



Lecture 4 Part-1

Bacterial taxonomy, Classification, and laboratory diagnosis



Objectives

Def. of Taxonomy

Nomenclature

Scheme of medical bacteria

Biochemical reactions





Bacterial Taxonomy

Taxon=group , Taxa=groups=classification

The science of biological classification





Bacterial Taxonomy

Classification

Taxonomy

Nomenclature

Identification





Bacterial Taxonomy Rank

- Kingdom or Domain
- Division or Phylum
- Class
- Order
- Family
- Genus
- Species
- Strains



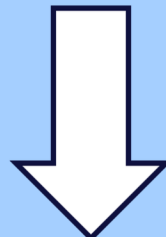


Bacterial Taxonomy

Strain

Individual member within a species

Staph. aureus
(Species)



MRSA
(Strain)





Bacterial Taxonomy

Species

A collection of strains that share many stable properties

Staph. aureus
(Species)

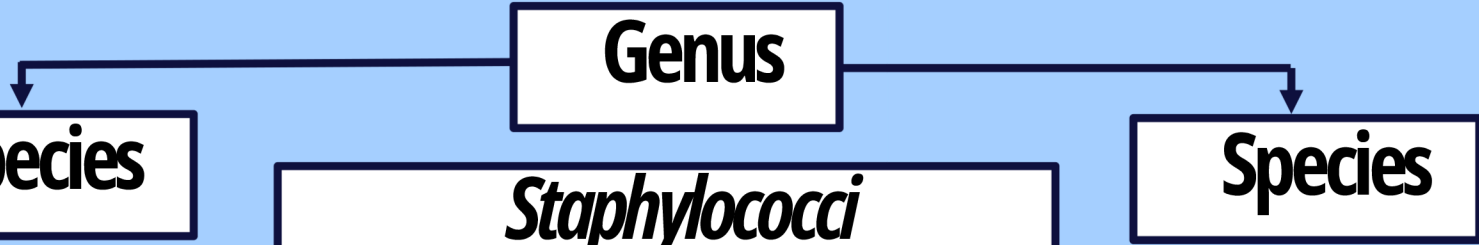


MRSA *VRSA*
(Strain) (Strain)





Bacterial Taxonomy



Staphylococci

S. epidermidis

S. aureus

One or more species
that share common properties



Nomenclature

Genus + species



Genus

Species



Nomenclature

Escherichia coli

Italic

I





Nomenclature

Escherichia coli

(*E.coli*)

