

# Enterobacteriaceae

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# Enterobacteriaceae

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- Found in
- soil,
- water,
- vegetable
- and are part of the normal intestinal flora of most animals and humans



# Enterobacteriaceae

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- Also called:
  - Enteric bacteria
  - Fermentative bacteria

# Enterobacteriaceae

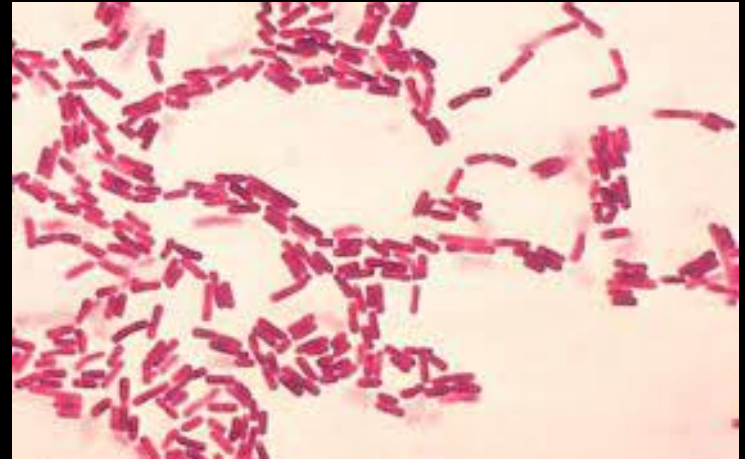
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- Escherichia coli
- Klebsiella
- Enterobacter
- Proteus
- Citrobacter
- Serratia
- Salmonella
- Shigella
- Yersinia
- Edwardsiella
- Hafnia alvei
- Morganella
- Providencia
- Erwinia
- Kluyvera
- Cedecea
- Ewingella
- Tatumella

# Enterobacteriaceae

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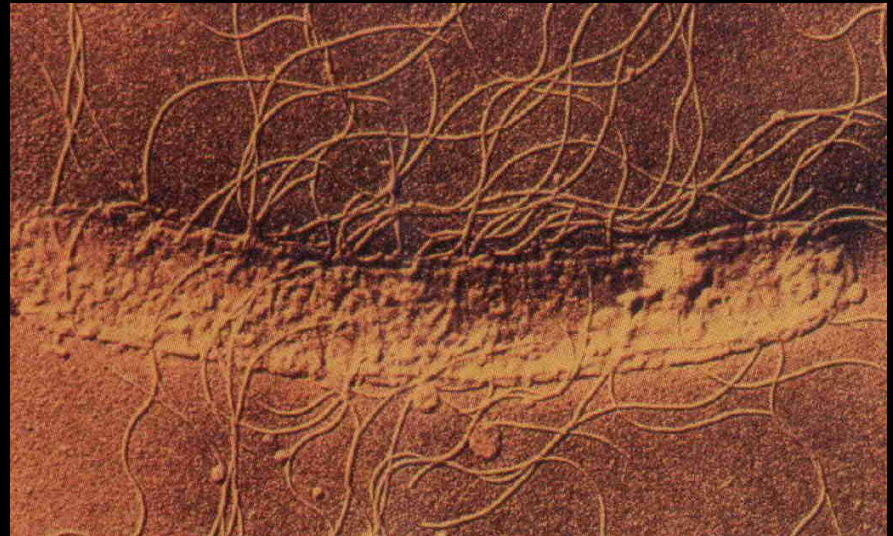
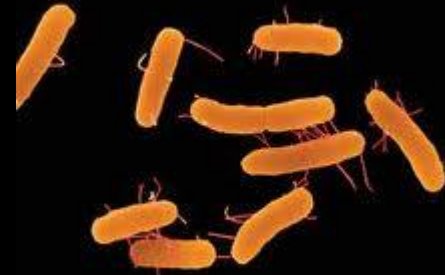
- **GENERAL CHARACTERISTICS**
- Gram negative bacilli/coccobacilli
- Moderate size 0.5-3  $\mu\text{m}$



# Enterobacteriaceae

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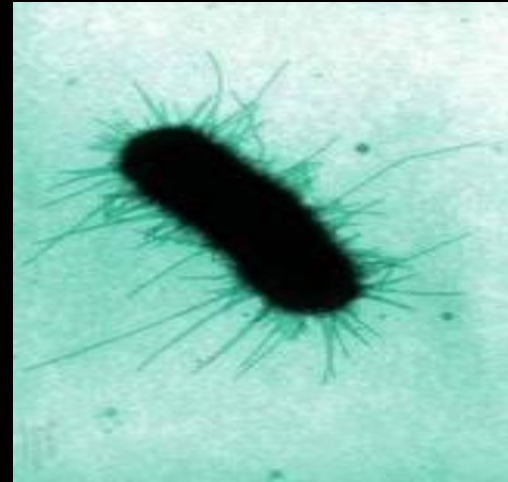
- **General**
- **Characteristics**
- Motile with peritrichous flagella
- Klebsiella,
- Shigella,
- Yersinia (some species)
- are non-motile)



# Enterobacteriaceae

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- **General Characteristics**
- Do not form spores
- Many have pili or fimbria(adhesive)
- Some species are encapsulated
  - e.g. Klebsiella



# Enterobacteriaceae

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- **General Characteristics**
- Facultative anaerob
- Grow on simple media:
  - Nutrient agar
  - Blood agar





