

ENTEROBACTERIACEAE

Coliform group

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- **Enterobacteriaceae** are Gram negative bacilli found as flora in the colon of man and animals.
- *They have certain features:*
 - ❑ *Facultative anaerobes.*
 - ❑ *All of them ferment glucose.*
 - ❑ *Oxidase negative.*
 - ❑ *Reduce nitrate to nitrite.*
- According to the effect on lactose, they are classified into:
 - ❑ *Lactose fermenters: E. coli, klebsiella, citrobacter, enterobacter, serratia. They are called coliforms.*
 - ❑ *Lactose non-fermenters: salmonella, shigella, proteus, yersinia.*

Escherichia coli

❑ Morphology:

- *Gram negative bacilli, motile, some strains are capsulated.*

❑ Cultural characters:

- *Facultative anaerobe.*
- *On MacConkey's medium:* *rose pink colonies.*
- *Strains causing urinary tract infection produce hemolysis on blood agar.*

(Gram stained film of E. coli)



(E. coli on MacConkey's agar)



(Lactose fermenters and non lactose fermenters on MacConkey's agar)



❑ Biochemical reactions:

- Ferment glucose, lactose, maltose, mannite, sucrose, salicin with acid and gas production.
- Indole +Ve, methyl red +Ve
- Voges proskauer's reaction -Ve, citrate -Ve
- H₂S -Ve, urease -Ve

❑ Serological characters:

- Somatic (O) antigen.
- Flagellar (H) antigen.
- Many strains have capsular (K) antigen.

□ Virulence factors:

- *Pili* or colonization factors that enable the bacteria to adhere to the mucosal cells.
- *Capsule* interferes with phagocytosis.
- *Endotoxin*.
- *Enterotoxins* produced by enterotoxigenic *E. coli*.
- *Verotoxin* produced by enterohemorrhagic *E. coli*.

❑ Diseases caused by *E. coli*:

1. Urinary tract infection (UTI):

- *E. coli* causes 90% of community acquired UTI.
- Uropathogenic *E. coli* colonize vagina and periurethral region from where they ascend to the bladder and kidney.
- These strains also possess pili that bind to urinary tract epithelium.

2. Hospital acquired infections:

- *E. coli* may also cause hospital acquired infections including UTI that is associated with urinary catheters.

3. 40 % of cases of neonatal meningitis.

4. Pneumonia and septicemia:

- o *Especially in immunocompromised individuals.*

5. Diarrhea:

- o *E. coli* ca

Enterotoxigenic *E. coli*

Enteropathogenic *E. coli*

Enteroinvasive *E. coli*

Enteraggregative *E. coli*

Enterohemorrhagic *E. coli*

❑ Diagnosis of E. coli infections:

❖ Specimen:

- *Urine, stool, pus, CSF*

❖ Direct smear:

- *Direct smear stained with Gram stain shows Gram negative bacilli among pus cells.*

❖ Culture on MacConkey's agar

- *Identification of the growing colonies is done by:*

**Colonial
morphology**

Rose pink colonies

Gram stain

Gram negative bacilli

**Biochemical
reactions**

Ferment all sugars with
acid and gas production

Indole and MR **+Ve**, VP,
citrate, H₂S, urease **-Ve**

**Serological
identification**

Latex agglutination test

❖ If enterohemorrhagic E. coli is suspected, rapid diagnosis is done by:

- Detection of the organism by immunofluorescence.
- Detection of verotoxin by ELISA, tissue culture.
- Detection of the gene for verotoxin by PCR or nucleic acid probes.

❑ Treatment of E. coli infections:

- ❖ Rehydration is the most important item in treatment of diarrhea.
- ❖ Antibiotics could be given to shorten the duration of diarrhea.

Klebsiella

- *Klebsiella* exists as normal flora in the intestinal and respiratory tracts.
- It exists also as saprophytic bacteria in soil and water.