I





Scheme of medical bacteria

Shape



Cocci

Bacilli

Spiral

Miscellaneous

Scheme of medical bacteria

Cocci

Gram stain

Positive

Negative

Cluster

Chain or Pairs

Pairs

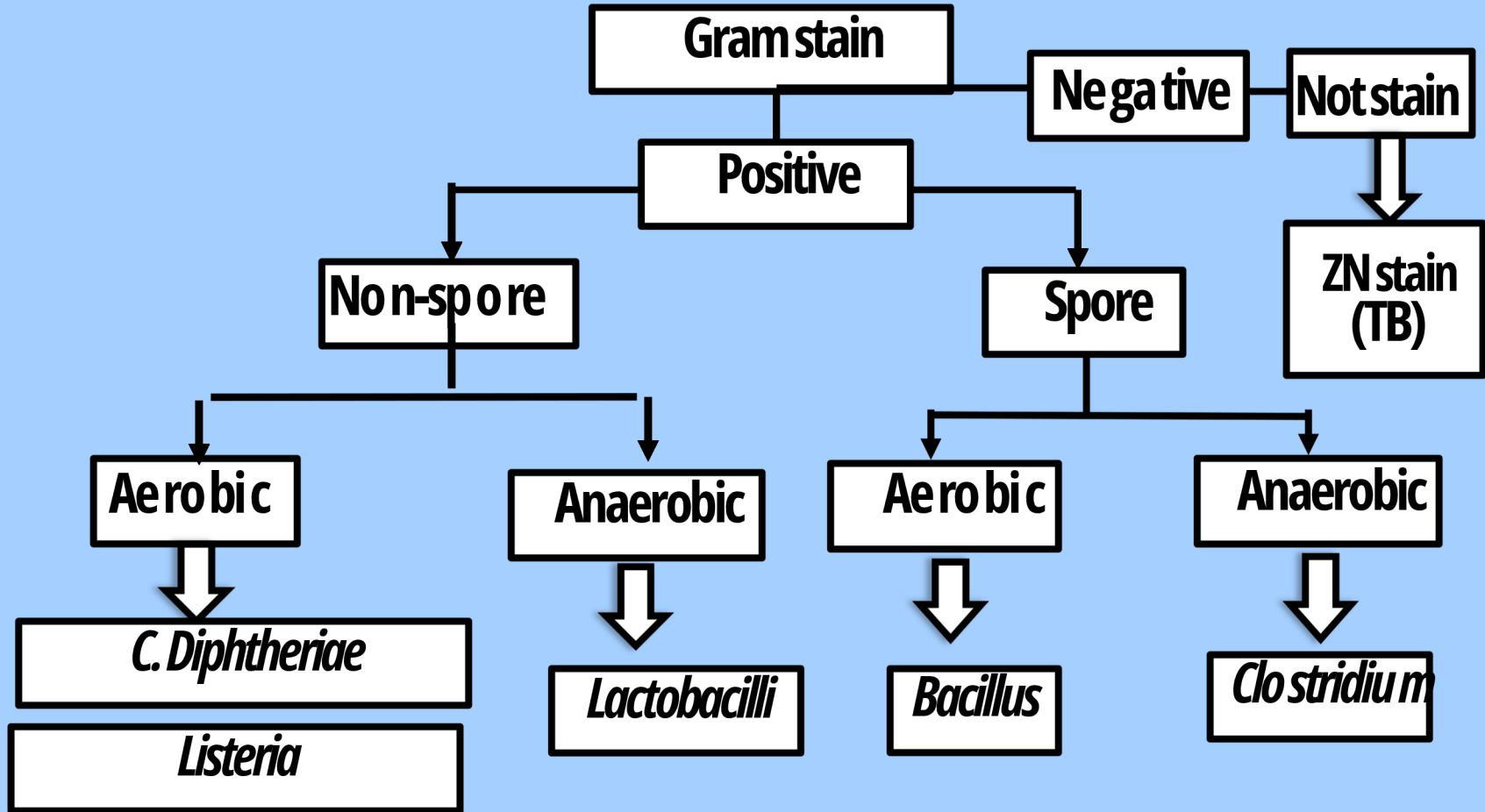
Staphylococci

Streptococci

Enterococcus

Neisseria
(*Diplococci*)

Bacilli



Gram negative bacilli

☐ *Enterobacteriaceae*

☐ *Vibrio*

☐ *Campylobacter*

☐ *Helicobacter*

☐ *Pseudomonas*

☐ *Haemophilus*

☐ *Bordetella*

☐ *Brucella*

☐ *Legionella*

☐ Gram –veanaerobes

Spiral

- ☐ *Treponema*
- ☐ *Borrelia*
- ☐ *Leptospira*



Miscellaneous group

- ☐ No cell wall
- ☐ Not stain by gram
- ☐ Obligate intracellular
- ☐ Mycoplasma
- ☐ Chlamydia
- ☐ Rickettsia
- ☐ Coxiella
- ☐ Actinomycetes

Systematic Bacteriology

Morphology & Culture

Virulence factor & Pathogenesis

Diseases

Lab. diagnosis

Treatment & Prevention

Biochemical reactions



1) Indole test

Bacteria

**Peptone
(TRYPTOPHAN)**

break down ↓ **(Tryptophanase)**

**Indole
+
Kovac's R.**

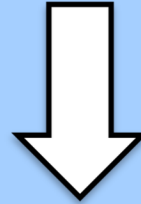
Red



2) Methyl red test

Organism →

Glucose



**Large amount of Mixed acid
(Acetic, lactic, & succinic)**

Low pH

<4

Methyl red indicator

high pH

6

2) Methyl red test

Bacteria

Peptone (Glucose)

