

Farmers' Market Food Safety

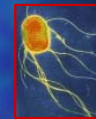
Discussion Topics

- 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 (Aw)

- 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

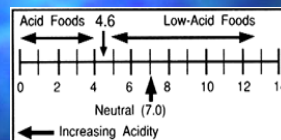
Temperature

- 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 Insti. - 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 field
 - 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