

# **Urinary tract infection**

## **Microbiology &**

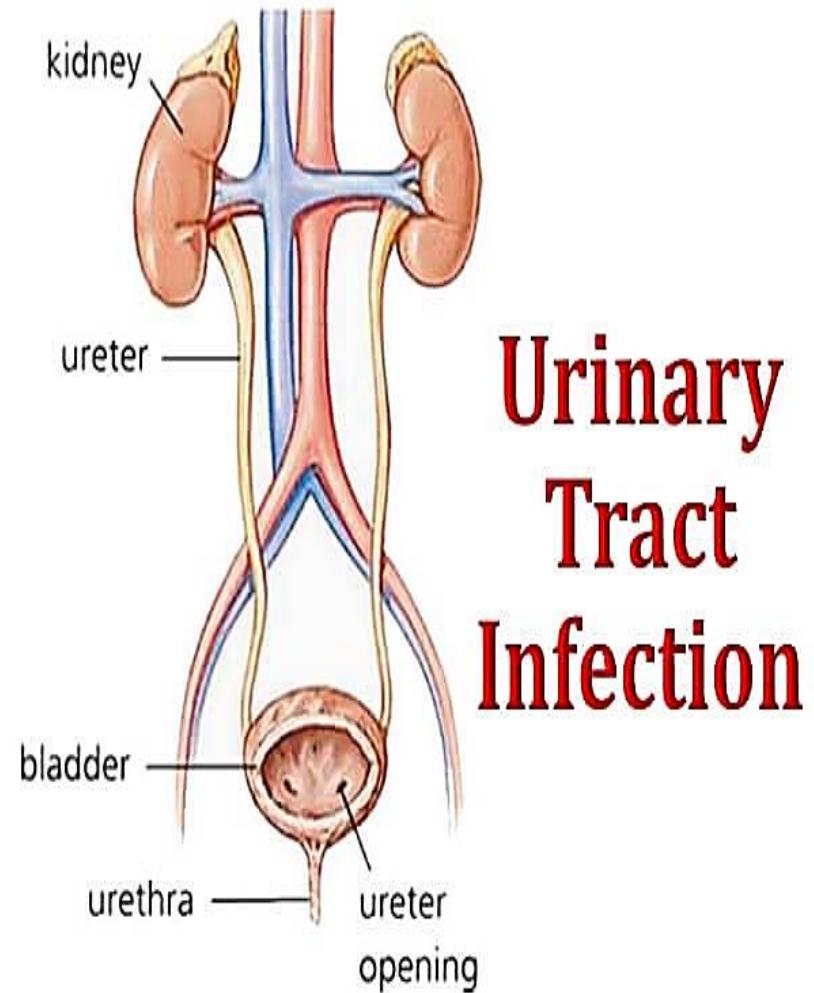
## **Immunology Department**

## Objectives-

- ✓ Enlist different urinary tract infections.
- ✓ Identify the common etiological agents causing urinary tract infections.
- ✓ Discuss the laboratory diagnosis of the common etiological agents causing urinary tract infections.

# Urinary tract infection

- **Urinary tract infection (UTI)** is an infection in any part of the urinary system. The urinary system includes bladder (cystitis), urethra (urethritis) or kidneys (kidney infection).



- UTI is caused by a range of pathogens **most commonly** by
  - *Escherichia coli*
  - *Proteus mirabilis*
- *Less common pathogens*
  - *Klebsiella pneumoniae*
  - *Pseudomonas aeruginosa*
  - *Staphylococcus saprophyticus.*



Enterobacteriaceae(gram negative bacilli)  
classified according to their ability to ferment  
lactose to