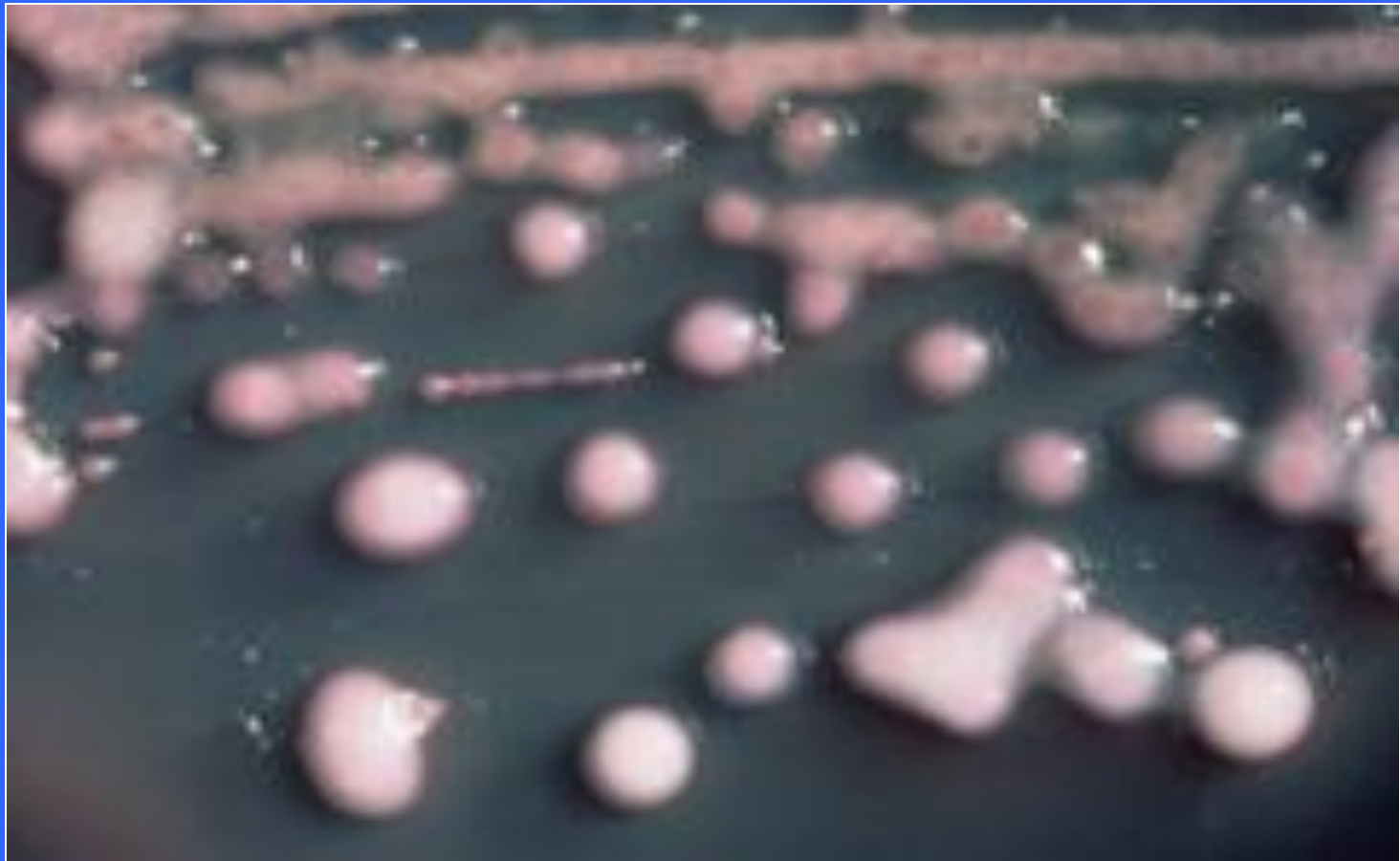
❑ Morphology:

- Gram negative bacilli, capsulated, non motile,

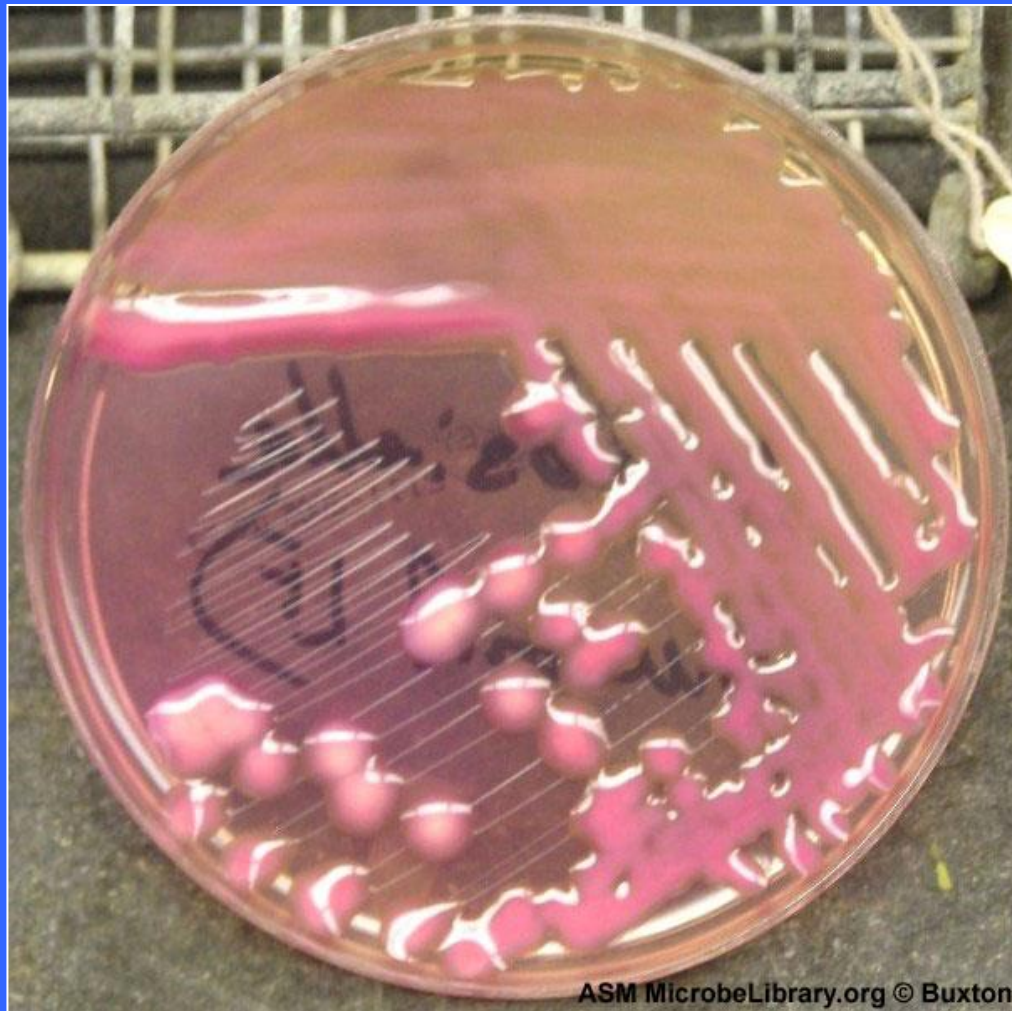
❑ Cultural characters:

- Facultative anaerobe.
- On MacConkey's medium: it produces rose pink colonies which are mucoid due to production of extracellular slime.

(Mucoid colonies of Klebsiella)



(Muroid colonies of *Klebsiella*)



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❑ Biochemical reactions:

- Ferment glucose, lactose, maltose, mannite, sucrose, salicin with acid and gas production.
- Indole -Ve, methyl red -Ve
- Voges proskauer's reaction +Ve, citrate +Ve
- H₂S -Ve, urease -Ve