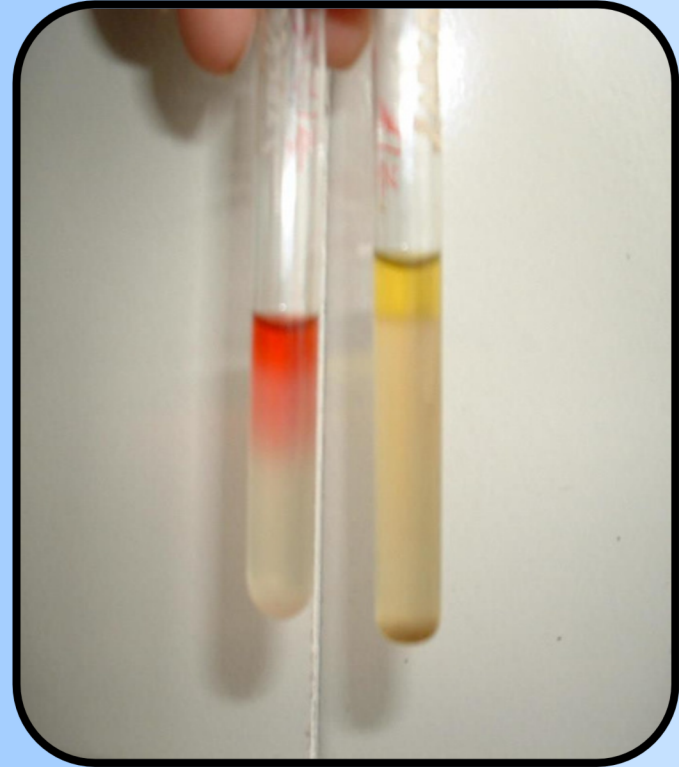
Incubate at 37 °C for 48h

(Large Acid) Mixed

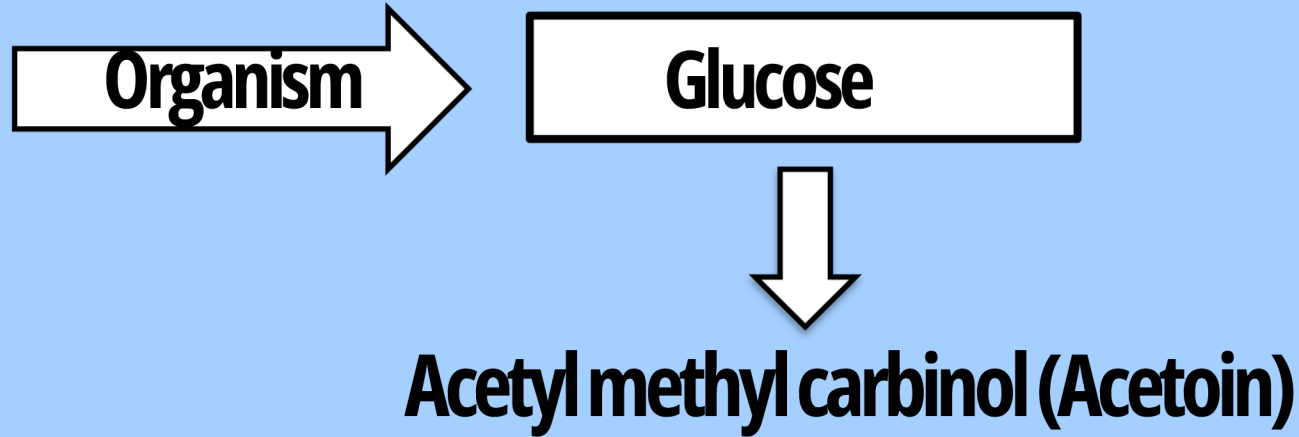
pH



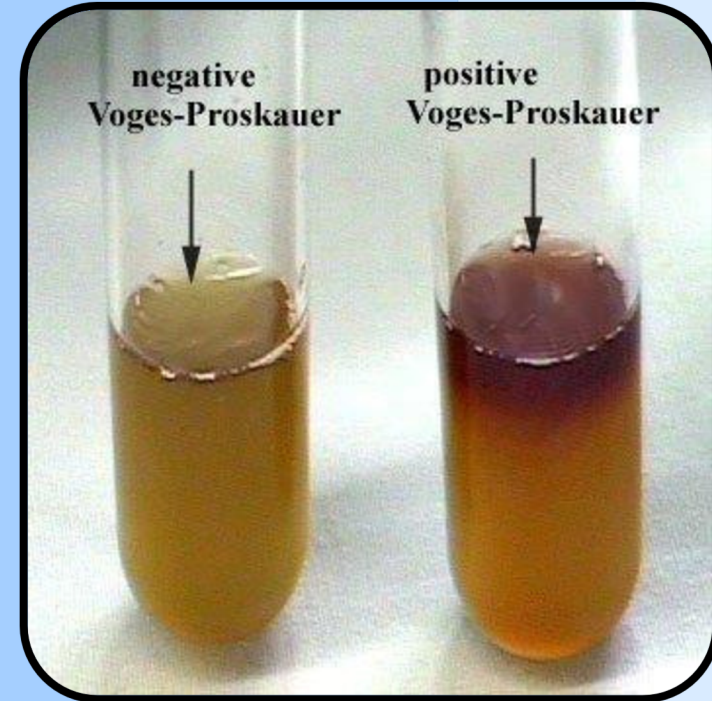
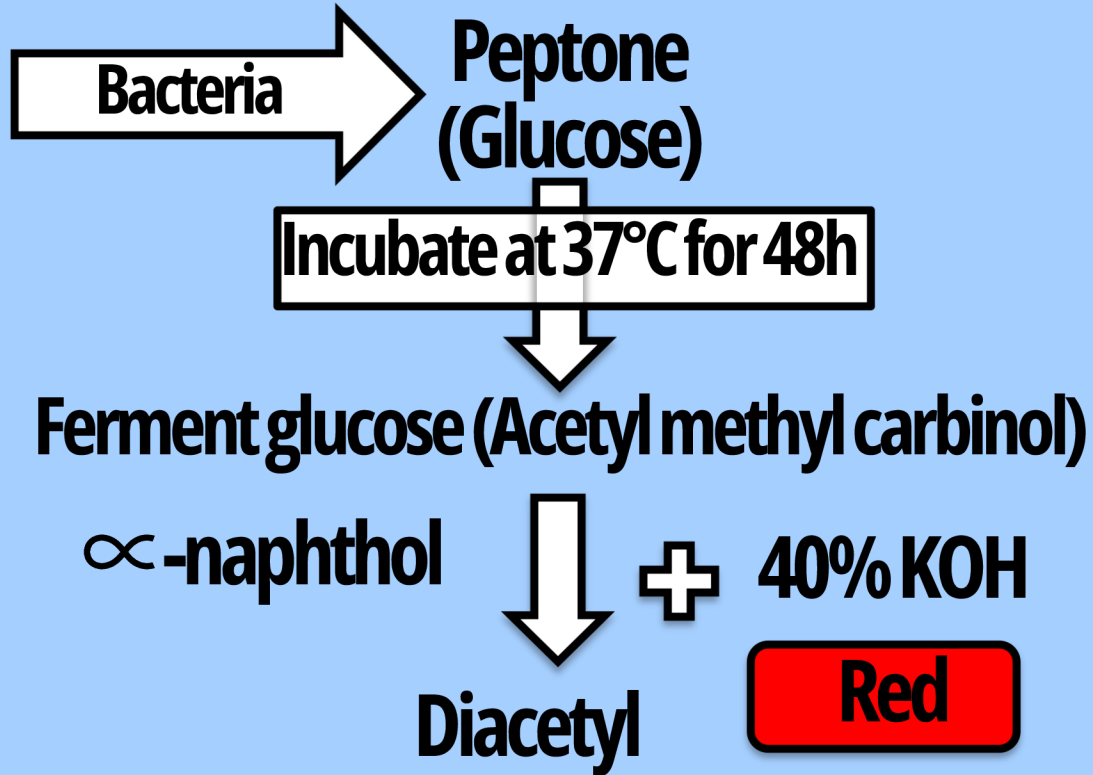
MR indicator



3) Voges-Proskauer test (V.P)