Lactose  
Fermenters

- 1- *Escherichia coli*
- 2- *Klebsiella*
- 3- *Citrobacter*
- 4- *Enterobacter*



Non-Lactose  
Fermenters

- 1- *Salmonella*
- 2- *Shigella*
- 3- *Proteus*



# *Laboratory diagnosis:*

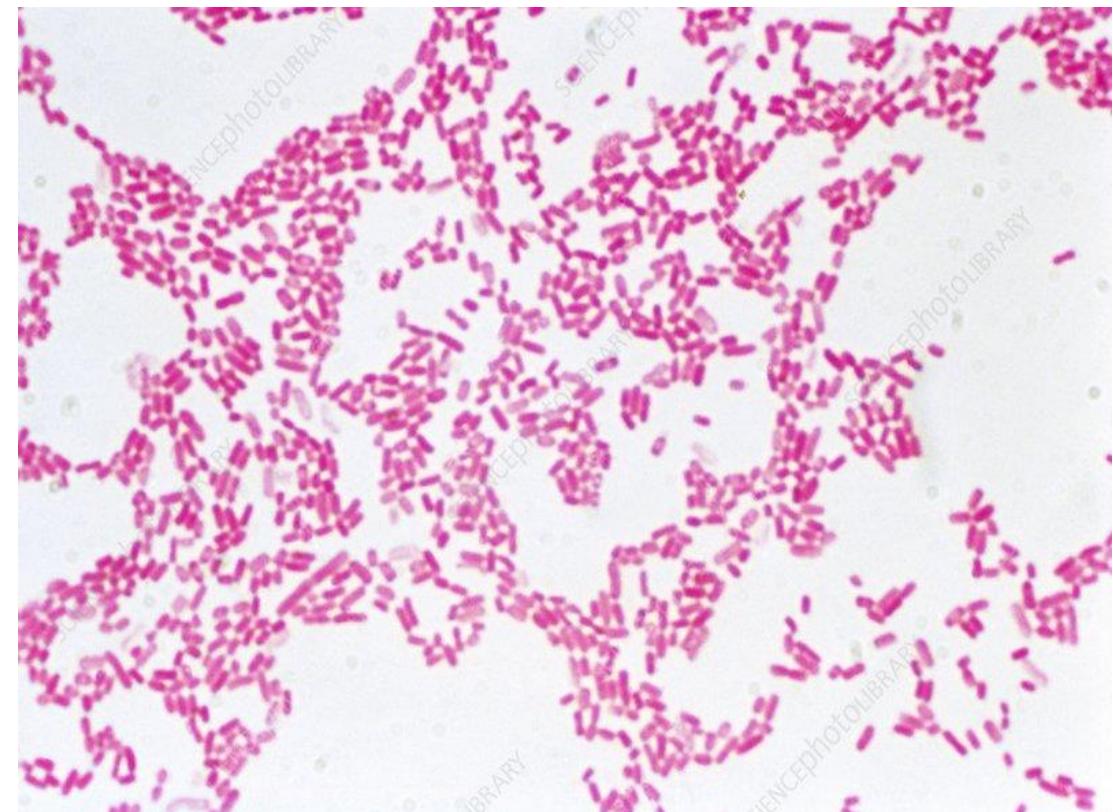
1. Sample (urine).
2. Gram staining.
3. Culture.
4. Biochemical reactions.

# **Escherichia coli**

- They are normal inhabitants of the intestine, but some can cause diseases.
- E.coli is the most common cause of UTI.
- Transmission from own fecal flora → urethra.

# Gram staining

- **Morphology:** Gram negative bacilli, motile, some strains are capsulated

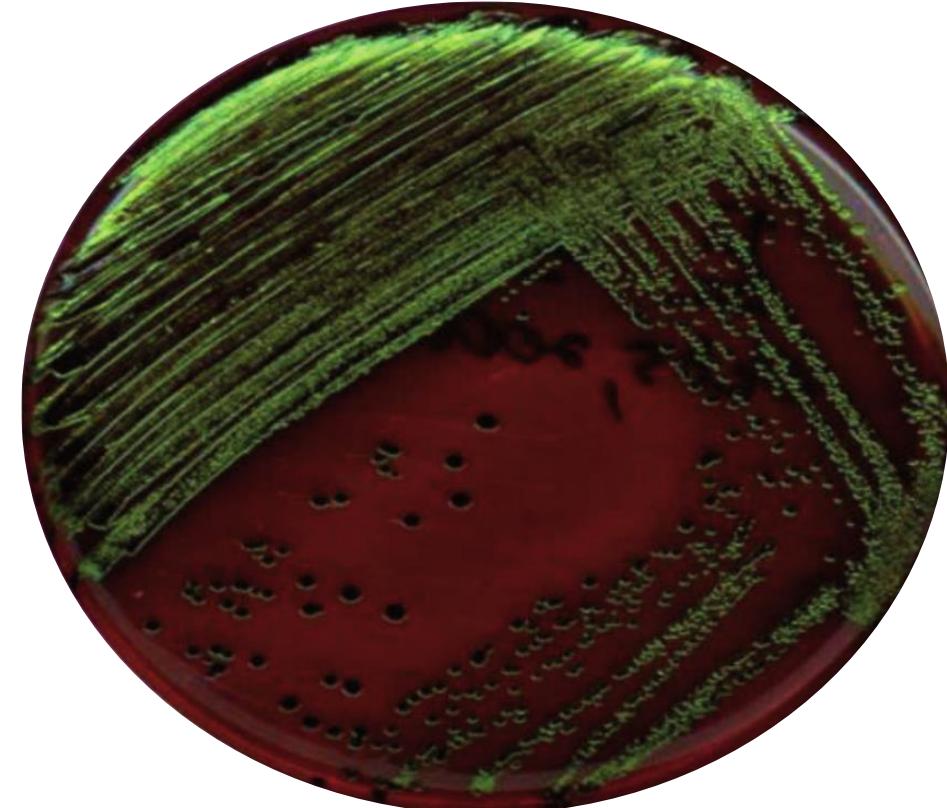


# Culture

1-MacConkey's agar (which contain bile salts that inhibit the growth of G+ve cocci) → rose pink color due to lactose fermentation