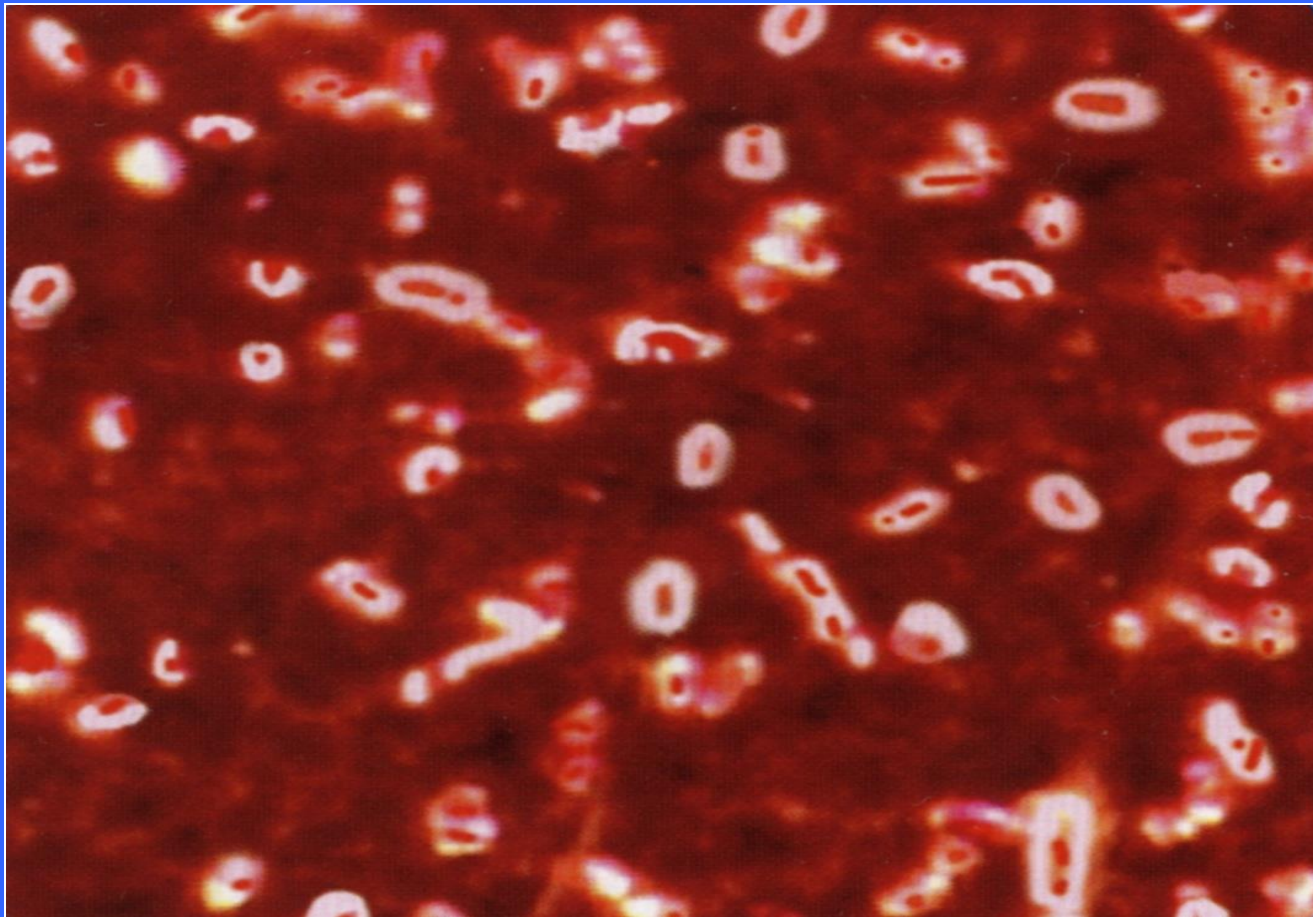
❑ Species of klebsiella:

- *Klebsiella pneumoniae*
- *Klebsiella rhinoscleromatis*
- *Klebsiella ozaenae*
- *Klebsiella oxytoca*

Klebsiella pneumoniae

- It causes lobar pneumonia, urinary tract infection, meningitis and septicemia.
- It is considered an important cause of nosocomial infections.
- It is highly pathogenic to laboratory animals. If it is injected intraperitoneal in mice, it will die within 24-48 hours and the capsulated bacteria could then be detected in tissue smears stained with Gram stain.

(*Klebsiella pneumoniae* in tissue smears from mice)



Klebsiella rhinoscleromatis

- o *It causes rhinoscleroma in nose and throat.*

Klebsiella ozaenae

- o *It causes atrophic rhinitis.*

Klebsiella oxytoca

- o *It causes hospital acquired infections.*

Enterobacter citrobacter serratia

- These bacteria are found in the stool, soil and water.
- They cause urinary tract infection, wound infections, blood stream infections in hospitalized and immunocompromised patients especially those with urinary catheters, intravenous catheters and respiratory intubation.
- **Enterobacter is citrate positive, H₂S negative and differentiated from klebsiella by being motile.**
- **Citrobacter is citrate positive and H₂S positive.**