Escherichia coli
Escherichia coli

- *E. coli*
  - Gram negative bacteria
  - Non-spore former
  - Rod shape
  - Facultative anaerobic
  - Motile
  - Commonly found in the intestinal tract of humans and animals
  - Some *E. coli* serotypes cause foodborne diseases (Foodborne infection)
**Escherichia coli**

- EPEC (Enteropathogenic *E. coli*)
- ETEC (Enterotoxigenic *E. coli*)
- EIEC (Enteroinvasive *E. coli*)
- EHEC (Enterohamorrhagic *E. coli*)
**Enteropathogenic* *E. coli***

- Gastrointestinal illness
- Large numbers of M/O at point of consumption \(10^6-10^9\) organisms
- Cause:
  - infant mortality
- FEEC
  - non-EPEC serotype
  - associated with diarrhea may include with normal intestinal microflora
**Enterotoxigenic** *E. coli*

- Produce endotoxins
  - **Heat labile enterotoxin (LT)**
    - Enterotoxin related cholera toxin
    - Increase fluid secretion in small intestine
  - **Heat stable enterotoxin (ST)**
    - Non antigenic
    - Heat stable
    - Inactivate at 121°C for 15 min or 100 °C for 30 mins

- **ETEC**
  - Host specific
  - Some strain causes diarrhea in pig (not in humans)
  - Severely effect in small animal
Enterotoxigenic *E. coli*
Travellers’ Diarrhoea

- Worldwide illness
- Brief duration and occurs among people travelling from area of good hygiene and a temperature climate to areas which a lower standard of hygiene and often tropical climate
- Waterborne and/ or Foodborne
- Incubation period 12-72 hrs followed by diarrhea and other signs (nausea, vomiting, and abdominal cramps)
Enterotoxigenic *E. coli*

**Travellers’ Diarrhoea**

- Large doses of enterotoxigenic *E. coli* ($10^6$-$10^9$ organisms)
- Organisms enter raw food via contaminate water or food handler
- Organism is killed by heat (Cooking etc)
- Cross contamination from raw food to cooked food
Enteroinvasive *E. coli*

- Invade intestinal cell
- Cell dead, mucous, blood
- Need low infective dose (Few microorganisms)
- Shigella like dysentary
  - bloody diarrhea (dysentery)
  - diarrhea in nursing home (person-person transmission)
**Enterohemorrhagic** *E. coli*

- Important *E. coli* group: *E. coli* O157:H7
- Major foodborne pathogen
- Produce toxin
  - Shiga-like toxin (SLT)
- Watery or blood stool and abdominal cramps
- Hemorrhagic colitis and may cause kidney failure (hemolytic uremic syndrome) (HUS)
- Low infective dose
**Escherichia coli**

- *E. coli* isolation and identification
  - **Selective media**
    - MacKonkey agar → Bright pink colony
    - EMB agar → Dark colony with metallic sheen
    - Fluorocult agar → Fluorescent colony under UV light
  - **Biochemical test**
    - IMViC test
Escherichia coli
O157:H7
**E. coli O157:H7**

- Major foodborne pathogen
- Produce toxin
  - Shiga-like toxin (SLT)
- Watery or blood stool and abdominal cramps
- Hemorrhagic colitis and may cause kidney failure (hemolytic uremic syndrome) (HUS)
- Low infective dose
**E. coli**

Slide agglutination

- **O antigen** (Somatic antigen): Heat stable somatic antigen
  - 164 serotypes
- **K antigen** (Somatic antigen): Heat labile somatic antigen
  - 100 serotypes
- **H antigens** (Flagella antigen): Heat labile flagella antigen
  - 56 serotypes
\textit{E. coli O157: H7}

- Cause food borne infection
- Major outbreaks in the US and Japan
- 7,600-20,400 cases/year
- 98% recovered from diarrhea (hemorrhage colitis)
- 2% hospitalization and may develop HUS
E. coli O157:H7

Shiga-like toxin (SLT1, Verotoxin, Verocytotoxin)