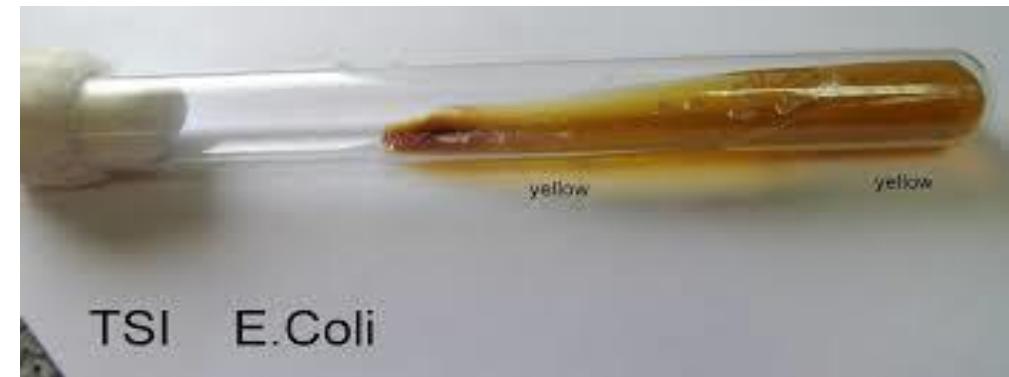


**2- Eosin-methylene blue agar(EMB) (which is selective as it contains methylene blue) → small dry colonies with green metallic sheen.**



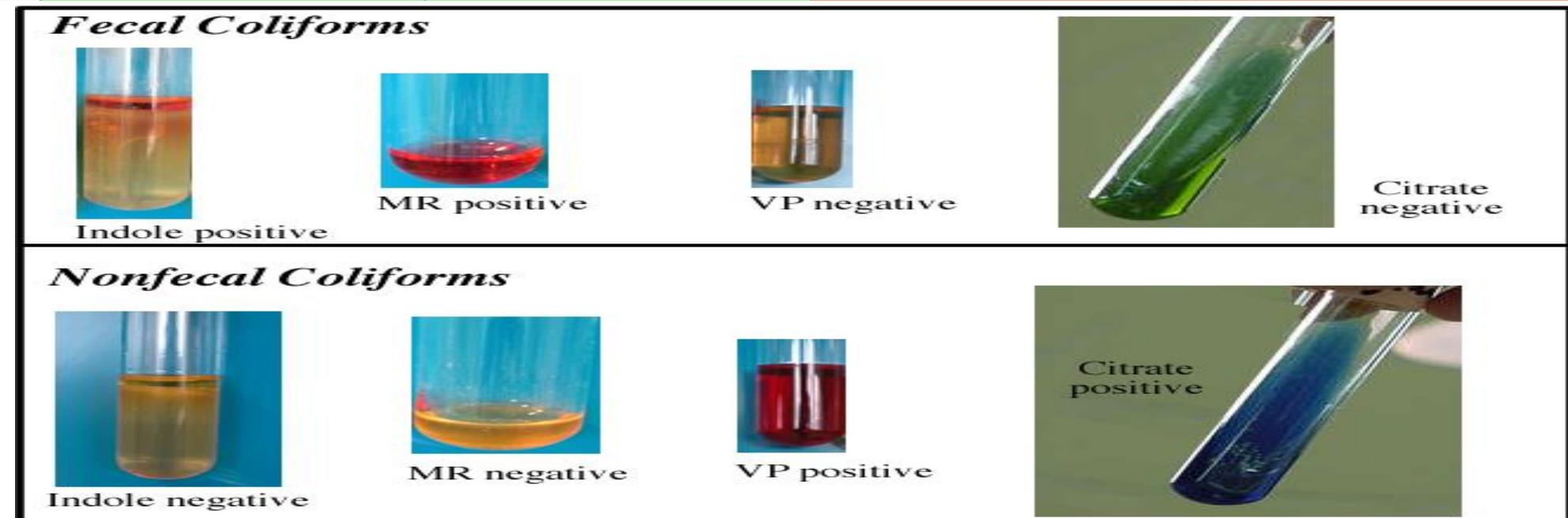
# Biochemical reactions

1-They ferment glucose, lactose, maltose, mannite, sucrose and salicin with production of acid and gas so→ on **TSI medium** they produce yellow (acid) butt and yellow slant.



# 2-IMVC tests: + + - -

<b>Species</b>	<b>Indole</b>	<b>Methyl Red</b>	<b>Voges-Proskauer</b>	<b>Citrate</b>
<i>Escherichia coli</i>	Positive	Positive	Negative	Negative



# Proteus

- Proteus species are saprophytes and are normal inhabitants of the intestine of man.
- They cause infections only when they leave the intestine.
- The genus includes two important species; *Pr. vulgaris* and *Pr. mirabilis*.

# Gram staining

- **Morphology:** Gram negative bacilli, very pleomorphic and highly motile.