# Enterobacteriaceae

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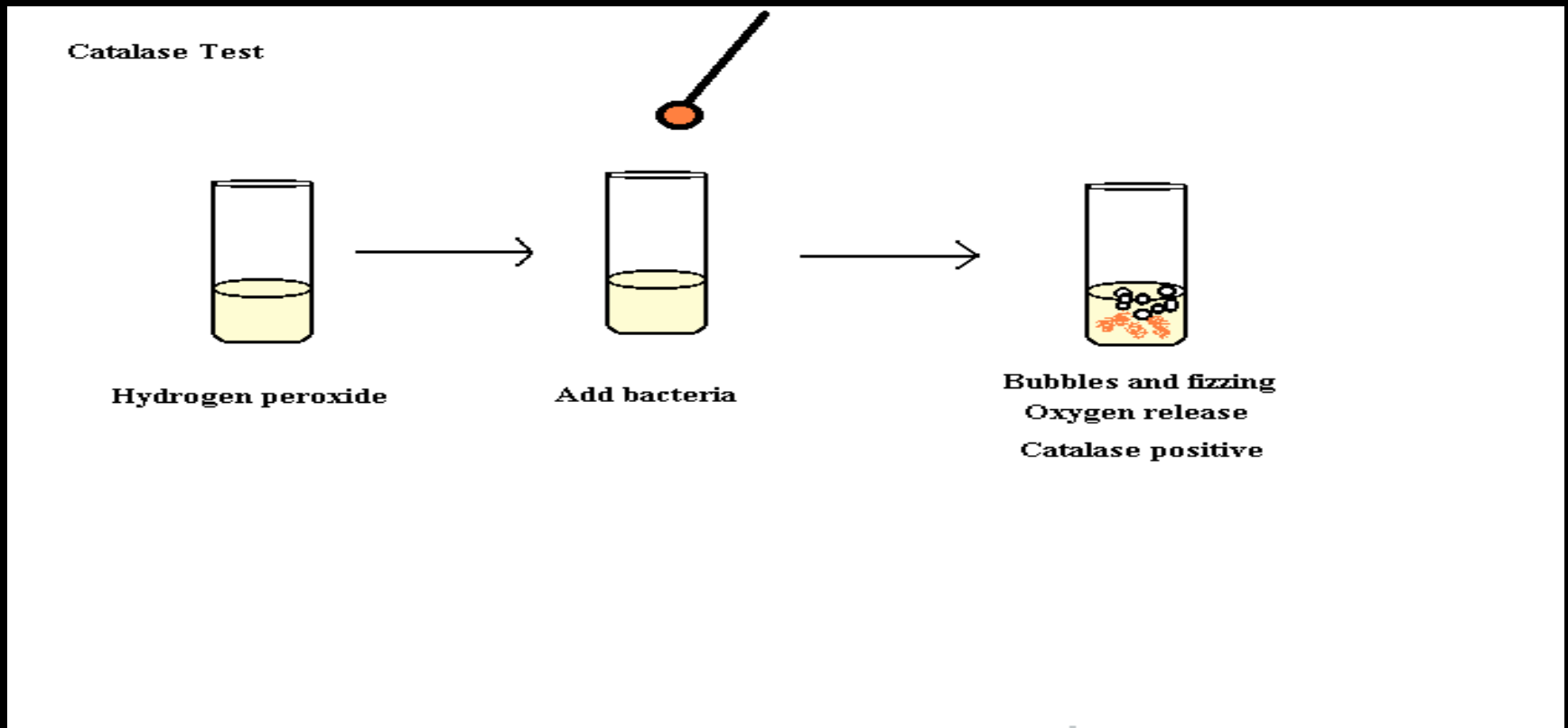
- **General Characteristics**
- All enteric bacteria
  - ferment glucose and produce acid,
  - +/- gas



# Enterobacteriaceae

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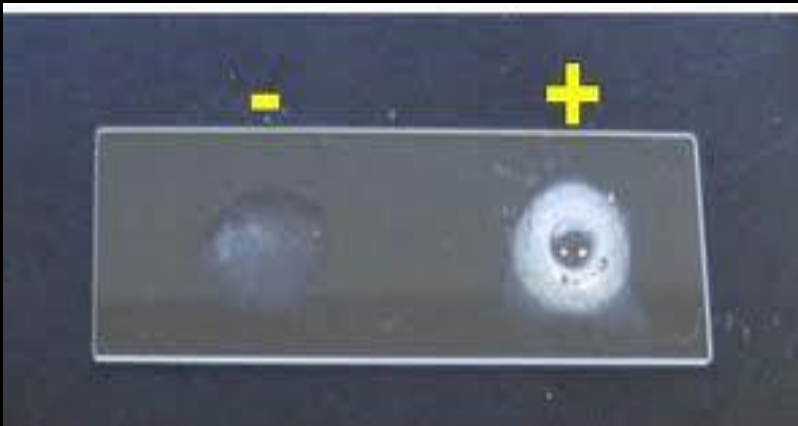
- General characteristics
- Catalase positive



# Enterobacteriaceae

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- Catalase positive



# Enterobacteriaceae

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- General characteristics
- Oxidase negative