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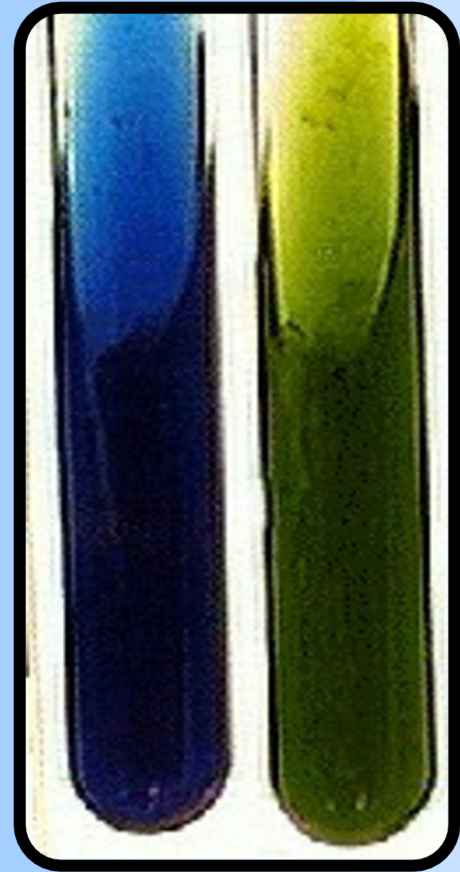


MR&VP

If methyl red is positive, the voges-proskauer should be negative and reverse is right.

4) Citrate utilization test

**Utilized citrate as only source of
carbon**



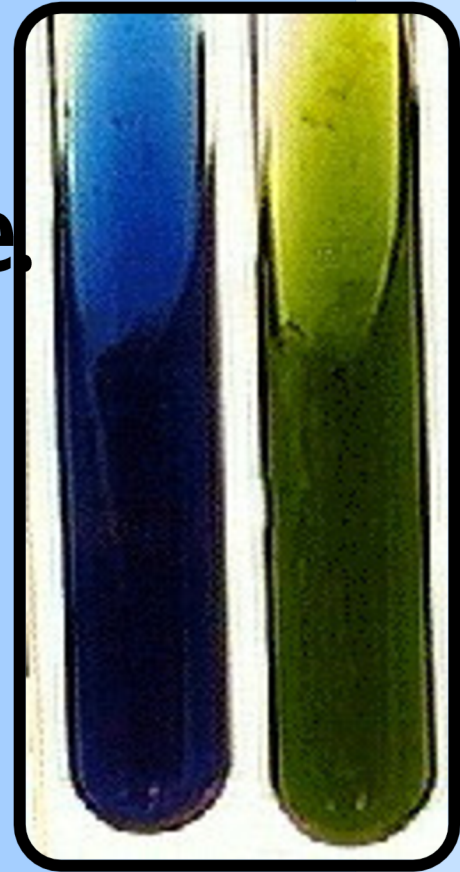
4) Citrate utilization test

The indicator is bromothymol blue.

