Escherichia coli

E. coli (Escherichia coli) is the name of a germ, or bacterium that lives in the digestive tracts of humans and animals.

There are many types of E. coli, and most of them are harmless. But some can cause bloody diarrhea. Some strains of E. coli bacteria (such as a strain called O157:H7) may also cause severe anemia or kidney failure, which can lead to death.

Other strains of E. coli can cause urinary tract infections or other infections.

Figure 1.1 Gram stain of Escherichia coli showing Gram-negative bacilli

Morphology

- *E. coli* is a gram-negative, straight rod measuring 1-3 × 0.4-0.7 μm
- It is motile by peritrichate flagella
- Fimbriae and capsules are found in some strains.
- It is nonsporing and noncapsulated.

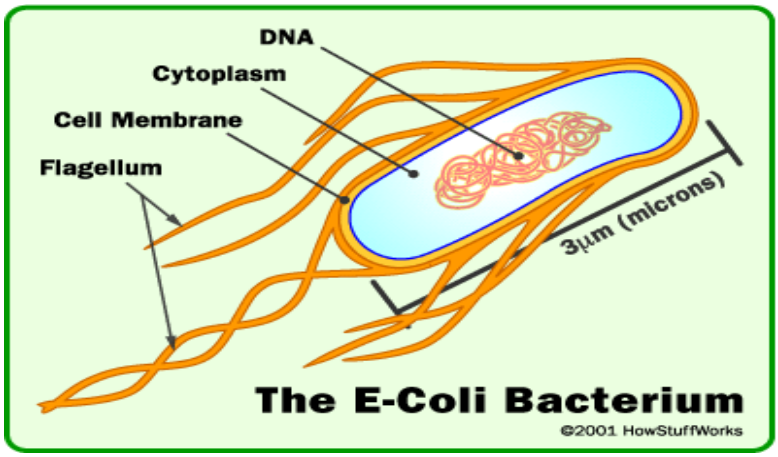


Figure 1.2 *Escherichia coli* structure

Cultural Characteristics

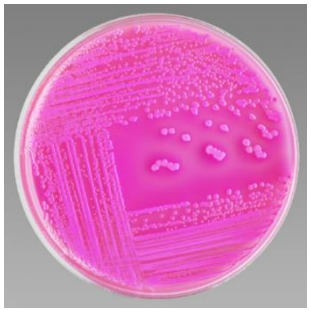


Figure 1.3 *E.coli* in Macconkys medium

- It is an aerobe and a facultative anaerobe
- temperature range is 10-40°C (optimum 37°C)
- The optimum pH for growth is 6.0 to 8.0.
- It can grow on ordinary media like nutrient agar
- Colonies are large, thick, grayish white, moist, smooth opaque

On blood agar

Those isolated from pathogenic conditions, are hemolytic.

On MacConkey's medium

Colonies are red or pink due to lactose fermentation.

Source

Escherichia coli is a common inhabitant of the intestinal tract of man and warm-blooded animals. Most strains of E. coli are harmless and are a part of the normal intestinal microflora. These strains serve a useful function in the body by suppressing the growth of harmful

Antigenic Structure

Serotyping of *E. coli* is based on three antigens

- the flagella antigen H
- somatic antigen O
- capsular antigen K

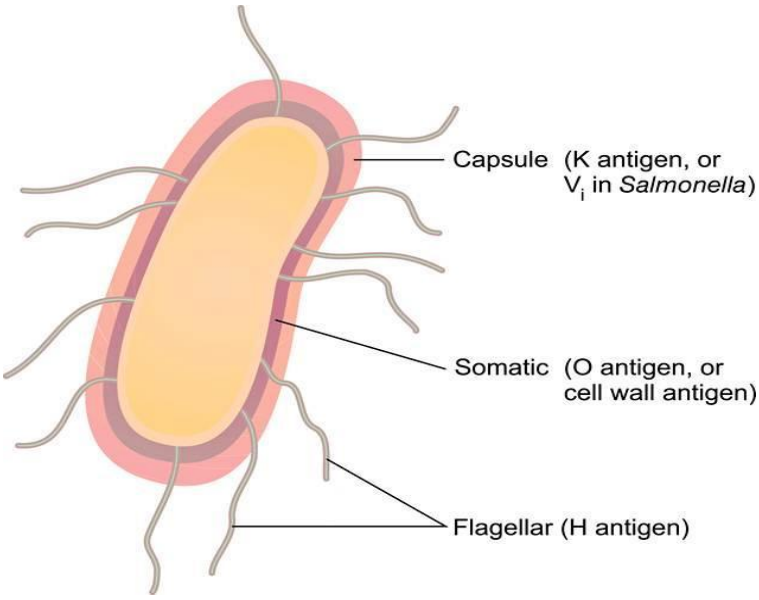


Figure 1.4 *E.coli* Antigenic Structure

Toxins: ***E. coli*** **produce two kinds of exotoxins:**

a. Hemolysins

b. Enterotoxins

Enterotoxins are important in the pathogenesis of diarrhea Causes a movement of water and ions from the tissues to the bowel resulting in watery diarrhea.

