

## OTHER FOODBORNE INFECTIOUS BACTERIA

PHR 250

## OTHER FOODBORNE INFECTIOUS BACTERIA

- Infectious bacteria only
- May be transmitted by food, water or contact
- Some are not conclusively proved to be foodborne criteria for “foodborne”

## Categories

- Historic foodborne agents
- Sometimes foodborne
- Questioned foodborne pathogens

## Historic foodborne agents

- *Brucella* spp.
- *Corynebacterium diphtheriae*
- *Mycobacterium bovis*

## (1) *Brucella* spp.

Species of concern are:

- *B. abortus* (cattle)
- *B. melitensis* & *B. ovis* (sheep & goats),
- *B. suis* (swine), and
- *B. canis* (dogs; although rare).

## *Brucella* spp.

- Brucellosis (Malta fever) is a worldwide problem.
- Incidence of brucellosis in the US:
  - ~ <0.5 cases per 100,000
  - Most reported from California, Florida, Texas, and Virginia.

### ***Brucella* spp.**

Transmission of *Brucella* is usually zoonotic. The organism is carried and shed by animals.

- Livestock such as cattle (beef and dairy) are a primary source of the pathogen, at least in the US.
- Some pets (e.g., dogs) also a source.

### ***Brucella* spp.**

Food vehicles:

- Unpasteurized milk (cows, sheep, or goats) and milk products.
- Carcasses of infected animals (including swine and buffalo)—don't typically lead to consumer infections.

### ***Brucella* spp.**

- Incubation period is 5 d–2 mo.
- Recurrent, prolonged, febrile, systemic infection.
- Recurrences are common and may be accompanied by arthritis.
- Antibiotic treatment

### ***Brucella* spp.**

- Pasteurization will destroy the *Brucella*—avoid drinking raw milk and eating raw-milk cheese
- No vaccines available for humans.
- Live vaccines available for animals, may cause disease in humans.

### **(2) *Corynebacterium diphtheriae***

- Diphtheria first clinically described by Hippocrates in the 4<sup>th</sup> century B.C.
- An epidemic swept Europe in the 17<sup>th</sup> century. Called “El garatillo” (the strangler) in Spain & the “gullet disease” in Italy.
- Reached American colonies in the 18<sup>th</sup> century—whole families wiped out.

### ***C. diphtheriae***

- Toxigenic (phage-mediated) infection, usually of upper respiratory tract
- Life-threatening
- Controlled by vaccination of humans (no animal hosts)

### ***C. diphtheriae***

- Milkborne outbreaks recorded in the US before widespread practice of immunization and pasteurization of milk (machine milking?).
- No foodborne outbreak reported in recent years in the US.

### **(3) *Mycobacterium bovis***

- *M. bovis* causes a contagious and debilitating disease in humans and animals called bovine tuberculosis (TB).
- WHO: ~8 million new cases and 3 million deaths each year.

### ***Mycobacterium bovis***

- Most common means of contracting the disease is through inhalation of aerosols containing the agent.
- Tuberculosis caused by *M. bovis* indistinguishable from *M. tuberculosis*; infects consumers via the digestive tract → extrapulmonary tuberculosis more likely

### ***Mycobacterium bovis***

- Food vehicles: Mainly raw cows' milk and its products.
- In 2002, California lost its TB-free status after three herds tested positive for the disease.

### ***Mycobacterium bovis***

- Most heat-resistant of milk-borne pathogens are *M. bovis* and *C. burnetii*.
- The heat resistance of *M. bovis* provided the basis for the conditions of high-temperature, short-time pasteurization (72°C, 15s) of milk.

### **Bacteria rarely foodborne**

- *Clostridium difficile*
- *Coxiella burnetii*
- *Streptococcus pyogenes*

### **Bacteria rarely foodborne**

#### *Clostridium difficile:*

- Free-living in soil & sediments
- Can contaminate foods, but not specifically shown to be foodborne
- Causes diarrhea after antibiotics—altering flora allows *C. difficile* to grow in intestinal tract, produce toxin, & cause watery diarrhea.