N

High pH

7



4) Citrate utilization test

Bacteria

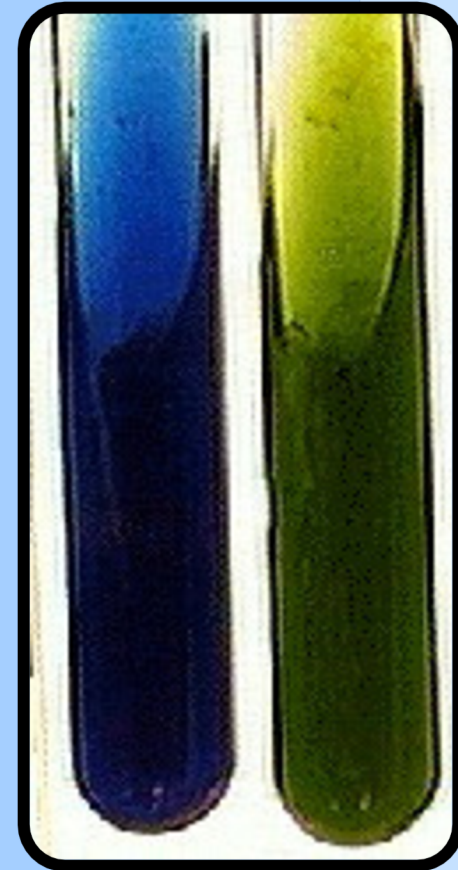
Citrate medium

Incubate at 37°C for 48h

Liberated CO_2

CO_2 +with sodium

sodium carbonate(Alkaline)
Indicator change to blue



5) Urease test

Phenol red indicator

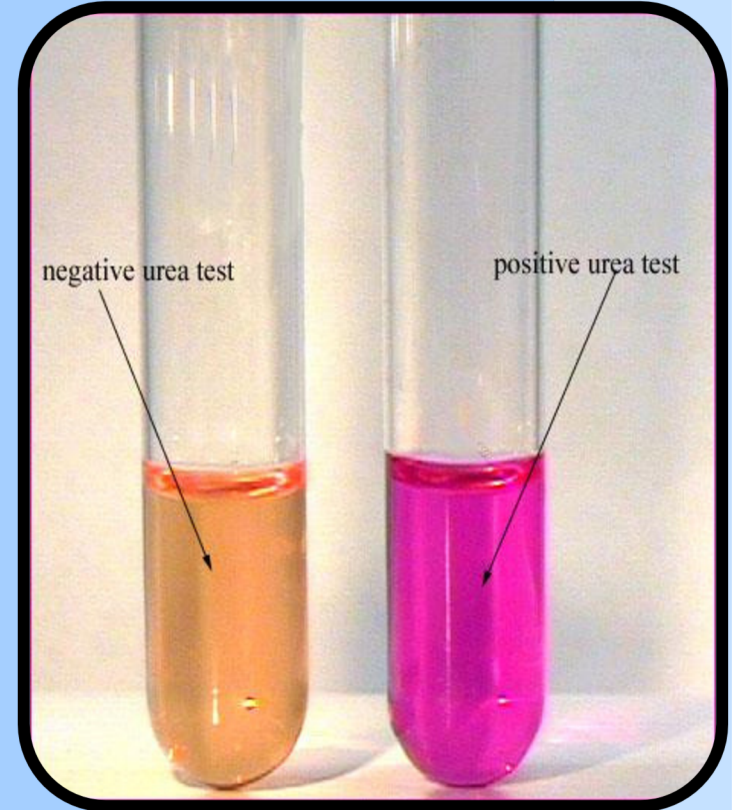
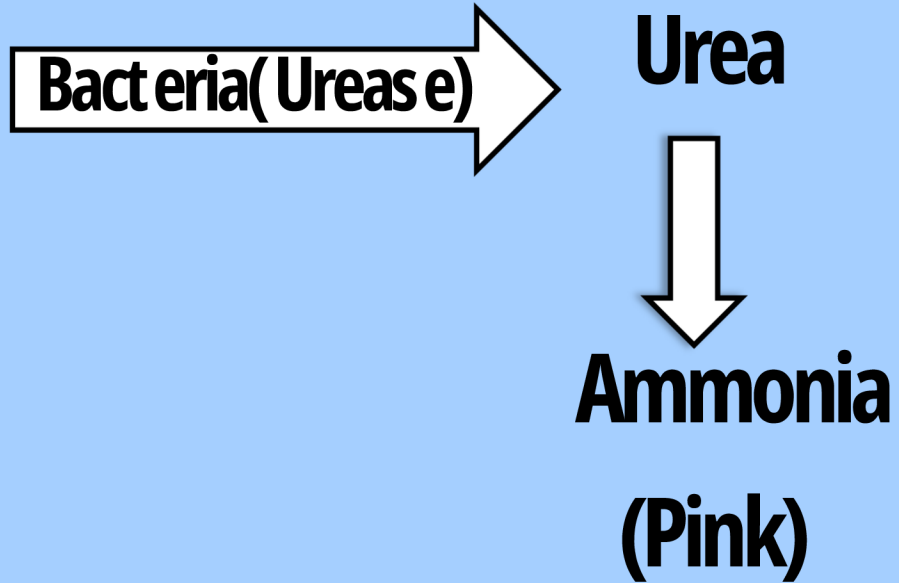
Acid

6

Alkaline

8

5) Urease test



6) TSI

0.1% glucose

1% lactose

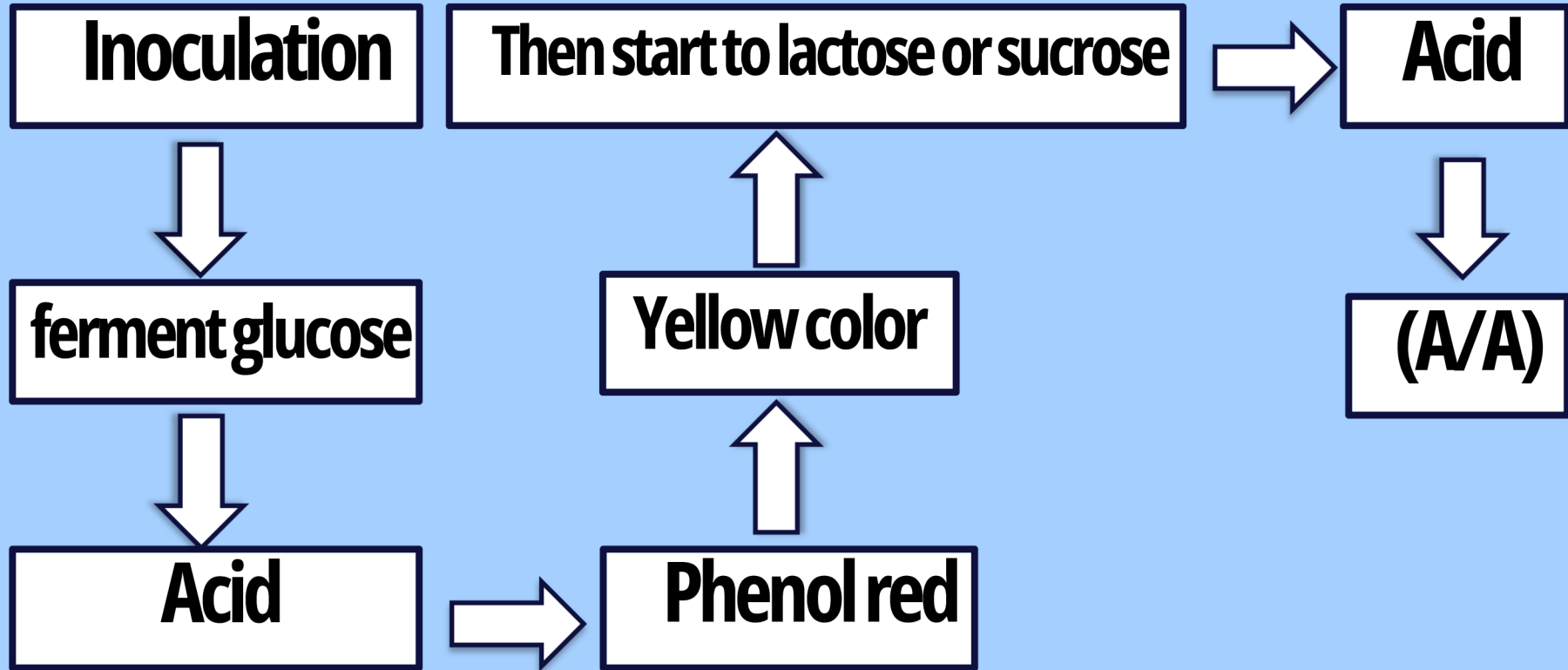
1% sucrose

Ferrous sulfate

pH indicator: Phenol red



6) TSI a) Acid over acid (A/A)



