



## Microbiology II/ ENTEROBACTERIACEAE

### Classification of Bacteria

This family has Gram positive and negative Cocci, Bacilli and Rods

### Enterobacteriaceae Features

- Commonly present in large intestine
- Non sporing , Non Acid fast, Gram – bacilli.
- A complex family of organisms, • Some are non pathogenic
- A few are highly Pathogenic, • Some commensals turn out to be pathogenic. as in UTI after catheterization.

### Characters of Enterobacteriaceae

- All Enterobacteriaceae
  - Gram-negative rods
  - Ferment glucose with acid production
  - Reduce nitrates into nitrites
  - Oxidase negative
- Facultative anaerobic
- Motile except Shigella and Klebsiella

- Non-capsulated except Klebsiella
- Non-fastidious
- Grow on bile containing media (MacConkey agar)

### **Basic Tests :** Basic characters

- Catalase +
- Oxidase –
- Reduce nitrates,
- All are Gram negative and non spore forming.
- Wide diversity / Antigenic heterogeneity

### **Classification of Enterobacteriaceae**

Enterobacteriaceae is divided to

- 1- Lactose fermenters E. coli, Citrobacter, Klebsiella, Enterobacter
- 2- Non-lactose fermenter Salmonella, Shigella Proteus, Yersinia

There are several selective and differential media used to isolate distinguishes between LF & LNF

The most important media are:

- MacConkey agar
- Eosin Methylene Blue (EMB) agar
- Salmonella Shigella (SS) agar
- In addition to Triple Sugar Iron (TSI) agar

## **Enterobacteriaceae Taxonomical**

- Tribe I Escherichia: Genus

- 1- Escherichia,
- 2- Edwardsville
- 3- Citrobacter
- 4- 4 Salmonella
- 3- 5 Shigella

- Tribe II; Klebsiella: Genus

- 1- Klebsiella
- 2- Enterobacter,
- 3- Hafnia
- 4- Serratia

Tribe III ; Proteaeae : Genus

- 1- Proteus
- 2- Morganella
- 4- Providencia

- Tribe IV; Erwinieae Genus: Erwinia

## Highly Pathogenic Enterobacteriaceae

- Salmonella
- Shigella
- All are Lactose – non fermenters,
- Produce colorless colonies on MacConkey medium
- LF also called as Para colons,

## Escherichia coli

Escherichia coli is a Gram negative, facultative anaerobic, rod-shaped bacteria. It is a commensal that is found inhabiting the lower intestine of warm blooded animals. A small proportion of E. coli strains are pathogenic.

- The harmless strains produce vitamin K and prevent colonization of the intestine by pathogenic bacteria.
- E. coli is classified into serotypes based on cell wall (O), capsular (K), fimbrial (F) and flagellar (H) antigens. Example E. coli O157:H7

Kingdom	•Bacteria
Phylum	•Proteobacteria
Class	•Gammaproteobacteria
Order	•Enterobacteriales
Family	•Enterobacteriaceae
Genus	•Escherichia
Species	•Escherichia coli

## **Pathogenic Strain**

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

## **Pathogenesis**

### **Enterohaemorrhagic E. coli**

- This is a strain of E. coli that produces cytotoxins that disrupt protein synthesis within host cells.
- These toxins are also called verocytotoxins or Shiga- like toxins.
- Enterohaemorrhagic E. coli are pathogenic to humans.
- They produce verocytotoxins that form attaching and effacing lesions on epithelial cells.
- Infection occurs via the faecal-oral route.
- Symptoms range from mild diarrhoea to severe bloody diarrhoea.
- Complications include haemolytic uremic syndrome (HUS) which can lead to death if untreated.
- Common serotype E. coli O157:H7

### **Enterotoxigenic E. coli**

- Also known as traveler's diarrhoea.
- Infection leads to watery diarrhoea which may last up to a week.
- Symptoms include abdominal cramps, sometimes nausea and headache.

- It establishes itself by adhering to the epithelium of the small intestine via colonization factor antigens (CFA).
- This is followed by expression of heat stable (ST) or heat labile (LT) enterotoxins.
- These toxins increase adenylate cyclase > CAMP levels > secretion of chloride ions and water.

### **Enteroinvasive E. coli**

- Transmitted through faecal-oral route.
- Following ingestion, organisms invade epithelial cells of the intestine resulting in a mild form of dysentery.
- Illness is characterized by presence of blood and mucus in stools of infected individuals.
- Characteristic features of EIEC are their ability to induce entry into epithelial cells and disseminate from cell to cell.
- EIEC infection can occur through contaminated food or water or through mechanical factors such as flies.
- The genes required for entry is clustered on a virulence-associated invasion plasmid in EIEC strains.

## **Enteropathogenic E. coli**

- Following ingestion, organisms adhere to the epithelial cells of the intestine causing watery or bloody diarrhoea.
- Adherence is mediated by EPEC adherence factor (EAF) and intimin- a non-fimbrial adhesin.
- EPEC attach to and alter the integrity of the intestine.
- Bloody diarrhoea is associated with attachment and an acute tissue-destructive process.
- EPEC do not produce toxins.
- Their virulence mechanism involves the formation of attaching and effacing lesions followed by interference with host cell signal transduction.
- This strain is most commonly associated with paediatrics/kids.

## **Lab Diagnosis**

Tests for identification of E. coli:

- MacConkey agar- positive
- Indole- positive
- Methyl red- positive
- Citrate- negative
- TSI (H<sub>2</sub>S)- negative
- Lysine decarboxylase- positive
- Motility (36°C)- positive
- Acid/gas production- positive
- Lactose fermenter
- Oxidase- negative

## **Molecular Methods**

### **Polymerase Chain Reaction**

- It amplifies a specific gene target.
- The primers used in PCR may detect a characteristic virulence factor as well as other genes.
- Closely related E. coli have genes encoding the O antigen and this can be exploited to differentiate between different strains.
- Real-time PCR assays use fluorescence to detect presence/absence of a particular gene.

## **Treatment**

- Patients, especially healthy adults need no treatment for E. coli infection because it is self-limited.
- In some studies, it has been noticed that treatment with antibiotics increases the chances of getting HUS.
- This effect occurs because antibiotics destroys the bacterial cell wall, causing them to release even more toxin.
- When necessary, treatment includes the replacement of fluids and electrolytes to treat or prevent dehydration.

## **Reference**

1. [http://en.wikipedia.org/wiki/Escherichia\\_coli](http://en.wikipedia.org/wiki/Escherichia_coli)
2. [http://www.antimicrobialresistance.dk/data/images/e.%20coli%20o157\\_1\\_pdf.pdf](http://www.antimicrobialresistance.dk/data/images/e.%20coli%20o157_1_pdf.pdf)
3. Stephen A., William J., Elmer K., Gary P., Paul S., Gail W. Koneman's Color Atlas & Textbook of Diagnostic Microbiology. 6th ed. China: Lippincott Williams & Wilkins; 2006.

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