### **Bacteria rarely foodborne**

#### *Coxiella burnetii:*

- Globally distributed
- Causes Q-fever
- Primary reservoirs: sheep, cattle, goats, companion & wild animals, birds, ticks

### ***Coxiella burnetii***

- Commonly airborne (risk to vets & herdsman in contact with animals, especially at parturition)
- Can be shed in milk of infected animals (basis for low-temperature, long-time pasteurization)

### ***Coxiella burnetii***

- *C. burnetii* is a highly infectious agent.
- Resistant to drying, heat, and a number of disinfectants.
- It can survive for long periods in the environment.

### ***Streptococcus pyogenes* (= Group A)**

- Groups B, C, D, F, and G.
- Based on a combination of antigenic, hemolytic, and physiological traits
- Groups A and D can be foodborne & cause human illness.
- Group A = one species (*S. pyogenes*) with 40 antigenic types.

### ***Streptococcus pyogenes***

- Most common vehicle is raw cows' milk, but any food (potato salad, eggs, egg salad, and rice pudding) may be contaminated by infected handler.
- Infective dose is low (est. <1000 cells).

## ***Streptococcus pyogenes***

- CDC (U.S., '98-'02): 1 outbreak, 4 cases, 0 deaths
- CAST: 52,000-500,000 cases, 150 deaths/yr, \$540/case

## Questioned foodborne pathogens

- *Aeromonas hydrophila*
- *Enterococcus* spp.
- *Plesiomonas shigelloides*
- *Pseudomonas aeruginosa*

## ***Aeromonas hydrophila***

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- Some strains can cause illness in fish and humans.
- Often found in human intestines (normal and diarrheal); proposed cause of diarrhea in humans (especially young children).

## ***Aeromonas hydrophila***

- The bacterium is found in all freshwater environments, and brackish water
- Causation of diarrhea and transmission via food or water have not yet been conclusively proven.
- Suspected food vehicles: fish, shellfish, and meats including beef, pork, lamb, and poultry.

## ***Enterococcus* (fecal *Strep.*) spp.**

- The genus *Enterococcus* is new name for fecal *Streptococcus*.
- Experiments have failed to cause illness in human volunteers.
- Transmission via food and water is proposed, but unproven.

## ***Plesiomonas shigelloides***

- Found in humans with watery diarrhea (causation not proved, but two outbreaks have been documented in Japan) or with septicemia, often accompanied by meningitis.
- Most reported cases of gastroenteritis involve people with pre-existing health problems (e.g., cancer, sickle-cell anemia).

### ***Plesiomonas shigelloides***

- Suspected to be waterborne — disease agent might be present in unsanitary water used for drinking, recreational purposes, or rinsing foods to be eaten raw.
- Eating contaminated, raw shellfish may lead to illness. All reported foods involved with cases of gastroenteritis were of aquatic origin (salted fish, crabs, and oysters).

### ***Pseudomonas aeruginosa***

- Opportunistic pathogen
- Alleged to cause gastroenteritis in humans if ingested in large numbers.
- Can be isolated from soil and water and is commonly associated with spoilage of food such as eggs, cured meats, fish and milk.

### ***Pseudomonas aeruginosa***

- *P. aeruginosa* is pathogenic only when introduced into areas lacking normal defenses such as tissue damage of mucous membranes and skin, severe burns, intravenous or urinary catheters.
- Transmission via food and water is proposed, but unproven.

### **“Emerging foodborne pathogens”**

- Agents not previously recognized as foodborne
- Agents in food, not previously recognized as pathogenic
- Problems with Koch's postulates
- "Old" agents, newly named

### **Summary**

- "Emerging" vs disappearing foodborne pathogens (affluent countries)
- On-farm measures vs zoonoses
- Some agents that occur in foods may threaten only "vulnerable" populations
- Some alleged pathogens may be virtually harmless

### **“At risk” populations, U.S.**

- |                             |            |
|-----------------------------|------------|
| ● Age > 65                  | 29,400,000 |
| ● Pregnant women            | 5,657,900  |
| ● Newborns                  | 4,002,000  |
| ● Cancer outpatients        | 2,411,000  |
| ● Nursing home residents    | 1,553,000  |
| ● AIDS patients             | 135,000    |
| ● Organ transplant patients | 110,270    |

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