6) TSI (a) Acid over acid (A/A)



a) Acid over acid (A/A)

**Detection of gas production by
break up the medium or
pushed up the tube.**

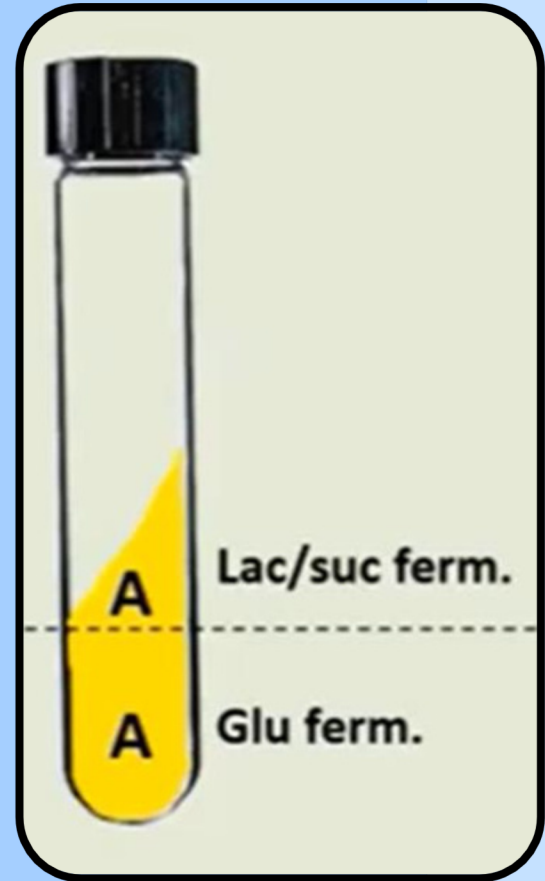


a) Acid over acid (A/A)

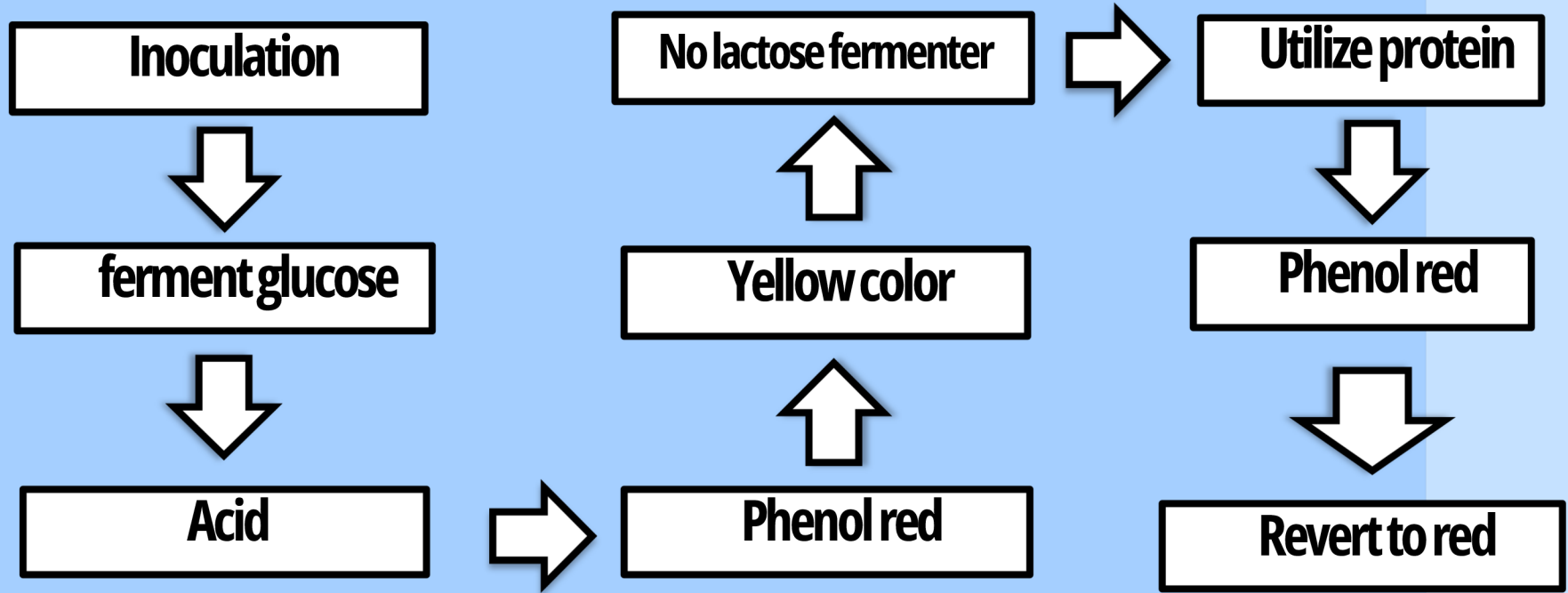
A/A

Glucose fermenter

Lactose fermenter



b) Alkaline over acid (K/A)



