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# Farmer's Market Food Safety

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# Farmer's Market Food Safety

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# Discussion Topics

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

# Food Microbiology Overview

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# Food Microorganisms

- Bacteria

- Yeast

- Mold

- Viruses

- Parasites

- Pathogens – any microorganism that causes disease in humans



# Microorganism transfer

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

# Microbial Growth

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

# Microbial Growth

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



# Bacterial Multiplication

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

# Foodborne Illness

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- 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

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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

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

# Water activity ( $A_w$ )

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- 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

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

# Temperature

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

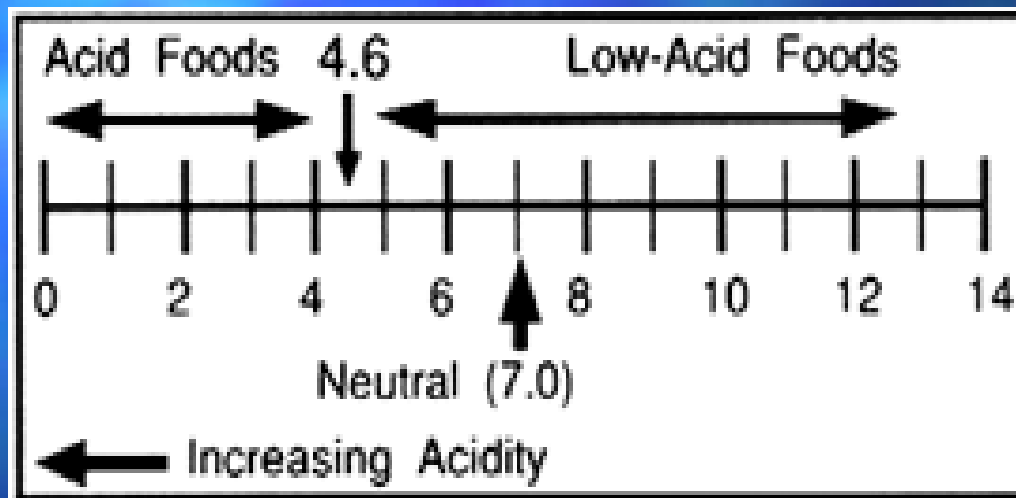
# Oxygen

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- 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

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- Measured using colorimetric or electrometric methods

# Buffering Capacity

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

# Acidified Foods

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# Acidified Foods

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

# FDA Definition

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- 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

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- 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

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



# Required Regulation-FDA

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

# Regulations-Acidified Foods

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- 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)

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- *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

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- 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

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- 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

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- 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

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- 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

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

# Basic Principles

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

# Record Keeping

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- 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

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- 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

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- 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

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

# Site Selection

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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