## Oxidase Test



Bacteria on test strip



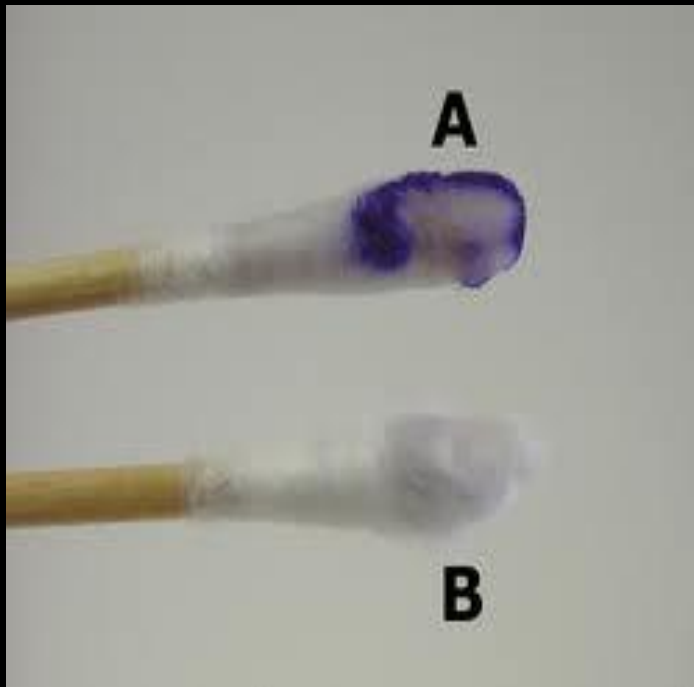
Add oxidase reagent



Purple reaction  
Oxidase positive

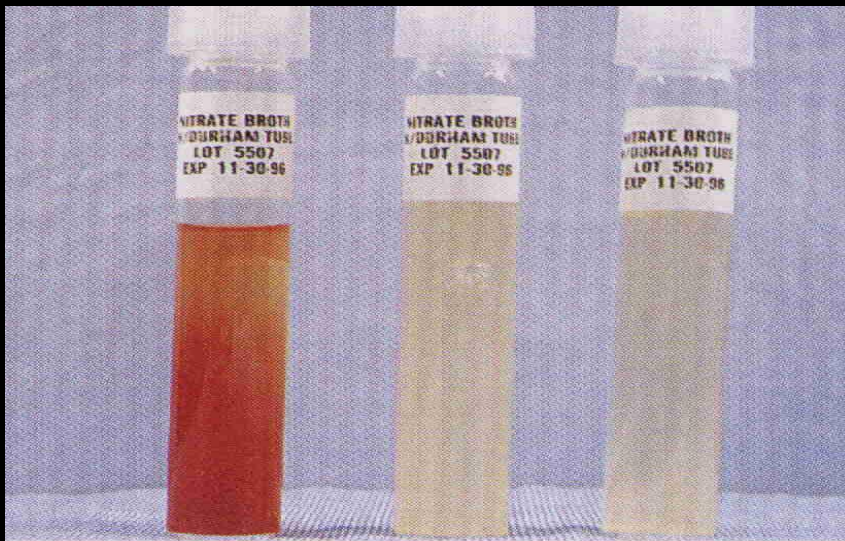
# Enterobacteriaceae

- Oxidase negative



# Enterobacteriaceae

- General characteristics
- Reduce nitrate to nitrite
- (Except some strains of yersinia)



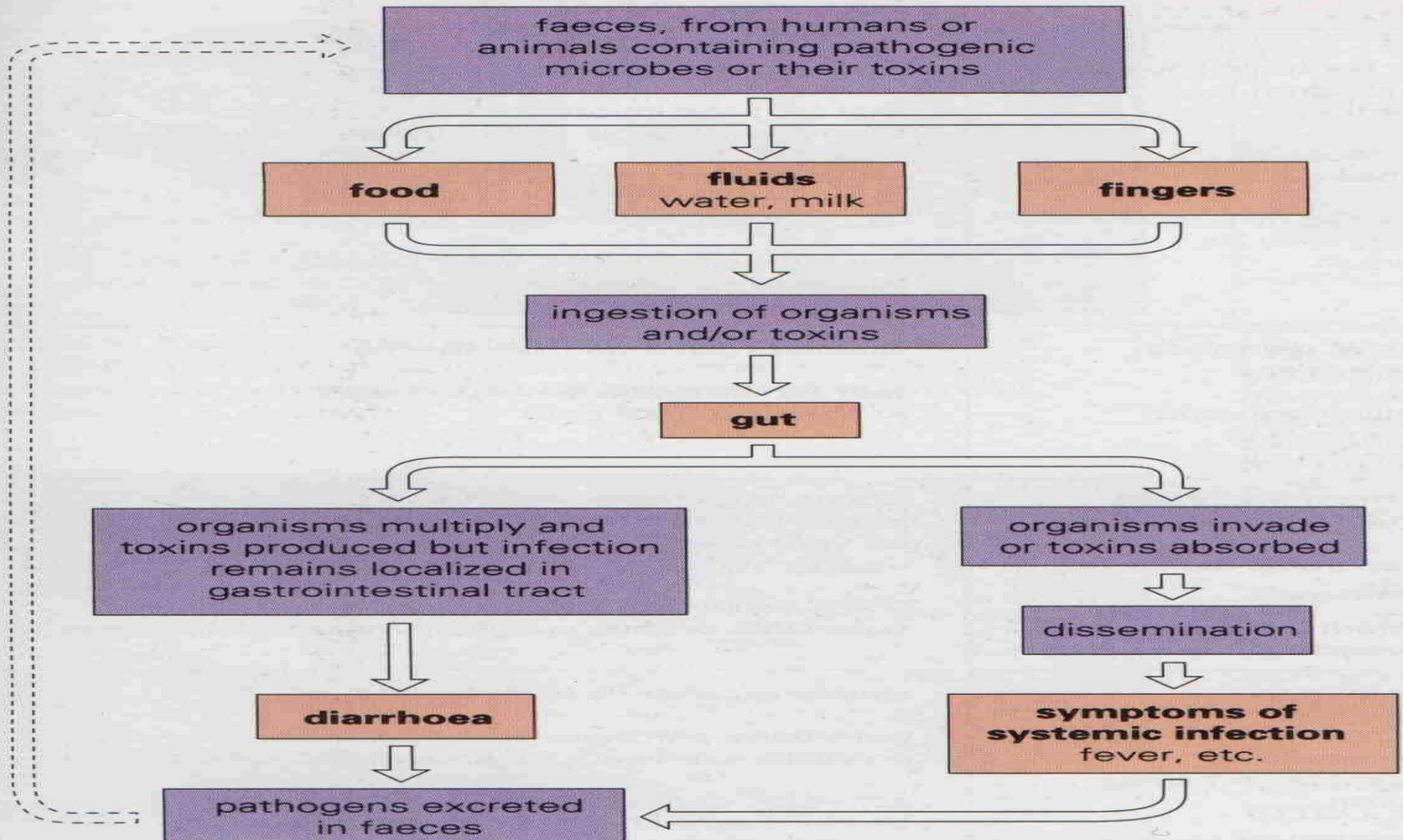
# Enterobacteriaceae

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- Antigenic Structure:
- Somatic O antigen: Induces Ig M
  - Cell wall LPS
  - Heat stable
- H antigen (Flagellar antigen): Induces Ig G
  - Protein
  - Heat-labile
- K antigen (Capsular antigen)
  - Heat-labile polysaccharide
  - Protein: E.coli
  - Polysaccharide: Klebsiella
  - Vi antigen: S. typhi