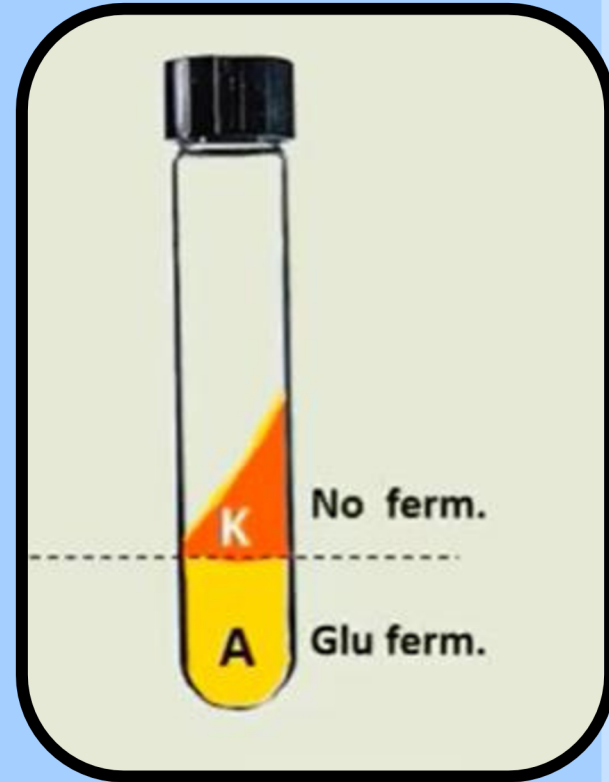
a) Alkaline over acid (K/A)



a) Alkaline over Alkaline (K/K)

K/A

Glucose fermenter
Non-lactose fermenter



a) Alkaline over Alkaline (K/K)

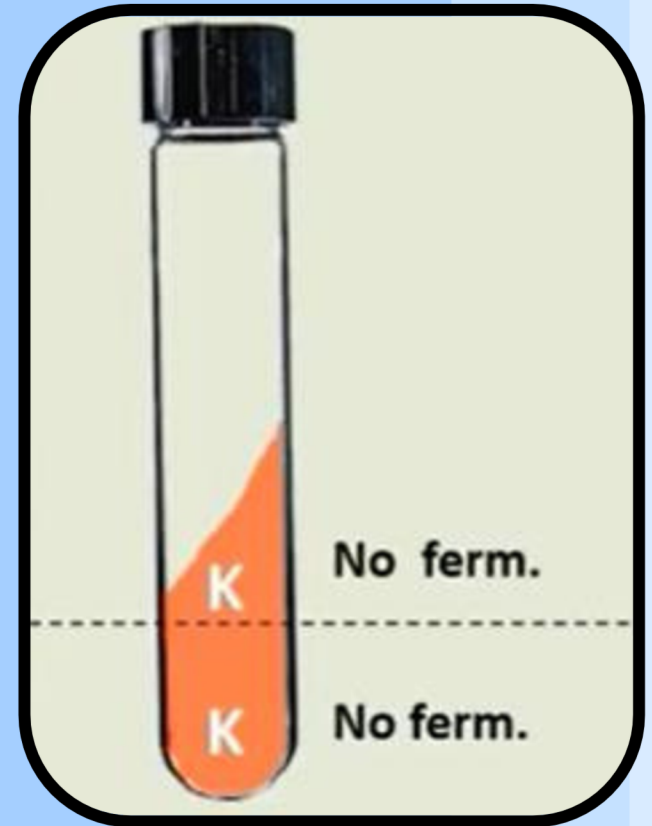
If the organism can not use the glucose in the medium.

The color of the medium remains red.



a) Alkaline over Alkaline (K/K)

K/K
No sugar fermenter



H₂S production

Bacteria (Reduce)