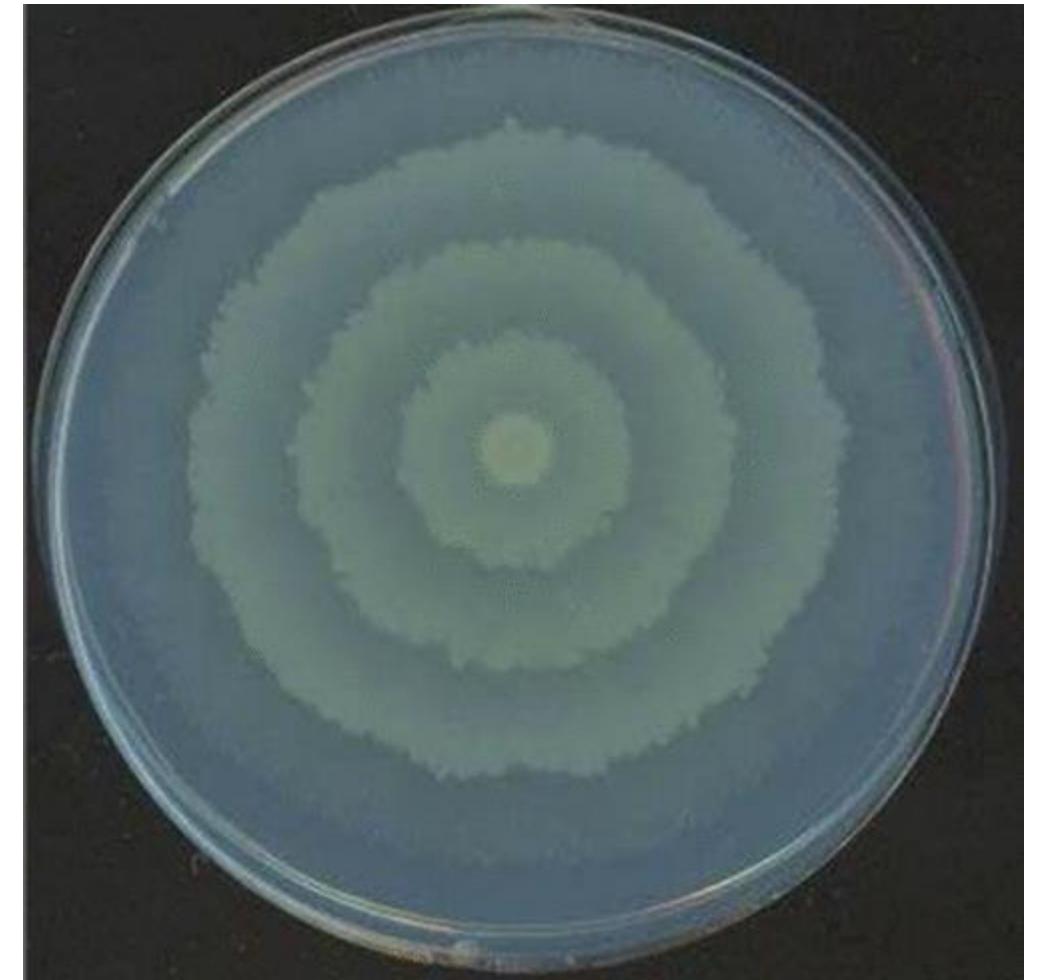


# Culture

1- **On MacConkey's agar:** they produce pale yellow non-lactose fermenting colonies.



**2- On nutrient agar:** Due to their high motility, they give colonies which swarm in successive waves over the surface (swarming).



# Biochemical reactions

- **Urease test** : They are urease positive; which differentiates them from salmonella and shigella.

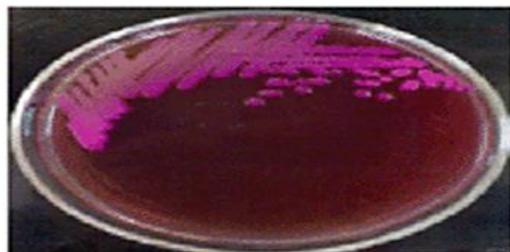


- **Triple Sugar Iron (TSI)** agar. They produce H<sub>2</sub>S which blackens the butt of TSI.

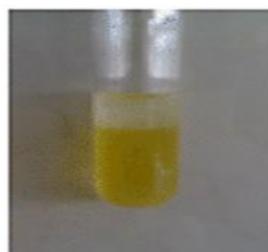


# Klebsiella

They are gram negative capsulated bacilli. Some of them cause diarrhea in man. The most important species is *K.pneumoniae*.



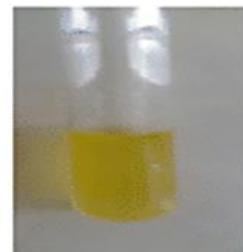
Positive lactose fermenter on MacConkey medium showing mucoid colonies



Negative Indole test



Positive Citrate utilizers on Simmons Citrate medium



Negative Methyl red test



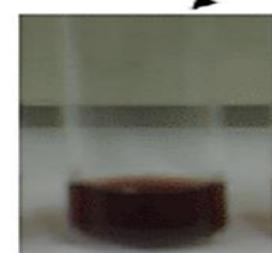
Change the color of TSI in to yellow color in the butts and along the slant



