Measuring Sodium Hypochlorite 5.25%(chlorine) accurately

| Target ppm | ml/liter | tsp/5 gal | cup/50gal |
|------------|----------|-----------|-----------|
| 50         | 0.95     | 3 2/3     | 3/4       |
| 75         | 1.43     | 5 1/2     | 1 1/10    |
| 100        | 1.90     | 7 1/4     | 1 1/2     |
| 125        | 2.40     | 9 1/10    | 1 7/8     |
| 150        | 2.90     | 10 7/8    | 2 1/4     |

tsp = teaspoon

## Guide to Measuring Sodium Hypochlorite 12.75%(chlorine) accurately

| Target ppm | ml/liter | tsp/5 gal | cup/50gal |
|------------|----------|-----------|-----------|
| 50         | 0.39     | 1 1/2     | 1/3       |
| 75         | 0.59     | 2 1/4     | 1/2       |
| 100        | 0.78     | 3         | 3/5       |
| 125        | 0.98     | 3 3/4     | 4/5       |
| 150        | 1.18     | 4 1/2     | 9/10      |

tsp = teaspoon

## Cooling

- Maintain cool temperatures
  - Optimum produce quality
  - Minimize pathogen growth
  - Do not overload refrigeration rooms
- Keep air cooling and chilling equipment clean and sanitary
- Keep water and ice clean and sanitary
  - Potable water source

## Transportation

- Inspect transportation vehicles for cleanliness, odors, obvious dirt and debris before loading
- DO NOT use trucks which have carried live animals or harmful substances without thorough cleaning
- Good hygienic and sanitation practices should be used when loading and unloading fresh produce
- Load produce to minimize physical damage
- Maintain proper transport temperatures

## Summary

- Keep everything clean and sanitary
  - Surfaces, containers, hands
- Clean Water and Ice source
- Personal Hygiene
- Don't Cross contaminate
- Proper temperatures
- Proper Manure Management