# Enterobacteriaceae/ Pathogenesis

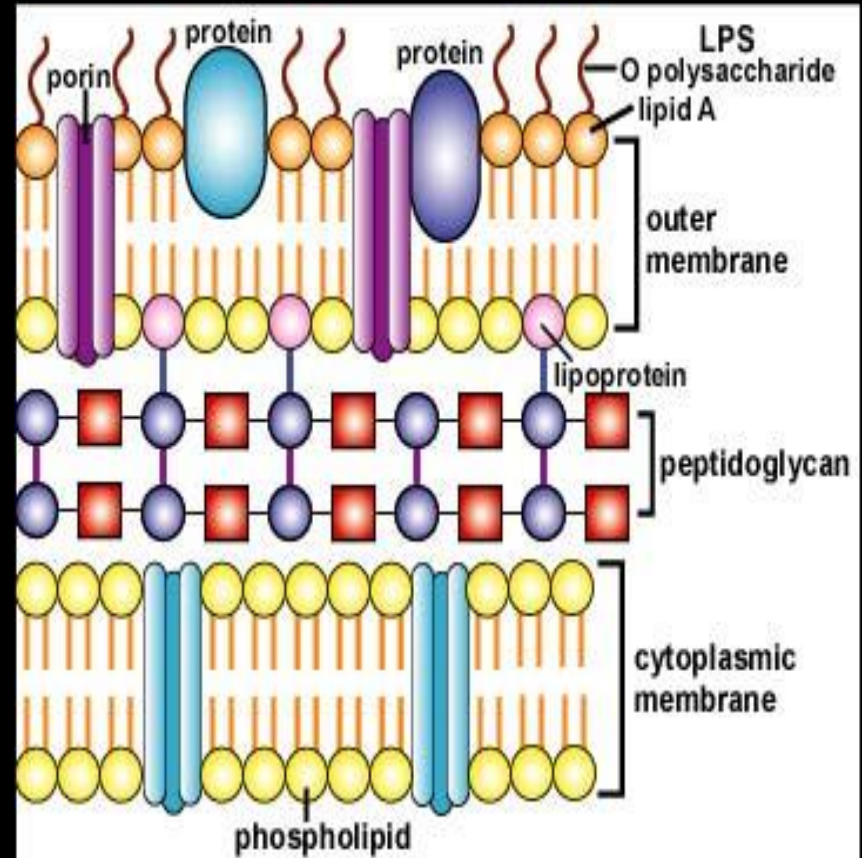
## ACQUISITION AND TRANSMISSION OF GASTROINTESTINAL PATHOGENS





# Enterobacteriaceae

- **VIRULENCE FACTORS**
- **Endotoxin:** Lipid A fraction of LPS
- Bacteremia



# Enterobacteriaceae

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## Exotoxin

- Heat labile enterotoxin  
Adenylate cyclase    cAMP    secretory diarrhea  
e.g. Salmonella, E. coli
- Heat stable enterotoxin  
Guanylate cyclase    cGMP    secretory diarrhea  
e.g. E.coli, Y. enterocolitica
- Shiga and Shiga-like toxins (verotoxin)  
e.g. Shigella, EHEC

# Enterobacteriaceae

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- Exotoxin
  - Hemolysins
  - Especially effective in E.coli infections
  - Most of the uropathogen E.coli release hemolysins
  - Alfa hemolysins are cytotoxic
  - Beta hemolysins are protect neutrophil kemotaxis and phagocytosis

# Enterobacteriaceae

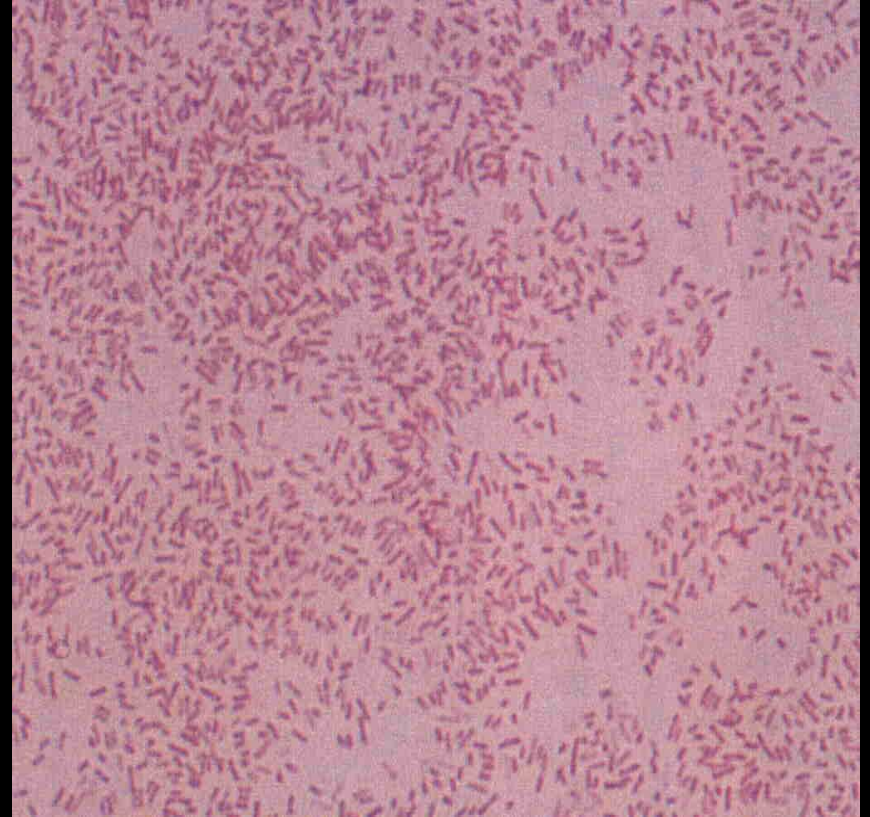
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- **Capsule**
  - Reduce connection of antibody to the bacteria
  - Protect phagocytosis
- **Expression of adhesin factors**
  - Colonization factor antigen
    - CFA I, CFA II in *E. coli* (gastroenteritis)
  - P fimbriae: Uropathogenic *E. coli*
- **Intracellular survival and multiplication**
  - *Salmonella*, *Shigella*, EIEC, *Y. enterocolitica*