Carbohydrate fermenter with acid and gas production



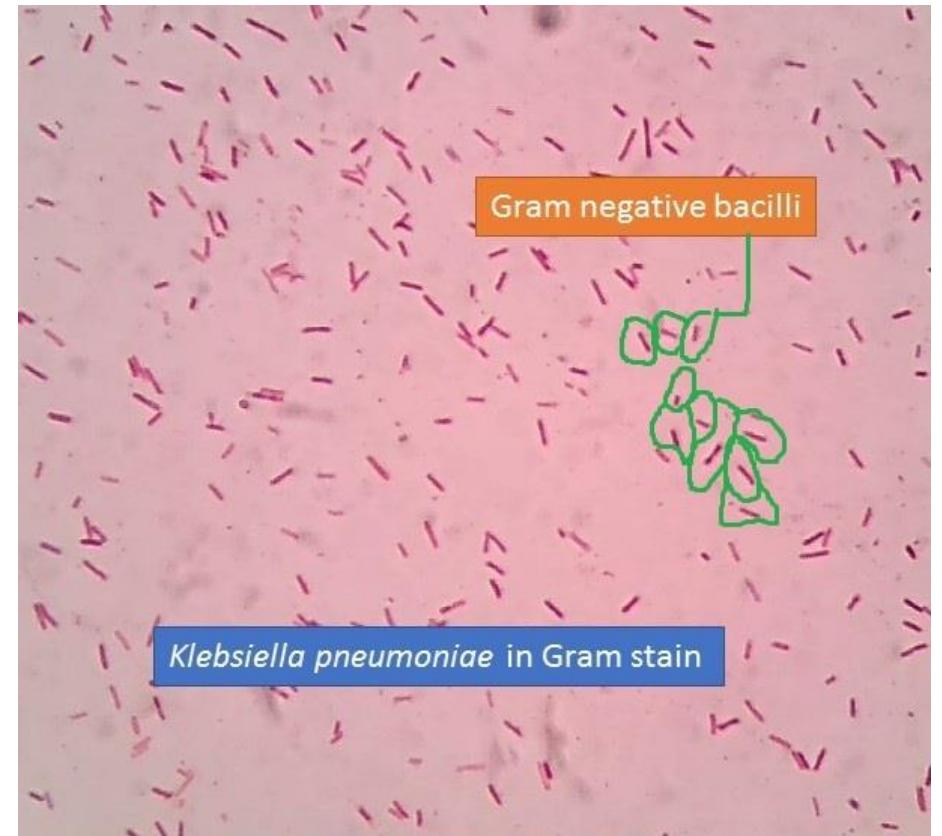
Positive Urease test



Positive Voges Praskauer's test

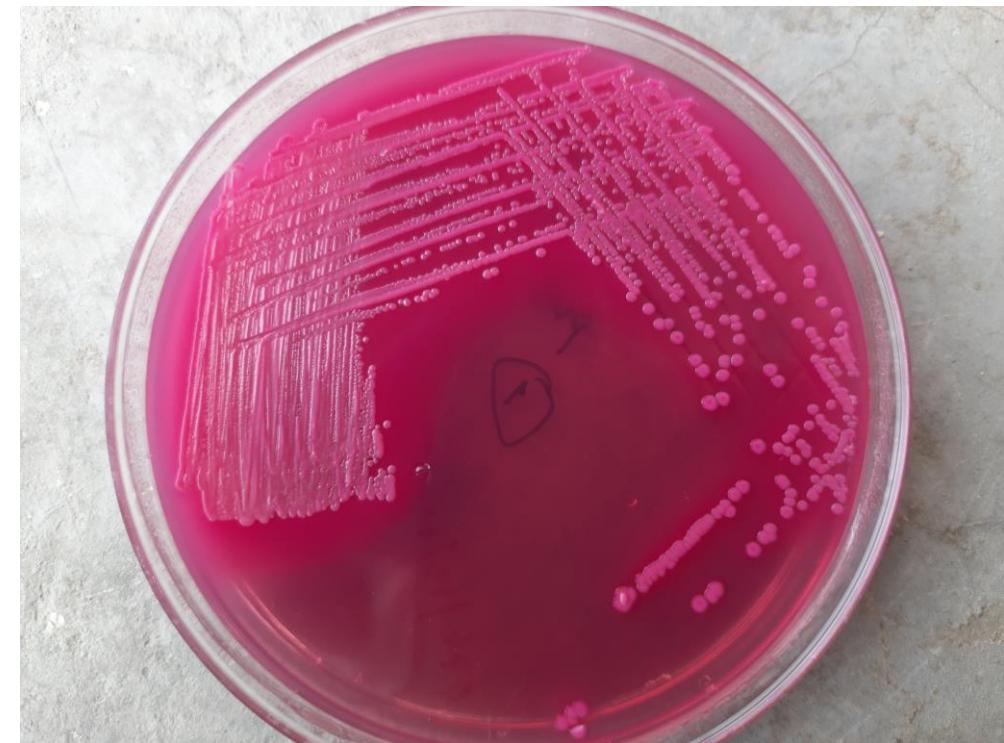
# Gram staining

- **Morphology:** Gram negative bacilli, capsulated, non motile, non spore forming.



# Culture

1-MacConkey's agar (which contain bile salts that inhibit the growth of G+ve cocci) → rose pink color due to lactose fermentation



# 2-Eosin Methylene Blue (EMB) agar

*K.pneumoniae* show large dark pink, mucoid colonies.

