Produce Food Safety

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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

- Hepatitis A Virus
- Salmonella
- Cryptosporidium parvum
- Sacchromyces cervisiae
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 on 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

<table>
<thead>
<tr>
<th>Pathogen</th>
<th># of foodborne illnesses / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus</td>
<td>9.2 million</td>
</tr>
<tr>
<td><em>Campylobacter</em> spp.</td>
<td>1.9 million</td>
</tr>
<tr>
<td><em>Salmonella</em>, non-typhoidal</td>
<td>1.3 million</td>
</tr>
<tr>
<td><em>Clostridium perfringens</em></td>
<td>248,000</td>
</tr>
<tr>
<td><em>Giardia lamblia</em></td>
<td>200,000</td>
</tr>
</tbody>
</table>

Mead et al., 1999

### Most deadly Foodborne Illnesses in the United States

<table>
<thead>
<tr>
<th>Pathogen</th>
<th># of deaths / year</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Salmonella</em>, nontyphoidal</td>
<td>553</td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>499</td>
</tr>
<tr>
<td><em>Toxoplasma gondii</em></td>
<td>375</td>
</tr>
<tr>
<td><em>Campylobacter</em> spp.</td>
<td>99</td>
</tr>
<tr>
<td><em>E. coli</em> O157:H7</td>
<td>52</td>
</tr>
</tbody>
</table>

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!

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