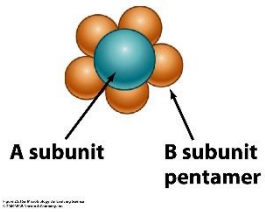
Three distinct types of *E. coli* enterotoxins have been identified:

i. Heat labile toxin (LT)

ii. Heat stable toxin (ST)

iii. Verotoxin (VT) also known as Shiga-like toxin (SLT).

Figure 1.*5 E.coli* toxins structures and mechanism



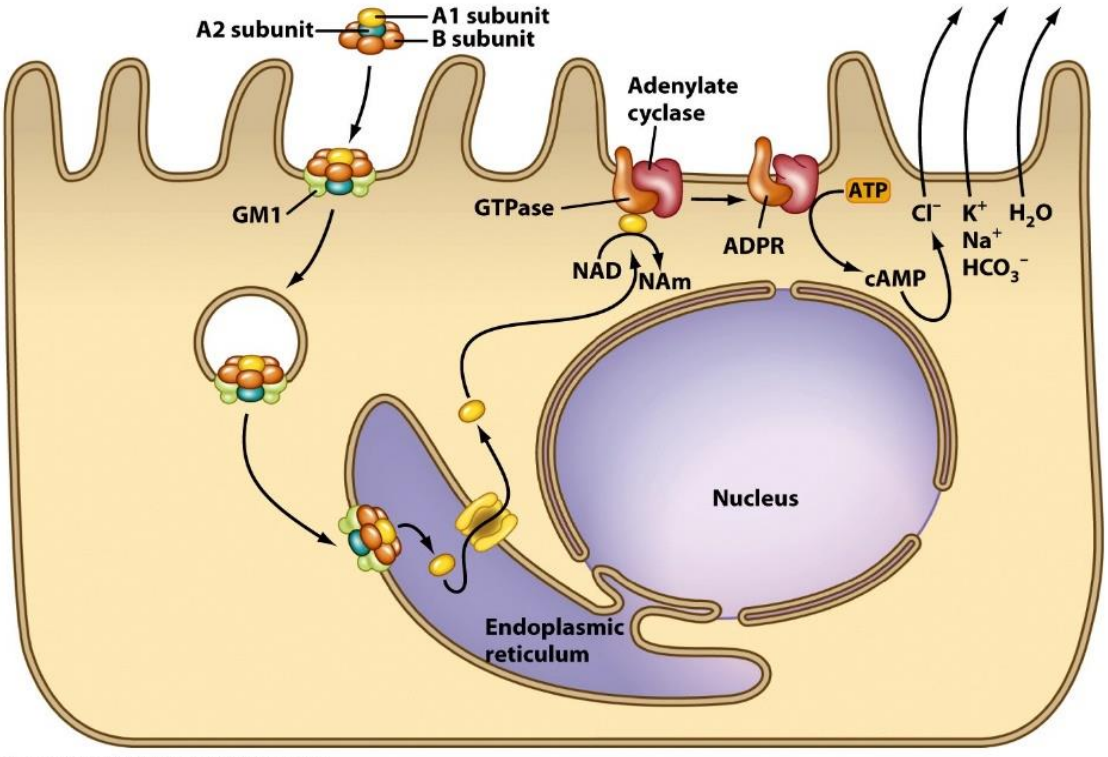


Figure 25.19a Microbiology: An Evolving Science

Pathogenicity

Infections result from relocation of E. coli bacteria from one's own flora to places on or in the microorganism where they are not supposed to be but where conditions for their proliferation are favorable.