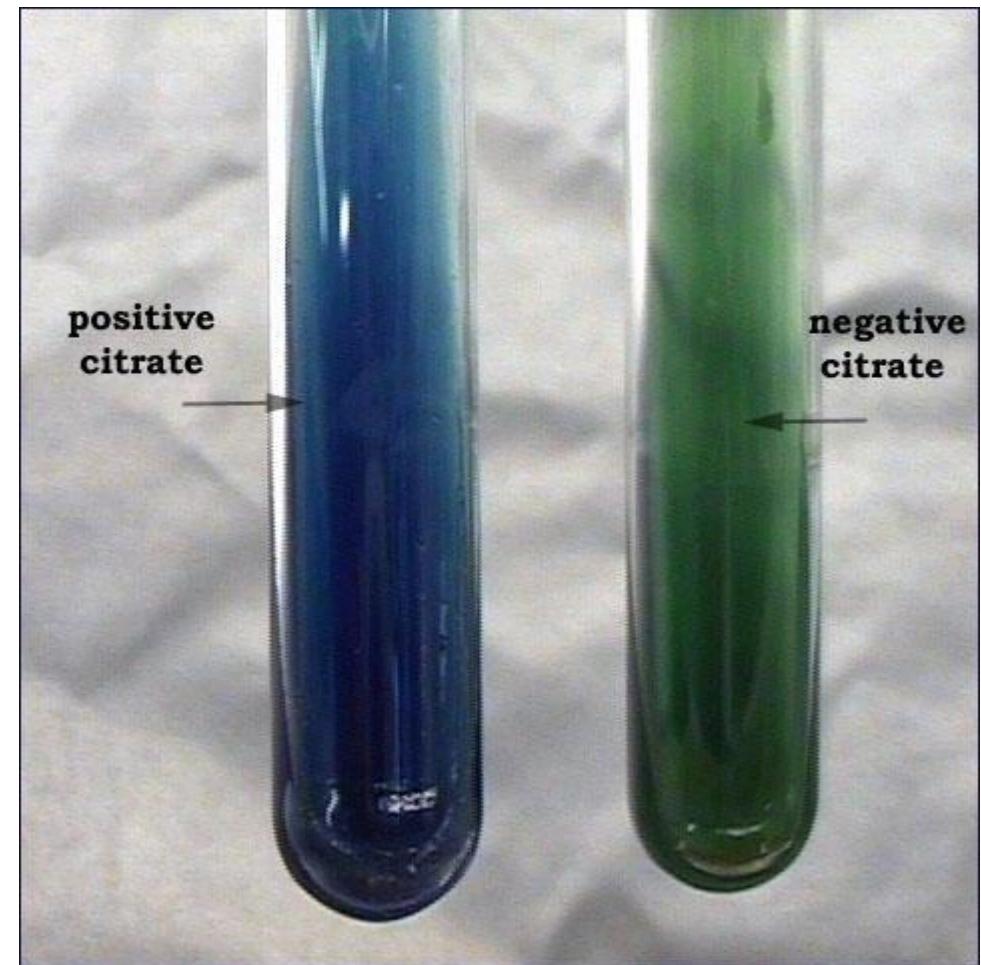


# Biochemical reactions

- I.M.V.C. test: -ve, -ve, +ve, +ve.

RESULTS OF IMVIC TESTS FOR COLIFORMS				
	Indole	MR	VP	Citrate
	-	-	+	+

- Simmon's citrate test: positive (blue).



- **TSI:** acid (yellow) butt and slant with gas production.



# *Pseudomonas aeruginosa*

- *P. aeruginosa* is an opportunistic Gram-negative pathogen frequently isolated in urinary tract infections (UTI) affecting elderly and catheterized patients (nosocomial infection), which lead to pyelonephritis.

# Gram staining

**Morphology:** Gram-negative, aerobic (and at times facultatively anaerobic), rod-shaped bacterium with **unipolar motility**.



