Salmonella

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Salmonella on cantaloupe

Salmonella spp.

- Illness: Salmonellosis
- Rod shaped
- Non-spore forming
- Facultative Anaerobe
- Gram Negative
- Extremely durable and adaptable
Salmonella spp: Characteristics

- 2 species: *enterica* and *bongori*
- 2,463 serovars: 5 subgroups
- Large variation
  - Some have flagella
  - Some like elevated temperatures and others like psychotrophic environments
Salmonella spp: Characteristics

- Three Main Groups
  - Those that infect humans only
    - *S. Typhi, S. Paratyphi*
  - The host-adapted serovars
    - *S. Galinarium, S. Dublin,*
  - Unadapted serovars
    - Most of the foodborne pathogens
General Sources

• Intestinal tract of birds, reptiles, farm animals, humans, and some insects

• Organs of animals: liver, spleen, bile, lymph nodes, feces

• Polluted water, soil, factory surfaces and kitchen surfaces
Typical Associated Foods

• Raw meats
• Raw poultry and Eggs
• Milk and dairy products
• Fish, shrimp, yeast, coconut, sauces and salad dressing, cake mixes, cream-filled desserts and toppings, dried gelatin, peanut butter, cocoa, and chocolate.
Salmonella spp.: Growth

• Optimal at 37°C (5°C to 45°C)
• Catabolize D-glucose and other carbs with the production of acid and gas
• Survives under 60-80% carbon dioxide
• pH growth at 6.5 to 7.5 but can survive at 4.5 to 9.5
**Salmonella spp.: Growth**

- D-Value is 4 to 5 minutes at 60C
- Growth is inhibited at 3-4% salt, but tolerance of salt increases when temperature is raised
  - Survival in above 9% salt
Salmonella spp.: Growth

- 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
Statistics

- ERS estimates it cost about $2.65 billion per year
- 1.4 million cases in each year
- 415 deaths
Typhoid Mary

• Asymptomatic carrier
  – Carry pathogenic organism without symptoms
  – “Typhoid Mary” – Mary Malone
• 53 people, 7 outbreaks, 3 deaths
Classification based on Disease Syndrome

1. Typhoid fever
2. Paratyphoid fever
3. Salmonellosis (Gastroenteritis)
Salmonella typhi

- Habitat: GI tract of humans, polluted H₂O
- Vaccine
- Poor Sanitation
- Not common in U.S.
- Infectious dose – 1-10 cells
Salmonella typhi: Symptoms

- High fever – 105°F
- Sever Diarrhea
- Vomiting
- Dehydration
- Cardiovascular collapse
- Death
Salmonella Paratyphi

- Habitat: GI tract of humans, Polluted H₂O
- Similar to typhoid fever but not as severe
- Disease: paratyphoid fever
Gastroenteritis

• Foodborne Infection
• Serovars adapted to specific host
  – S. Dublin – cattle
  – S. Typhimurium – Human tract
  – S. Enteritidis – Humans GI tract
Gastroenteritis: Infection

- Onset: 6 – 72 hrs
- Duration: 2-3 days
- Infective Dose- $10^3$ - $10^6$
Gastroenteritis: Symptoms

• Nausea
• Vomiting
• Diarrhea
• Headache
• Fever
• Chills
• Sweating
• Weakness
Gastroenteritis: Symptoms

- Severity depends on:
  - Type of Salmonella
  - # of cells ingested
  - Age of individual
    - Age of Individual – 4.1% mortality rate mostly elderly
  - Health of individual
Gastroenteritis: Reservoirs

- Carriers/Implicated foods
  - Poultry – meat and eggs
  - Cattle – beef and dairy prod.
  - Swine – pork
  - RTE foods
Gastroenteritis: Implicated Foods

- Wild game
- Orange juice
- Alfalfa sprouts
- Nuts – Snickers
- Cantaloupes/Melons
SALMONELLA OUTBREAKS
2012

- Mangoes – *Salmonella* Braenderup
- Cantaloupe – *Salmonella* Typhimurium
- Ground Beef - *Salmonella* Enteritidis
- Live Poultry - *Salmonella* Infantis, Newport, and Lille
- Dry Dog Food - *Salmonella* Infantis
2012, cont.

