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Farmer's Market Food Safety

Dianne Peters

University of Nebraska - Lincoln, dpeters1@unl.edu

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Farmer's Market Food Safety

Dianne Peters
Microbiological Services Manager
The Food Processing Center
University of Nebraska

Discussion Topics

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

Food Microbiology Overview

Food Microorganisms

- Bacteria

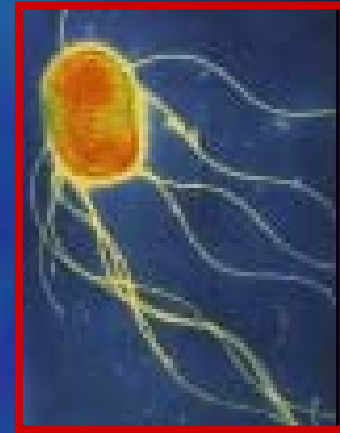
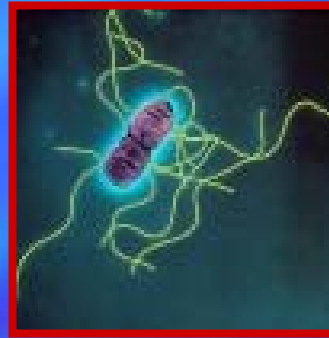
- Yeast

- 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

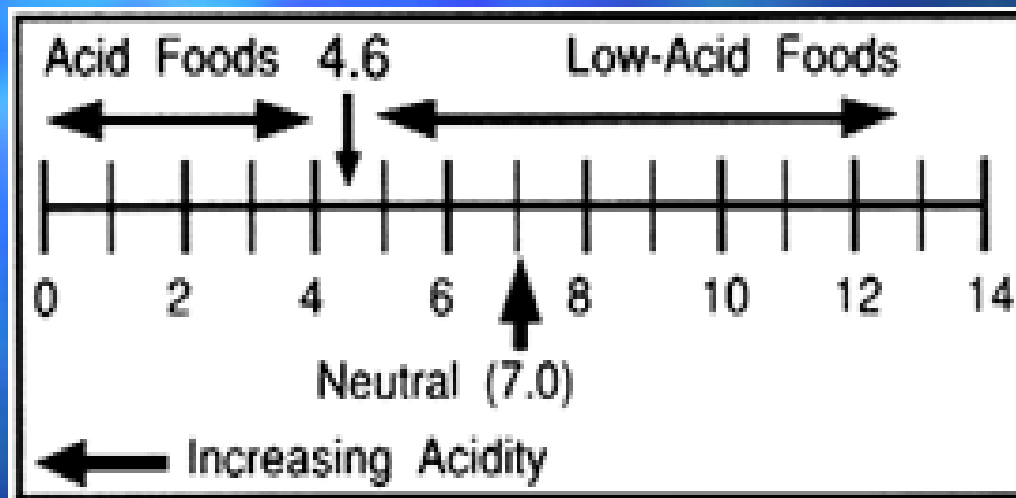
Temperature

- Keep food out of the temperature danger zone (40-140°F)
- Keep cold things cold $< 40^{\circ}\text{F}$
- Keep hot things hot $> 140^{\circ}\text{F}$

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

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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 titratable 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

Contact Information

Dianne L. Peters

Microbiological Services Manager

The Food Processing Center

232 Food Industry Complex

P.O. Box 830930

Lincoln, NE 68583-0930

Phone: (402)472-2829

FAX: (402)472-1693

dpeters@unlnotes.unl.edu