# Enterobacteriaceae

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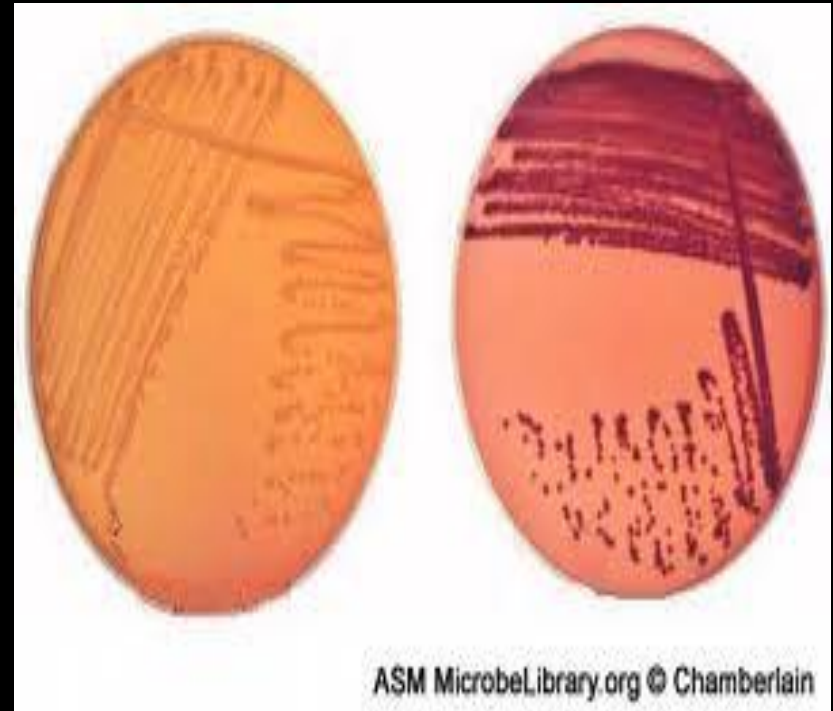
- Laboratory Diagnosis
- Direct microscopy
  - Gram stain



# Enterobacteriaceae

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- Culture Media:
- Blood agar
  - EMB, endo, MacConkey agar
  - Selenite F
  - SS: Salmonella- Shigella



# Enterobacteriaceae

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- Colony morphology:  
e.g. *Klebsiella mucoid*



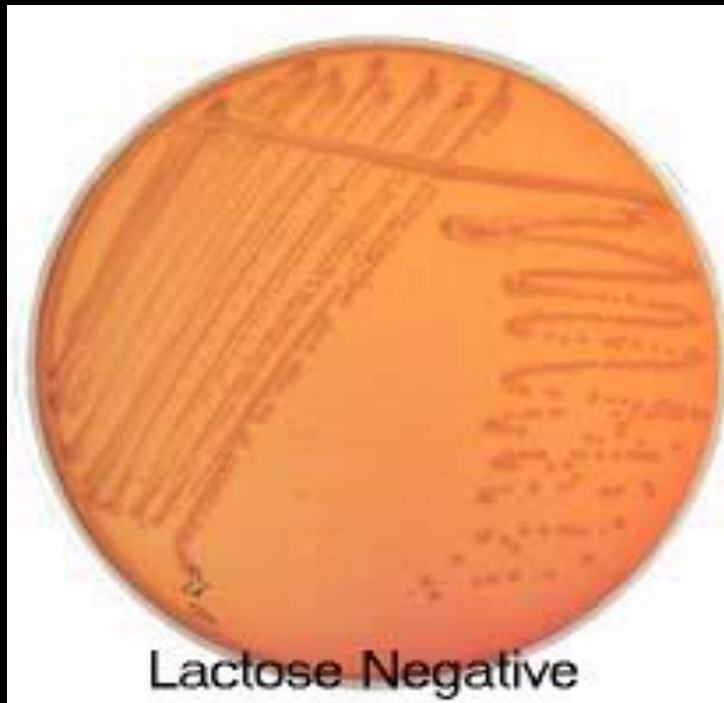
- Motility:  
e.g. *Proteus swarming*



# Enterobacteriaceae

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- Lactose fermentation:  
EMB, endo,  
MacConkey