# Culture

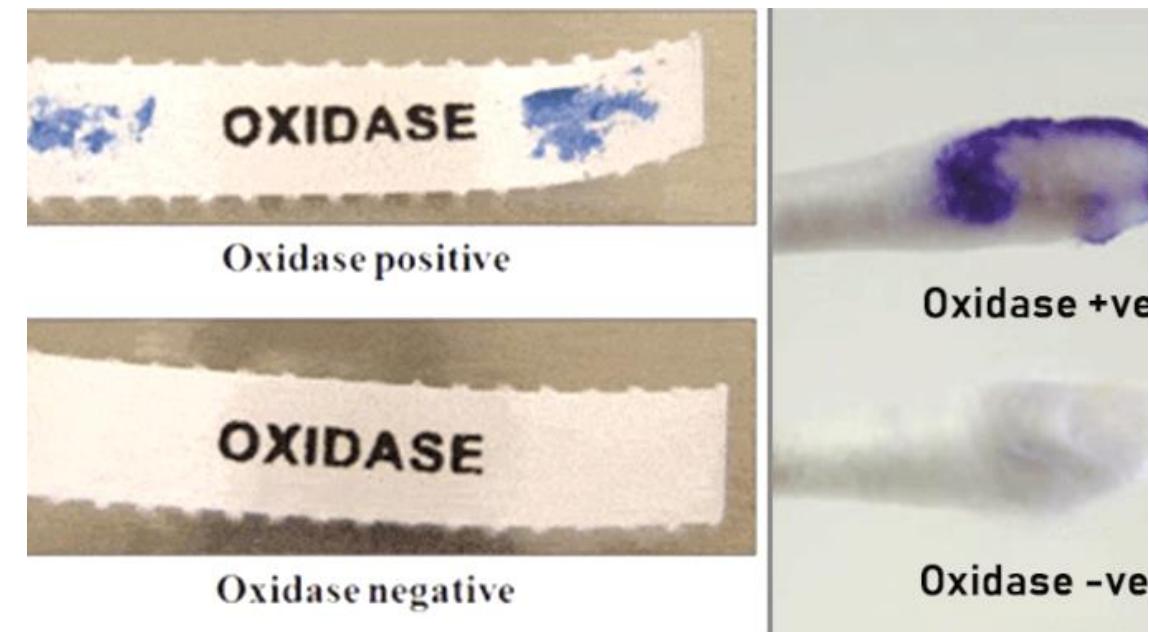
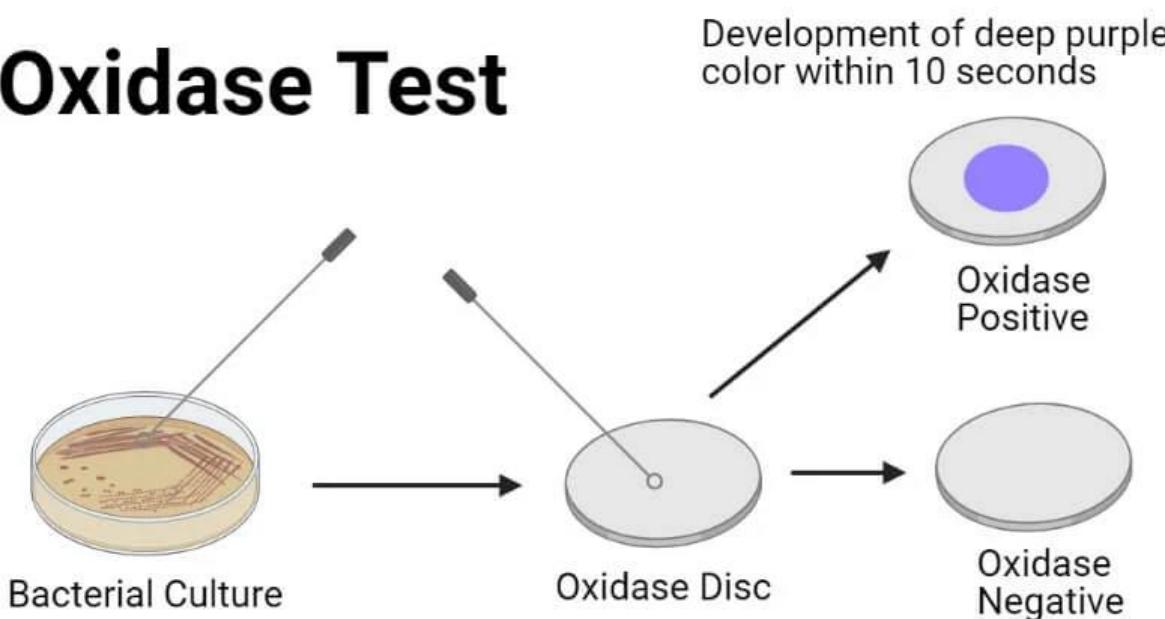
- **Nutrient Agar:** *Pseudomonas aeruginosa* on nutrient agar gives a characteristic **exopigment** showing **greenish** colouration due to production of Pyoverdin pigment.



# Biochemical reactions

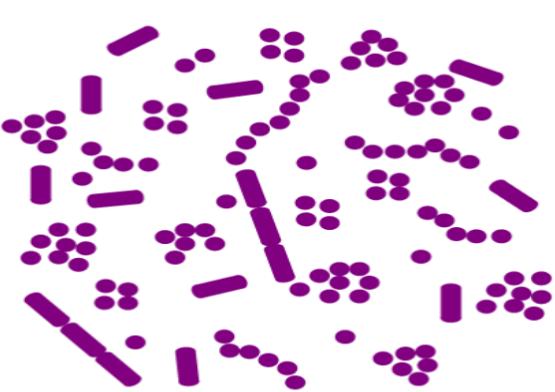
- **Oxidase test:** *P. aeruginosa* is oxidase **positive** and can be differentiated from the Enterobacteriaceae by the positive oxidase reaction and it does not ferment any sugar.

## Oxidase Test

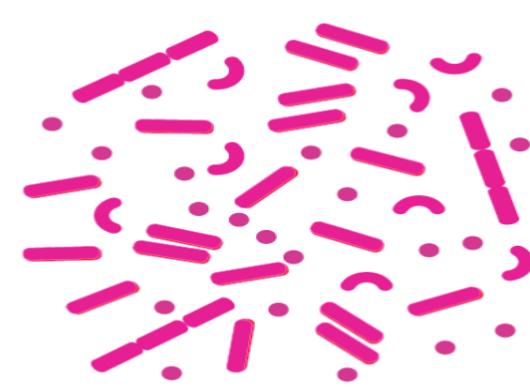


## Note

If the bacteria remain **purple**(retain the crystal violet color), they are **Gram-positive**. If the bacteria turn **pink** or **red**, they are **Gram-negative**.

