



Produce Food Safety

Dr. Karen Killinger
Washington State University



Understand what you want to prevent

- The better we understand how pathogens function, the better we can prevent their survival and growth in our food and water

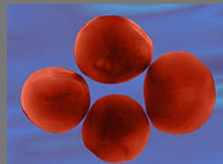


Overview

- Food Microbiology Overview
- Foodborne Disease Overview
- Produce Food Safety
- *E. coli* O157:H7
- Indicator Organisms
- Risk Management
- Summary

Types of Microorganisms

- Viruses
- Bacteria
- Parasites
- Mold
- Yeasts



© 2004 Dennis Kunkel Microscopy, Inc.
Cryptosporidium parvum



Salmonella



Hepatitis A Virus



Saccharomyces
cerevisiae

Food Microbiology

- Microorganisms are present everywhere
- All raw foods contain microorganisms
- In foods, microorganisms can be
 - beneficial
 - cause spoilage
 - cause disease (pathogens)

There isn't a direct relationship between pathogens and spoilage

- Spoiled foods may not contain pathogens
 - You don't want to eat spoiled foods due to off-odors, off-flavors, etc.
- Foods that appear "safe" to eat may contain pathogens!

Why is food a good vehicle for pathogens?

- Foods are nutritious for microorganisms too!
- Pathogens are present at low levels in the environment and can be transferred to raw foods
- Food handling from farm to table can increase levels of contamination
- Foodborne pathogens do not discriminate based scale of production or management practices

Frequency of Foodborne Illness (FBI) in the United States per year

- | | |
|--------------------|------------|
| • Total FBI | 76 million |
| • Hospitalizations | 325,000 |
| • Deaths | 5,000 |

Most Susceptible Populations

- Very Young
- Very Old
- Immunosuppressed
- Pregnant Women



MythBusters: There is NO Stomach Flu!

If you think you have the “stomach flu”...
You likely have a Foodborne Illness!



Foodborne Illness: General Characteristics

- Incubation Period: 6 hours – 3 days
 - Time between ingestion and symptom onset
 - Depends on type of illness
- Types of Foodborne Illness
 - Foodborne Intoxication
 - Toxin-mediated infection
 - Foodborne Infection



Foodborne Disease: General Characteristics

- Symptoms:
 - Initial symptoms flu-like: Fever, Malaise/Fatigue, Headache, Muscle aches
 - GI symptoms: Nausea, Vomiting, Abdominal Cramps and Pain, Diarrhea
- Duration: 24 hrs – 3 days

Most Frequent Causes of Foodborne Illness in the United States

Pathogen	# of foodborne illnesses / year
Norovirus	9.2 million
<i>Campylobacter</i> spp.	1.9 million
<i>Salmonella</i> , non-typhoidal	1.3 million
<i>Clostridium perfringens</i>	248,000
<i>Giardia lamblia</i>	200,000

Mead et al., 1999



Most deadly Foodborne Illnesses in the United States

Pathogen	# of deaths / year
<i>Salmonella</i> , nontyphoidal	553
<i>Listeria monocytogenes</i>	499
<i>Toxoplasma gondii</i>	375
<i>Campylobacter</i> spp.	99
<i>E. coli</i> O157:H7	52

Mead et al., 1999



Why has addressing food safety on the farm become an area of focus?

Foodborne Pathogens & Produce

- Produce outbreaks have increased over the last 30 years
- Possibilities
 - More sophisticated detection methods
 - Increased communication of foodborne illness information among public health labs
 - Emerging pathogens



Food Safety for Raw Produce

- Most control measures reduce pathogen levels but no thermal “kill” step involved
- Steps to reduce risk from farm-to-table are available
- Every segment of the food chain must address food safety to reduce risk



Irradiation and Leafy Greens



- Irradiation for pathogen reduction approved for
 - Loose, fresh iceberg lettuce and spinach
 - Bagged, fresh iceberg lettuce and spinach
- Irradiated products retain nutrient value and are safe to eat
- Other products approved for pathogen reduction: spices, poultry & red meats, molluscan shellfish