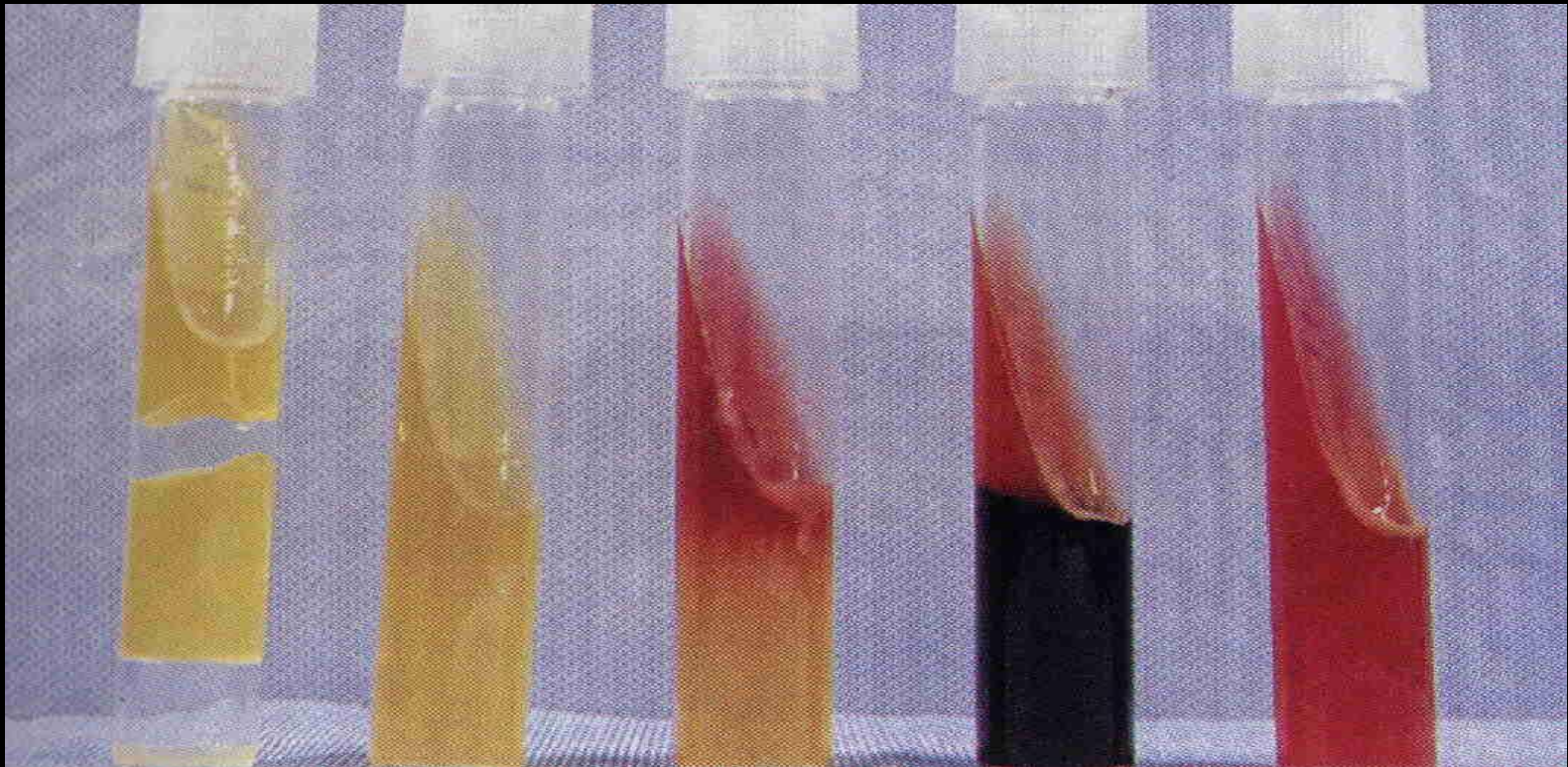




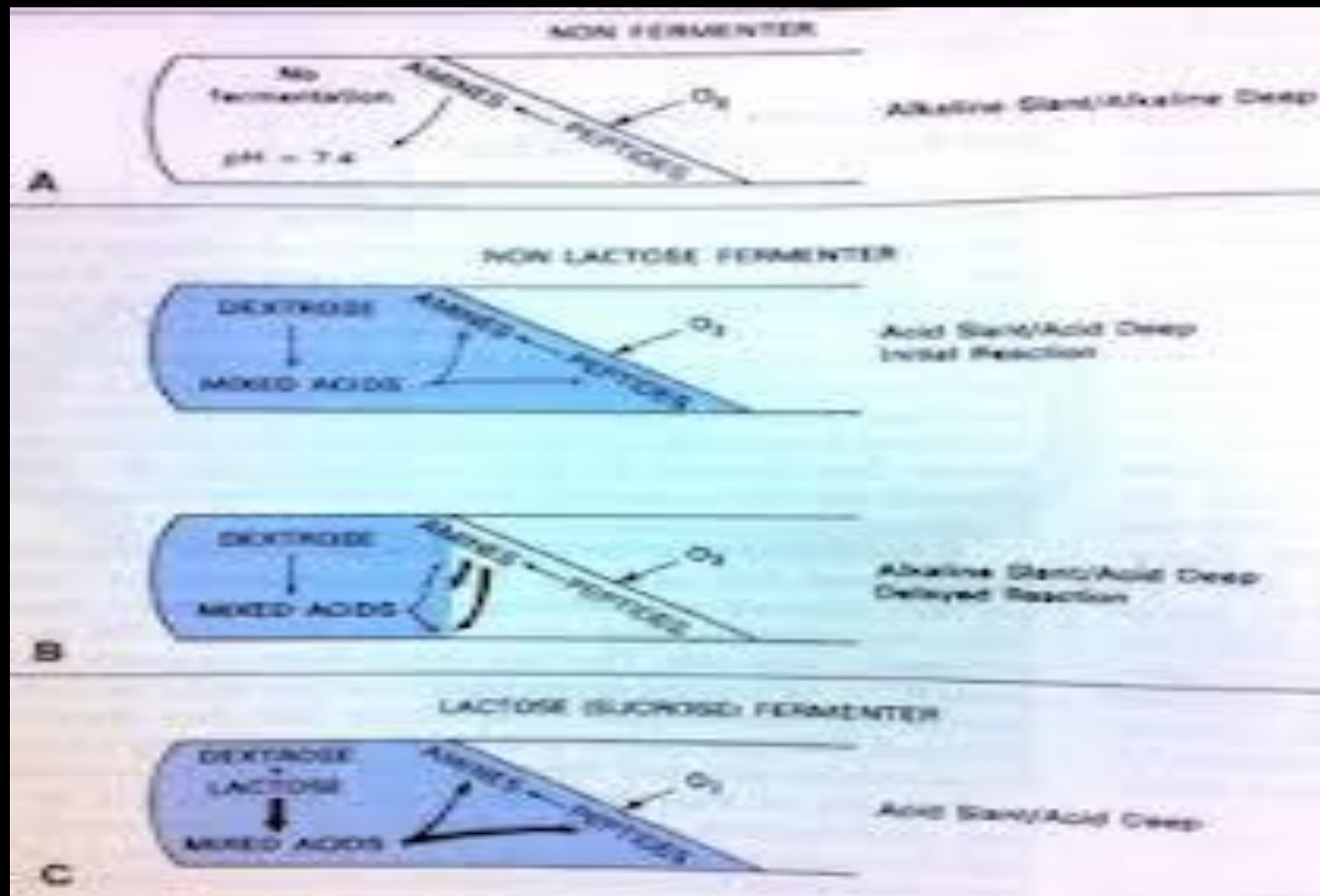
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- Production of acid and gas: Triple Sugar Iron(TSI), fermentation medium



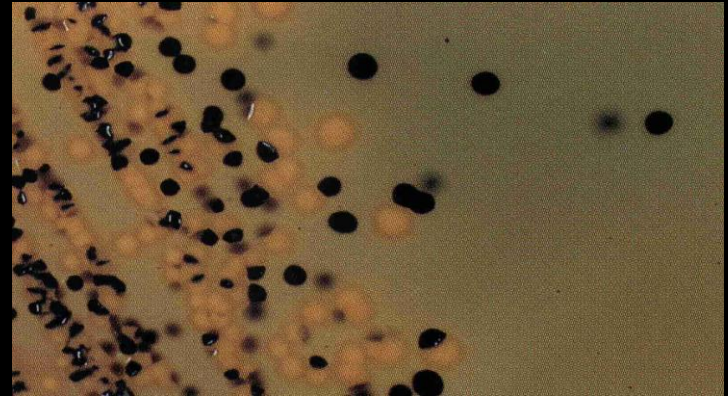
# Enterobacteriaceae



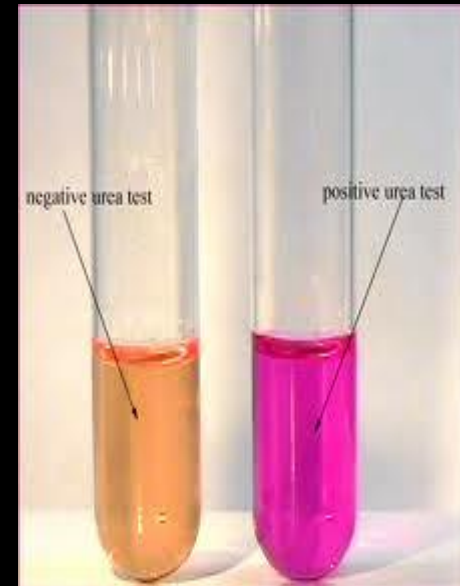
# Enterobacteriaceae

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- $H_2S$  production:
- Hydrogen sulphide
- TSI,
- SS,