- Toxin is neutralized by anti-Shiga antisera
- Cytotoxic to vero cell and lethal for mice
- Bacteria colonize in small intestine and produce toxin
  - Colonizing factors: Fimbriae, Pili etc
- Diarrhea results from enterotoxin activate intestinal adenylate cyclase increases intracellular cyclic adenosine monophosphate (cAMP) and losses of intracellular fluids
E. coli O157:H7

- Unique characteristic
  - Temperature 6.5 °C - 42 °C
  - pH 3-9
  - Infective dose: low infective dose (10-100 CFU/g)
    - 10 CFU/g can cause disease
  - Temperature effect growth rate

- Bacteria can survive
  - Low pH 3.6-4: Bacteria not grow but survive for longer time
  - Low temperature: Freezing: Bacteria can survive in frozen food (Ground beef) for 9 months
  - Low water activity: Fermented food: Sausage
**E. coli O157:H7**

- **Foodborne infection**
- **Incubation period:** 12-72 hrs
- **Duration of illness:** 1-7 days
- **Clinical signs**
  - No or low fever
  - Mild abdominal discomfort to severe abdominal cramps
  - Watery diarrhea to severe bloody diarrhea
- **Mostly recovery**
- **Some develop chronic kidney failure**
- **Death**
E. coli O157:H7 outbreaks

- Person to person transmission
  - Day care center
  - Nursing home
- Food handling
  - Hospital and nursing home
  - Fast food restaurant
- Raw food
  - Raw milk
  - Raw vegetable
- Water
  - Community well
  - Drinking water
E. coli O157:H7 outbreak

- Food
  - Raw milk
  - Pasteurized milk
  - Juice
    - Apple cider
    - Orange juice
  - Beef
  - Beef product: Sausage
Case study

E. coli O157:H7 outbreak

- Multi-states E. coli O157:H7 outbreak
- Fast-food restaurant (Jack in the box)
  - Hamburger
  - Beef
- Symptoms: bloody diarrhea and recovery within one week
- Small children developed kidney failure
- Death
- Case control study
  - Those who get sick and consume food
  - Those who not get sick and consume food
**E. coli O157:H7 outbreak study**

**E. coli O157:H7 contamination in ground beef**

- People get sick: Diarrhea, vomit
  - Bacterial culture: *E. coli* O157:H7

- Epidemiological investigation
  - Case control study
  - What, Where, When those people ate food
  - Expose group/ non expose group
  - Suspected source of contamination

- Ground beef from meat processing plant (A)
**E. coli O157:H7 outbreak study**

- *E. coli* O157:H7 contamination in ground beef
  - Ground beef from meat processing plant (A)
    - Sampling
    - Bacterial culture: positive *E. coli* O157:H7
    - Genetic characteristic (DNA fingerprinting): Molecular biology techniques
      - PFGE (Pulsed-Filed Gel Electrophoresis)
**E. coli O157:H7 outbreak study**

- **E. coli** O157:H7 contamination in ground beef
  - **E. coli** O157:H7 contamination in ground beef from meat processing plant (A)
  - Recall product
    - Lot number
    - Loss of product demand
    - Liability
  - Find source of contamination
    - Infected cattle
    - 1-2 infected animals cause contamination of the whole lot of ground beef
    - Need **E. coli** O157:H7 free animals
Role of Veterinarian

- *E. coli* O157:H7 free animals
  - No clinical sign in animals
  - Carrier for *E. coli* O157:H7
  - Test of *E. coli* O157:H7: Fecal culture
- Outbreak investigation
  - Department of health
- Diagnosis and researches
- Education
**E. coli O157:H7**

- Control of *E. coli* O157:H7 infection
  - Education
  - Reduce incidence of microorganism at farm level and raw food
  - Prevent fecal contamination in water and food
  - Store in freezing temperature: grow slowly
  - Heat treatment: Cooking temperature
    - Temperature use in meat: Internal temperature 60 °C
    - Cook each size (1 min)
    - Cook uniformly
  - Radiation very effective but low acceptance