Shigellosis
**Shigella spp.**

- Gram negative, rod-shape
- Non-motile
- Non spore forming bacteria
- Facultative anaerobic bacteria
- Rarely occurs in animals
- Principle disease of humans excepts other primates such as monkeys and chimpanzee
- Frequently found in polluted water (contaminated with human feces)
- Shigellosis account less than 10% of the reported outbreaks of foodborne illness (estimated 300,000 cases/years)
Shigella spp.

- Unique characteristic
  - *Shigella dysenteriae* is a primary pathogen that causes classical bacillary dysentery
  - *S. sonnei, S. flexneri*
  - Grow at temperature between 10 °C to 45 °C
  - pH range 6 to 8
  - Methods for bacterial isolation are insensitive
    (difficult to demonstrate bacterial contamination in food)
Shigellosis

- Foodborne infection
- Incubation period: 12-50 hrs
- Duration of illness: 5-7 days
- Clinical signs (Bacillary dysentery)
  - Fever, abdominal pain
  - Diarrhea (Pus, mucous, bloody stool)
  - Vomiting
- Infective dose: Low infective dose
  - As few as 10 cells
  - Transmitted by fecal-oral route
- High mortality rate: 10-15%
Shigellosis

- *Shigella* spp. attach to and penetrate to epithelium cells of the intestinal mucosa
- Bacteria invade intestinal mucosal cells
- Bacteria multiply intracellularly and spread to contagious epithelial cells resulting tissue destruction
- Some strains produce enterotoxin and Shiga-like toxin
  - Toxins not play an important role in foodborne illness
Shigellosis outbreaks

- Large outbreak foodborne shigellosis
  - Estimated 5,000 persons
  - Mexican restaurant chain
  - Vegetable (Lettuce)
  - *S. sonnei*
- 1985 Foodborne shigellosis
  - College students
  - Vegetables from salad bar
  - Associated with food service workers
Shigella spp.

- Isolation of *Shigella* spp.: Enterobacteriaceae protocol
- *Shigella* spp. prevention and control
  - Education
    - Good hygiene practice
  - Prevent cross contamination
  - Heat treatment
Campylobacteriosis
Campylobacter jejuni

- Gram negative, curved rod shape
- Motile
- Non spore forming bacteria
- Obligate microaerophilic bacteria
  - optimum growth condition 3-5% oxygen, 2 - 10% carbon dioxide
- Optimum growth at 25-42 °C
- Causes Campylobacteriosis in humans and animals
- Associated with warm blood animals
Campylobacter jejuni

- Leading cause of bacterial foodborne illness in the United States
- It is estimated that more than 2 to 4 million cases of campylobacteriosis occur in the U.S. annually
- *C. jejuni* is often isolated from healthy cattle, chicken, birds, and even fish
- It is sometimes present in water sources (ponds, lakes)
- Difficult to differentiate pathogenic from non-pathogenic strains
  - Many of the chicken isolates are pathogens
Campylobacter jejuni

- Unique characteristic
  - Require reduce oxygen tension (Microaerophilic bacteria)
  - Catalase positive and oxidase positive
  - Thermo tolerant
    - Tolerate temperature < 2 °C
    - Not grow < 25 °C
  - Sensitive to cold and NaCl
  - Infective dose: low infective dose (5x10^2-10^6 CFU/g)
    - Some studies suggested 400-500 bacteria may cause illness
Campylobacteriosis

- Foodborne infection (Campylobacter enteritis)
- Incubation period: 3-5 days
- Duration of illness: Few days with excretion for up to 3 months
- Clinical signs
  - Fever, abdominal pain
  - Nausea, headache, muscle pain
  - Watery diarrhea and may contain blood
  - Fecal leukocytes
  - Self limiting but relapses about 25% of cases
  - Patient secretes microorganisms for 5-7 days after recovery
- Complications are relatively rare
  - Reactive arthritis, septicemia, meningitis
- Case fatality ration: 0.1
Campylobacter jejuni outbreaks

- Most common: raw chicken
  - Some survey showed 20-100% of retail chicken are contaminated
  - Healthy chickens carry these bacteria in GI tracts
- Raw milk
  - Healthy dairy cattle and flied on farms
- Non-chlorinated water
Campylobacter jejuni outbreak

- *C. jejuni* foodborne infection
  - All age
  - More frequent in children under age 5 years and young adults (15-29)
  - Complication associated with people who have the human lymphocyte antigen B27 (HLA-B27)
  - 50% of infections are associated with either eating inadequately cooked or recontaminated chicken meat
Campylobacter jejuni outbreaks