- Urease test



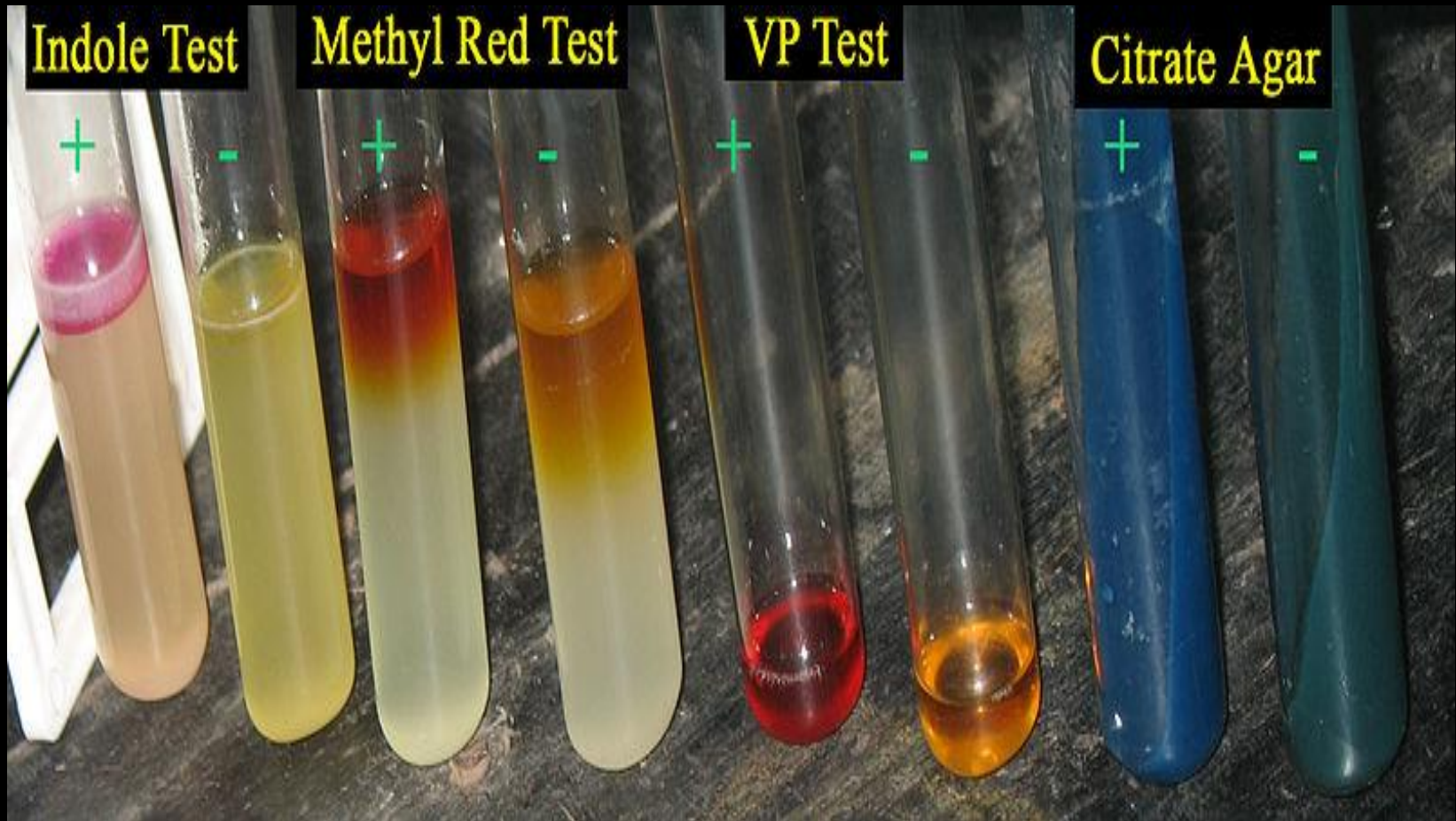
# Enterobacteriaceae

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- IMVIC:
  - Indole production
  - Methyl red test
  - Voges-Proskauer test
  - Citrate utilization

# Enterobacteriaceae

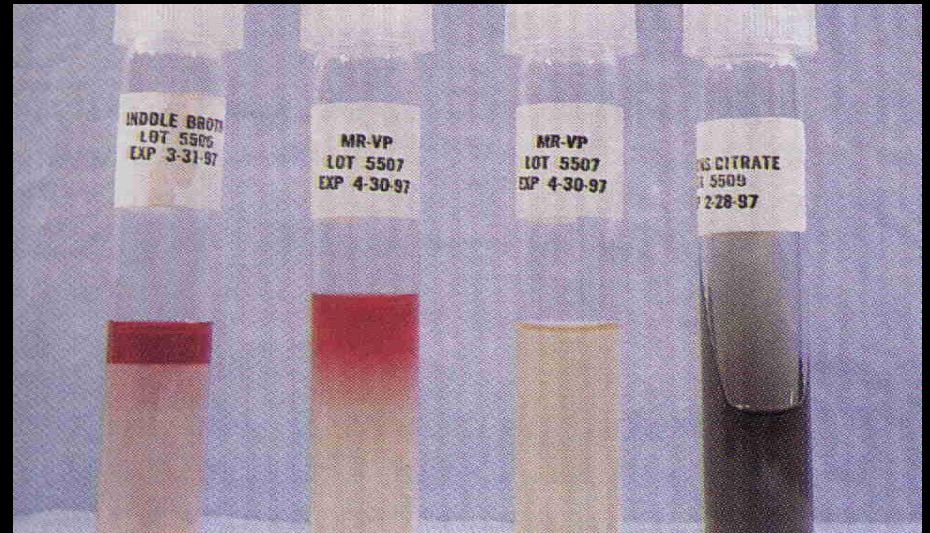
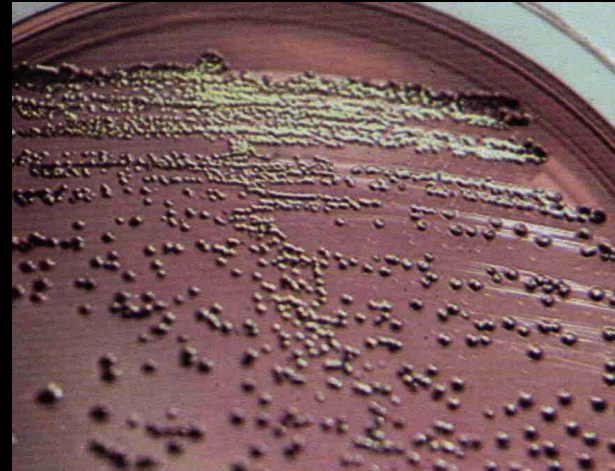
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# Enterobacteriaceae