Source of infection: Contaminated food or water, contact with an infected person

Four main types of clinical syndromes are caused by E. coli:

1. Diarrhea
2. Urinary tract infection
3. Pyogenic infections (التهابات قيحية)
4. Septicemia. (تسمم الدم)

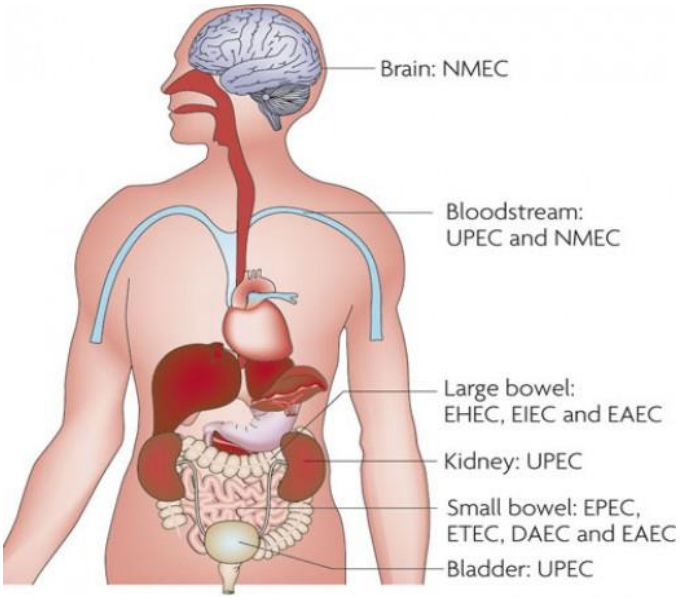


Figure 1.*6 Sites of pathogenic E Coli colonization in the human body*

1. Diarrhea

E. coli that cause diarrhea are extremely common worldwide. These *E .coli* are classified by the characteristics of their virulence properties.

There are 5 strains or categories that cause diarrheal illnesses or disease

A. Enteropathogenic *E. coli (EPEC)* causes severe diarrhea in infants that can last for over 2 weeks and results in death if dehydration is severe. In adults, the illness is characterized by severe diarrhea, nausea, vomiting, abdominal cramps, headache, fever, and chills. The time for onset of the illness is 17 to 72 hours; the duration of the illness is 6 hours to 3 days

. **B. Enterotoxigenic *E. coli (ETEC)*** cause travelers' diarrhea the pathogenicity of these bacteria is due to the heat-labile enterotoxin LT and The heat stable toxins ST. Present with **massive watery diarrhea, Nausea, Vomiting.**

C. Enteroinvasive *E. coli* (EIEC) is similar to shigellosis and is caused by bacterial penetration and destruction of intestinal mucosa. Symptoms include: chills, fever, headache, muscle pain, abdominal cramps, and profuse diarrhea. The illness occurs 8 to 24 hours after ingestion of food or water containing this organism. The ingestion of a large number of cells (104 to 105 cells) is required to cause the illness.

D. Enteroaggregative E. coli (EAEC)

Watery diarrhea without fever.

E. Enterohemorrhagic E coli (EHEC) produces verotoxin(E. coli O157:H7) is characterized by severe abdominal cramps usually, but not always, followed by bloody diarrhea (hemorrhagic colitis). Some individuals exhibit only watery diarrhea. Vomiting may occur but there is usually little or no fever. The incubation period is usually about 3 to 9 days.

2. Urinary tract infection UTI

E coli is the most common cause of urinary tract infection and accounts for approximately 90% of first urinary tract infections in young women

The symptoms include

1. Urinary frequency (تكرار البول)
2. Dysuria (عسر البول)
3. Hematuria ((دم في البول)
4. Pyuria. (قيح في البول)

3. Pyogenic Infections

E. coli form the most common cause of intra-abdominal infections (التهابات داخل البطن), such as peritonitis (التهاب الصفاق) and abscesses resulting from spillage of bowel contents (تسرب محتويات الأمعاء).

4. Septicemia

Blood stream invasion by *E. coli* may lead to fatal conditions like septic shock and 'systemic inflammatory response syndrome' (SIDS).
(متلازمة الاستجابة الالتهابية الجهازية)

Laboratory Diagnosis

- Diagnosis is by direct isolation of the microorganism from clinical samples, e.g. faeces, urine and blood.
- Identification of some pathogenic strains, e.g. VTEC, EPEC, may be achieved by serotyping
- Diagnosis of a urinary tract infection with midstream urine requires determination of the bacterial count to ensure that an infection can be distinguished from a contamination

  Counts >–10^5/ml tend to indicate an infection

  Counts <–10^3/ml tend to indicate an infection a contamination

Antibacterial therapy

- E. coli is commonly resistant to penicillin and ampicillin by production of b-lactamase enzymes.
- Aminopenicillins, ureidopenicillins, cephalosporins, 4-quinolones, or cotrimoxazole are useful agents.
- Severe diarrhea necessitates oral replacement of fluid and electrolyte

For further information you can refer to
1. Kayser, Medical Microbiology © 2005
2. Jawetz, Melnick, & Adelberg's Medical Microbiology 23ed.
3. Jaypee_Textbook of Microbiology 1st ed 2012.
4. Lecture notes. Medical microbiology and infection 5th ed -Wiley-Blackwell (2011).