- *C. jejuni* foodborne infection
  - Large outbreak involving 2,000 people occurred while the town was temporarily using non-chlorinated water source as a water supply
  - Outbreak in elementary school (estimated 100 children) due to consumption of raw milk
  - Outbreak in convention center due to BBQ chicken
Campylobacter jejuni case study

- *C. jejuni* foodborne infection
  - In April, 1986 school children were sick (Bloody diarrhea) and cultured for bacterial pathogens
  - *C. jejuni* was isolated

- Outbreak investigation
  - Food consumption/gastrointestinal illness questionnaires were administered to students at the school
  - 32 of 172 students reported symptoms of diarrhea, abdominal cramp, nausea, fever, bloody stools
  - Food questionnaire clearly indicated milk as the common source
  - Dose/response
Campylobacter jejuni case study

- *C. jejuni* foodborne infection
  - Investigation at milk processing plant
    - Pasteurization temperature
      - 135 °F for 25 min (requirement 145 °F for 30 min)
    - Raw milk had high somatic cell count
    - Cows from the herd supplying the dairy had *C. jejuni* in their feces
  - Outbreak point out the variation in symptoms which may occur with Campylobacteriosis
Campylobacter jejuni

- C. jejuni prevention and control
  - Education
  - Proper cooking
    - Cooking temperature
  - Prevent cross contamination
    - Handle of raw food and cooked food
  - Control source of contamination
    - Associated with poultry industries
Isolation of *Campylobacter jejuni*

- Fecal examination
  - Wet preparation
    - Phase-contrast microscopy
    - Rapid, jerking motility
  - Fix-smear
    - Stained by Carbol fuchsin
- Bacterial culture
  - sheep blood agar: spreading, watery appearance
  - Selective media: Charcoal-cefoperazone-deoxycholate agar
Yersiniosis
Yersinia enterocolitica

- Gram negative, small rod-shape
- Motile (22-25 °C), non-motile (35-37 °C)
- Non spore forming bacteria
- Facultative anaerobic bacteria
  - optimum growth temperature 25 °C
  - It is capable of growth at 4 °C to 37 °C
- Genus Yersinia: 3 pathogenic species
  - Y. enterocolitica and Y. pseudotuberculosis cause gastroenteritis
  - Emerging foodborne disease: Y. enterocolitica
  - Report of foodborne and water disease in some country: Y. pseudotuberculosis
- What is another pathogenic species?
Yersinia enterocolitica

- Unique characteristic
  - Psychrotroph
    - Can grow at temperature 0-5 °C
  - Tolerate to NaCl (can grow in upto 5% NaCl)
  - Infective dose: High infective dose (10⁹ CFU/g)
  - Many strain produce an enterotoxin (closely resembles to the ST enterotoxin)
  - Role of enterotoxin in the pathogenesis of yersinia enteritis is unknown
**Yersiniosis**

- Foodborne infection
- Incubation period: 24-36 hrs (range 3-5 days)
- Duration of illness: 3-5 days
- Clinical signs (Gastroenteritis)
  - Fever, abdominal pain
  - Diarrhea
  - Vomiting (rare)
  - Important symptom: Fever and abdominal pain: Mimic appendicitis (Pseudo-appendicitis)
- Complications
  - Infections of other sites such as wounds, joints and urinary tract
Yersinia enterocolitica outbreaks

- Meat
  - Pork, beef, lamb
  - Raw milk

- Non-symptom carriers occur in many species of animals and birds

- Strains associated with disease in man have been isolated from the tongue, tonsils, and intestinal contents of pigs

- Animals, particularly pigs, are an important reservoir of infection for humans

- Bacteria widely distribute in environment: Lake, stream, wells
Yersinia enterocolitica outbreaks

- 1976 1st Yersiniosis outbreak in the US
  - School children: Chocolate milk
- 1982 Y. enterocolitica enteritis
  - Community: Tofu
  - Source of infection: contaminated water
- 1982
  - Consumption of pasteurized milk
  - Source of infection: contaminated milk containers
Yersinia enterocolitica

- Y. enterocolitica prevention and control
  - Education
    - Good hygiene practice
  - Food with pH < 5
  - Vacuums packages
  - Pretreatment of water
    - Chlorinated or filtered water
  - Control source of contamination
    - Associated with water and animals
    - Pig farm
Isolation of *Yersinia enterocolitica*

- Bacterial culture from feces or food
  - Cold enrichment broth: inoculate with samples
  - Incubate at 4 °C or 22 °C for several days
- Then subculture on selective media
  - MacConkey agar: pale pink colonies (weak fermentation of lactose)
  - *Yersinia* selective agar: formulated for the isolation and enumeration of *Y. enterocolitica* from samples: Dark red colonies surrounded by a transparent border