• Raw Scraped Ground Tuna Product - *Salmonella* Bareilly and *Salmonella* Nchanga

• Small Turtles - *Salmonella* Sandiego, *Salmonella* Pomona, and *Salmonella* Poona

• Restaurant Chain A - *Salmonella* Enteritidis
2011

• Ground Beef - *Salmonella* Typhimurium
• Kosher Broiled Chicken Livers - *Salmonella* Heidelberg
• Turkish Pine Nuts - *Salmonella* Enteritidis
• Ground Turkey - *Salmonella* Heidelberg
• Whole, Fresh Imported Papayyas - *Salmonella* Agona
2011, cont.

- Alfalfa and Spicy Sprouts - *Salmonella Enteritidis*
- Chicks and Ducklings - *Salmonella Altona* and *Salmonella Johannesburg*
- Clinical and Teaching Microbiology Laboratories - *Salmonella Typhimurium*
- Turkey Burgers - *Salmonella Hadar*
- Cantaloupe - *Salmonella Panama*
2010

• Alfalfa Sprouts - *Salmonella* I 4,[5],12:i:-
• Shell Eggs - *Salmonella* Enteritidis
• Cheesy Chicken Rice Frozen Entrée - *Salmonella* Chester
• Frozen Mamey Fruit Pulp - *Salmonella* Typhi (Typhoid Fever)
• Restaurant Chain A - *Salmonella* Hartford and *Salmonella* Baildon
2010, cont.

- Frozen Rodents - *Salmonella* I 4,[5],12:i:-
- Alfalfa Sprouts - *Salmonella* Newport
- Red and Black Pepper/Italian-Style Meats - *Salmonella* Montevideo
- Water Frogs - *Salmonella* Typhimurium
Quick Facts: CDC

• 2002-2003
  • Produce accounted for 31 outbreaks
  • Poultry accounted for 29 outbreaks
• From 1990 to 2001
  – Poultry accounted for 121 Salmonella outbreaks
  – Produce accounted for 80
Outbreak 1: Eggs

- May 1\textsuperscript{st} to Nov 30\textsuperscript{th}, 2010
- 3,578 illnesses (1,519 illnesses)
- Wright County Egg and Hillandale Farms in Iowa
- 380 million of their shell eggs are being recalled
- Took samples of manure, as well as traffic areas such as walkways, equipment, other surfaces in and around the farm, and from the feed mill

[Image of eggs]
Source

- Positive sample in wash water
- Cross contamination was the cause
- Unsanitary conditions in the bird houses

- Birds ingest via soil, feces, contaminated feed
- Lives in intestinal tract as host
- Birds shed and cross contamination at processing
Laying hens were inoculated orally, intracloacally (IC), or intravenously (IV)

- Depression, anorexia, reduced egg production, diarrhea, and some mortality
- Lower doses → milder clinical signs
- *S. Enteritidis* was cultured from the shells of a few eggs but not from egg contents.
- Fecal shedding persisted for up to 6 weeks in some birds


Pathogenesis of *Salmonella enteritidis* infection in laying chickens. I. Studies on egg transmission, clinical signs, fecal shedding, and serologic responses.
Special Note: Yolk or Whites

- The structure of the shell membranes helps prevent the passage of bacteria
- The shell membranes also contain lysozyme, a substance that helps prevent bacterial infection
- The yolk membrane separates the nutrient-rich yolk from the white
Recommendations

• Reliable source of chicks
• Rodent and pest control
• House environmental testing
• All In and All Out policy
• Refrigerate eggs at 45C
• Keep it clean
Outbreak with Produce

- Cantaloupe in Multistate Outbreak
  - 22 States
- *Salmonella* Typhimurium
- 204 cases with 2 deaths and 78 hospitalizations
- Originating from Chamberlain Farms Produce, Inc.
Mention: Mango

• Mexico grown
• 105 persons ill
• 16 states since July 1st, 2012
• *Salmonella* Braenderup
• Daniella brand mangoes distributed by Splendid Products of Burlingame, California
Triggers Ice Cream Outbreak

• In 1994: ice cream outbreak
• 224,000 people got ill
• 41 states were affected
• From milk transported in a tanker truck with hauled liquid eggs
• *S. Enteritidis* was identified
Additional Questions

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