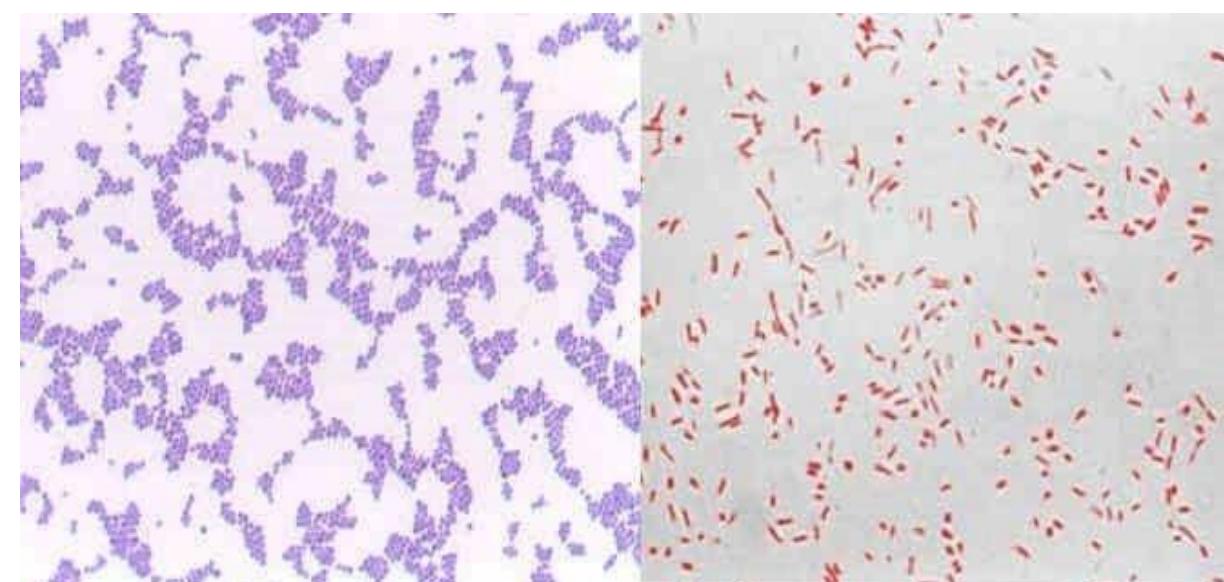


Gram Positive Bacteria  
(stains purple)



Gram Negative Bacteria  
(stains red/pink)

## Gram Staining

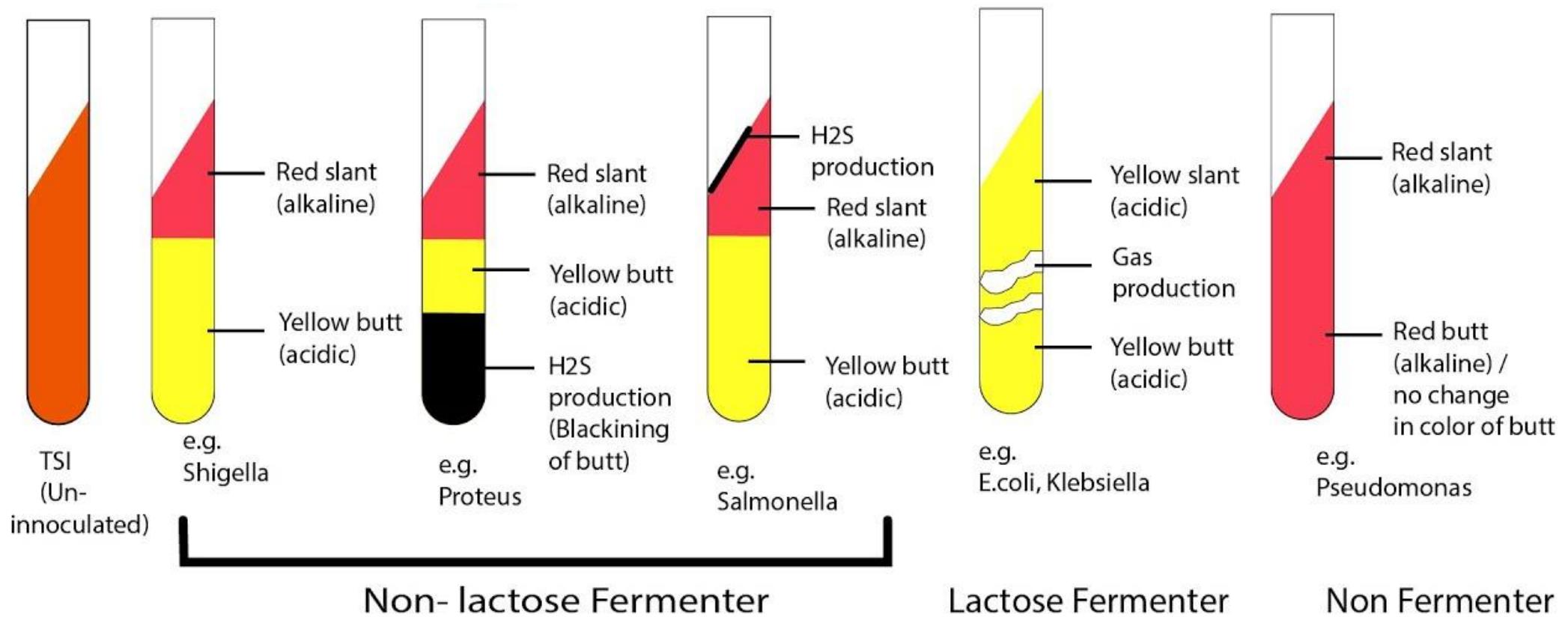


Gram +ve Bacteria

Gram -ve Bacteria



# TSI (triple sugar iron) test





Thank  
you