LATEST FOODBORNE OUTBREAKS
Funding

• College of Human Sciences Heddleson Grant
• “Equipping Iowa State University Families Extension specialist with food safety knowledge to impact Iowans lives”
Habitat

- Decaying vegetative matter
- Soil
- GI tract of animals and humans
  - at least 37 mammalian species
  - at least 17 species of birds
- Cool, wet, damp processing environments
Optimal Conditions

• pH of 6-8 is optimal (4.1-9.6 has been shown)
• Temperature: 1°C to 45°C
• Water activity of ≥ 0.97
• Sodium chloride levels of 10-12%
• Moist conditions: standing water, condensation, refrigerators
Survival: pH

- Ability to adapt to conditions containing acetic acid, lactic acid, citric acid, malic acid and chlorine bleach
- pH 4.6 at 35C for 1-3 days
  - Cabbage juice at pH 4.1 for 8 days
  - Cottage cheese at pH 5.05 and 5C wasn’t able to grow but it survived
Survival: Salt & Temperature

• pH 4.66
  – 8 days at 30C with 4% salt
  – 13 days at 30% with 6% salt
  – 15 days at 4C with 4% salt
  – 28 days at 4C with 6% salt

• Minimal growth at 0.5 to 3C
  – Survive 10 days at 0.5C
  – Lower than other strains of Listeria
Listeria monocytogenes Cantaloupe

• 146 persons infected, 30 deaths (Iowa miscarriage)
• Four outbreak-associated strains in 28 states
• Investigation from September 2\textsuperscript{nd} to October 19\textsuperscript{th}, 2011
• 99\% of the 144 people were hospitalized
Source of *L. monocytogenes*

- *L. monocytogenes* was traced back to the grocery store and the ill persons households
- Equipment and cantaloupe within packing facility
- Bought used equipment that was used for washing and drying potato's
- Unsanitary conditions within the packing house and poor farm management
Salmonella spp.

• Illness: Salmonellosis
• 2,463 serovars
• Three Main Groups
  – Those that infect humans only
  – The host-adapted serovars
  – Unadapted serovars
  • Most of the foodborne pathogens
PROBLEM IS...
MORE THAN 40
SECRETED VIRULENCE
FACTORS HAVE BEEN
IDENTIFIED IN
SALMONELLA
**Salmonella spp.**

- Optimal at 37°C (5°C to 45°C)
- pH growth at 6.5 to 7.5 but can survive at 4.5 to 9.5
- Facultative anaerobe (can survive under low oxygen environments)
- Non-spore forming
Salmonella spp

• Wet environments are ideal, but able to adapt to adverse conditions
• Water activity of below 0.93 does not support growth
  – Becomes more heat resistant and acid resistant as the water activity increases and/or the temperature increases
• Growth is inhibited at 3-4% salt, but tolerance of salt increases when temperature is raised
  – Survival in above 9% salt
Salmonella spp.

- Heat Tolerance
  - Low Water Activity Food was easily killed at 131°F to 140°F but at 158°F or higher it survived
- Peanut Butter (24 weeks)
- High sugar, low water-activity, peanut butter flavored candy fondant (7 weeks)
- Irrigation Water (7 weeks)
Surfaces

- *Salmonella enteritidis* has been shown to survive between 1-4 days on stainless steel and transfer to cucumbers or chicken fillet slices at a 20-100% transfer rate (wet surfaces had higher transfer rate) ([Kusumaningrum et al., 2003](#))

Surfaces, cont.

- Wood surfaces were the most difficult to clean and stainless steel were the easiest to clean
- No cleaning or rinsing occurred after handling poultry products, *Salmonella* could be cross contaminated onto tomatoes that were on wood, plastic, glass and stainless steel surfaces

Adhesion

• Easily able to attach to stainless steel, marble, granite, glass, cutting boards
• Plastic conveyor belts exhibited stronger bacterial adhesion compared with stainless steel
Lessons Learned

• Tomatoes/Pepper
  – Presence in soil and processing environment
• Peanut Butter 2007
  – Infrastructure issues
• Peanut Butter 2009
  – Infrastructure issues, intermingling raw and processed products
• Vegetable proteins 2010
  – Equipment sanitation
ESCHERICHIA COLI OUTBREAKS
Biofilm on Apple

• SEM image showing attachment and biofilm formation by *E. coli* cells in the calyx area of an inoculated Golden Delicious apple

• Formed with 72 hours

Tarver. 2009. Biofilms: A threat to food safety. Food Technology
Vectors of Contamination

- Water
- Manure and Land Use
- Wild animals
- Humans
- Air
- Equipment
Survival

• Temperature range: 4-45°C (can survive refrigeration and freezing)
  – Optimal 37°C
  – Most cannot grow above 45°C
• pH range: 5.5 and 7.5
  – EHEC strains can have a high degree of acid tolerance, surviving virtually unchanged during 7-hr exposures at pH 2.5 and 37°C
Survival

- Water activity: as low as 0.90
- Salt conditions of 3.5%
- Survive at 0.5 to 5.0% salt
- Survive several weeks in dry conditions in the refrigerator
- Able to move in the air (5 km)
Jimmy John’s Sprouts

- 29 individuals infected in 11 states
- *E.coli* O26
- Onset time December 25\(^{th}\), 2011 to March 3\(^{rd}\), 2012
- Age 9 to 57 (median 26 yrs.)
- 89\% of the ill were female
- 7 were hospitalized (no death or HUS)
Source: Sprouts Growing Conditions

- Sprouting seeds must be soaked in water for several hours and held at 20-26°C for multiple days for germination
- During this soaking phase of growth if pathogens are present on or in the seed, then microbial growth is favored
- Within two days of sprouting microbial populations have increase by ~3 logs
- No kill step
Leafy Greens

Twenty-six lettuce/leafy green-associated *E. coli* outbreaks 1995-2005

- 751 ill, 94 hospitalized, 2 HUS, 1 death
- Lettuce second most common food vehicle in *E. coli*O157 outbreaks