Foodborne Pathogens and Produce

- Most common pathogens associated with foodborne outbreaks in produce:
 - *E. coli* O157:H7
 - Norovirus
 - *Salmonella*

Enterohemorrhagic *E. coli* ex. *E. coli* O157:H7

- Evolved from Enteropathogenic *E. coli*
- Acquired toxin genes
 - Shiga-like toxins 1 and 2
- Virulent toxins attacks cells with specific receptors in the body
- Emerged as a foodborne pathogen in the mid 1970's – early 1980's



Enterohemorrhagic *E. coli* ex. *E. coli* O157:H7

- Where does it occur naturally?
 - GI tract of animals and man
 - Particularly ruminant animals
- Feces contaminates environment
 - Soil, water, farm equipment, clothes
- Low infectious dose: 1 – 10 cells



Enterohemorrhagic *E. coli*

- Complications
 - Hemolytic uremic syndrome (HUS)
 - Thrombotic thrombocytopenic purpura (TTP)
- Most Frequent Implicated Foods (Rangel, 2005)
 - Ground beef & beef products
 - Produce

Potential Sources of Pathogen Contamination on the farm can include:

- Contaminated Irrigation Water
- Raw or uncomposted manure
- Wild or domestic animals
- Infected workers
- Equipment
- Improper Storage
- Once produce is contaminated, difficult to remove



Spread of Contamination

- 1 gram of fecal material could contain 1,000,000 cells of *E. coli* O157:H7
- 1 gram of fecal material distributed evenly in water could contaminate 1,000 to 100,000 pieces of produce!

OSU, 2006



Pathogens & Indicator Organisms

- Pathogens are present at low levels in the environment, water and foods
 - Even at low numbers, high risk involved
 - Difficult to detect
- Indicator organisms are chosen
 - Present at higher, detectable levels
 - Indicate potential pathogen presence

Indicator Organisms

- Fecal Coliforms
 - Indicative of fecal contamination
 - Used in most states for bacterial water quality in recreational waters
 - Be aware of potential upstream influences

Indicator Organisms

- Generic *E. coli*
 - Species of fecal coliform
 - Human & animal fecal contamination
 - EPA recommendation for best indicator for recreational waters



Higher Risk Produce

- 88% of produce-related outbreaks (Anderberg, 2007)
 - Lettuce & Leafy Greens
 - Tomatoes
 - Sprouts
 - Green Onions
 - Melons
- Crops where product touches the soil



Risk Management

- There is no “silver bullet”
 - With almost any activity – there is a risk involved
 - Can’t provide “guarantees”
 - There is no “zero risk”
- All raw foods contain microorganisms
 - There is a possibility pathogens will be present
- Focus on reducing risk and managing risk



Why is Risk Management Important?

- If a food product makes someone sick –
Strict Liability will likely apply
 - you are automatically liable for that illness
 - NO IF's, THEN's or BUT's
- If negligence can be proven – failure to exercise reasonable care
 - punitive damages can be awarded

Marler-Clark, 2007



Produce Food Safety

- What should we tell consumers?
 - Wash produce under running water prior to preparation or serving
 - Pathogens are present at low levels in produce
 - High risk populations are at greater risk of illness from fresh produce products

Flooding

- Any product exposed to flood waters is considered adulterated by FDA and cannot enter the food chain
- Why? Not just microbial contamination...
 - Heavy Metals
 - Raw Sewage
 - Chemical Contaminants

The Silver Lining!

- Low pathogen prevalence on most foods
- Produce
 - 1.6% of domestic produce harbors pathogens
 - 4.4% of imported produce harbors pathogens

Janet Anderberg, 2007



The Good News

- For the most part, foodborne illness is preventable!
- Factors can be controlled or used to prevent microbial growth in foods!
- Preventative efforts will increase food safety



Teamwork!

- Opportunities for initial product contamination exist on the farm
- Efforts to limit contamination and bacterial growth must be coordinated from farm-to-table to prevent foodborne illness!
- Team approach



Go Cougs!

Dr. Karen Killinger
Assistant Professor
Washington State University
PO Box 646376
Pullman, WA 99164-6376
(509) 335-2970
karen_killinger@wsu.edu