## General properties of *E.coli*:

- Lactose positive
- Colony with a metallic sheen on EMB agar
- IMVIC +++--



# Enterobacteriaceae

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## Infections of E.coli

### Gastrointestinal infections

ETEC (Enterotoxigenic E. coli)

EIEC (Enteroinvasive E. coli)

EPEC (Enteropathogenic E. coli)

EHEC (Enterohemorrhagic E. coli)

e.g. E. coli O157 H7

Enteroadherent E. coli

EAggEC (Enteragggregative E. coli)

DAEC (Diffusely adherent E. coli)

# Enterobacteriaceae

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## Infections of E.coli:

- Extraintestinal infections:
  - Neonatal meningitis
  - Urinary tract infections
  - Septicemia
  - Pneumonia
  - Osteomyelitis
  - Nosocomial infections
  - Sinusitis, otitis media

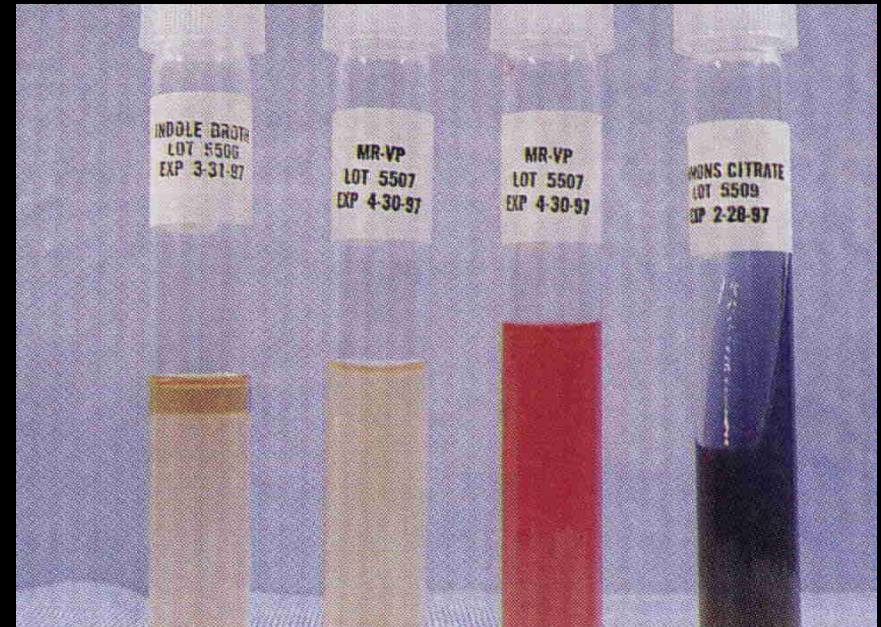


# Enterobacteriaceae

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- General properties of *Enterobacter* spp.
  - Lactose positive
  - Motile
  - IMVIC --++
- Infections:
  - Urinary tract infections
  - Meningitis
  - Septicemia

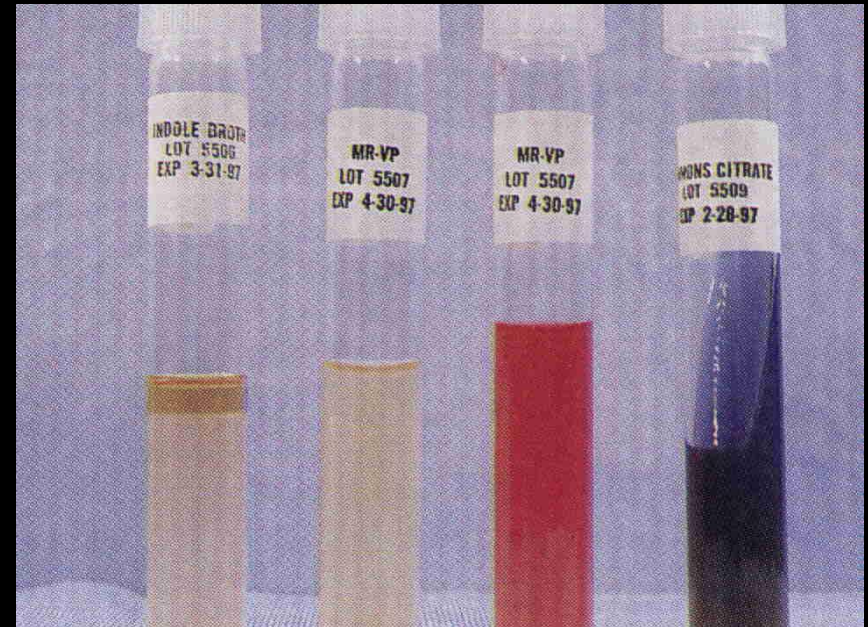
Resistance to antibiotics



# Enterobacteriaceae

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- General properties of *Klebsiella* spp.
  - Lactose positive
  - Non-motile
  - Mucoid colony
  - IMVIC --++
- Infections:
  - Community acquired lobar pneumonia (Friedlaender pneumonia): Ages <2 and >40
  - Urinary tract infections
  - Wound and soft tissue infections



# Enterobacteriaceae

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- General properties of *Proteus* spp.
  - Urease positive
  - Motile, swarming
  - Smell like sewage
- Infections:
  - Urinary tract infections
  - Meningitis
  - Septicemia



# Don't forget

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**stop**  
and  
sanitize

do your part  
to reduce the  
spread of infection



**Clean  
hands  
save  
lives!**

 WINDSOR  
REGIONAL  
HOSPITAL  
OUR FAMILY. CARING FOR YOUR FAMILY

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