Sulfur



**Hydrogen sulfide
(H₂S) iron**

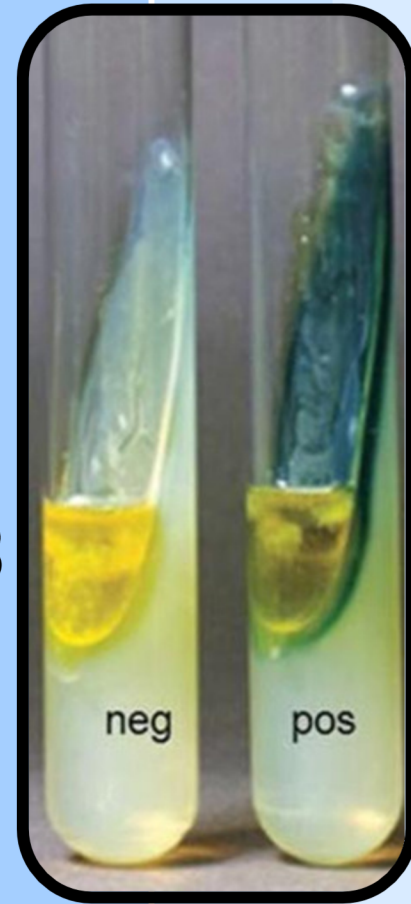
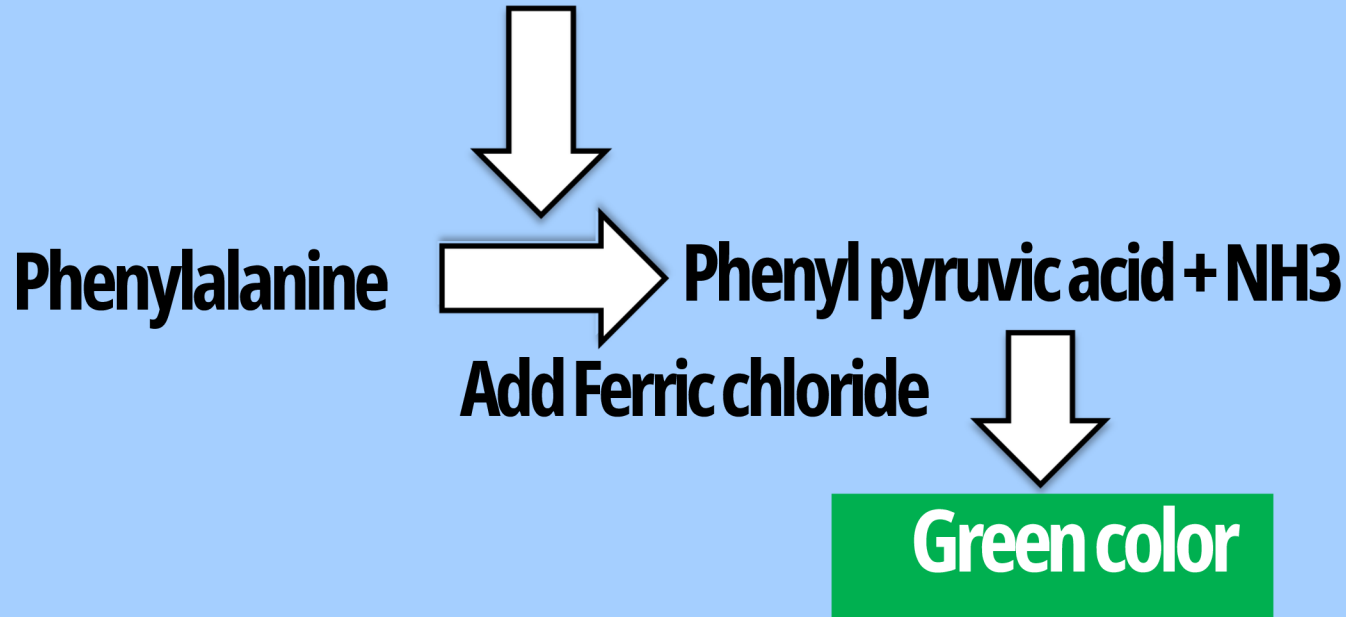


**Ferric sulfide
(Black)**



7) Phenylalanine deaminase

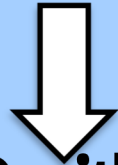
Phenylalanine deaminase



Distinguishes *Proteus* from *Salmonella* & *Shigella*

8) Ornithine decarboxylase

Ornithine decarboxylase

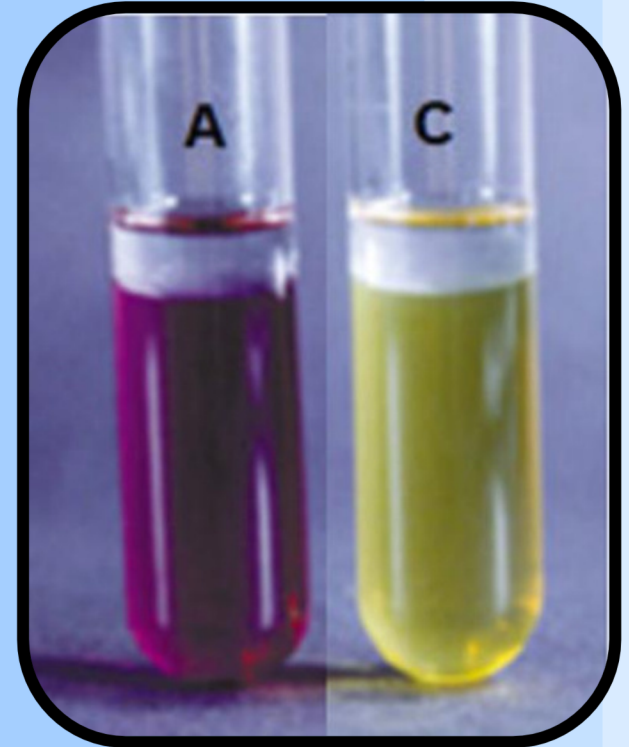


Ornithine

Source of carbon (energy for growth)

Providencia rettgeri & *Morganella morganii* (+ve)

P. rettgeri & *M. morganii*



8) Ornithine decarboxylase

Organism

ferment
glucose

Ornithine

Bromocresol purple (Indicator)

Yellow

Purple



Glucose
Ornithine

9) The analytical profile index (API)

The analytical profile index (API)
(Biochemical tests for identification)



9) The analytical profile index (API)

Several API systems for different groups of organism

API 20E & API 20NE (Enterobacteria)

API 20 STREP (Streptococci) etc.



9) The analytical profile index (API)



Color change



Oxidase test

Some bacteria produce
Oxidase enzyme Detection by
adding few drops of colorless
Oxidase reagent Colonies turn
deep purple in color (positive)

Oxidase Test

- All Enterobacteriaceae are **oxidase-negative**.
- This test is used to differentiate enterobacteriaceae from *Pseudomonas* which is **oxidase positive**.



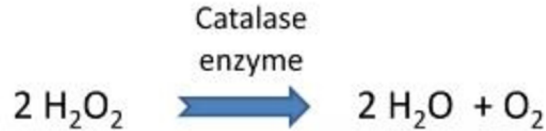
Catalase test

Some bacteria produce catalase enzyme
Addition of H_2O_2 lead to production of gas bubbles (O_2 production)

- Catalase test:

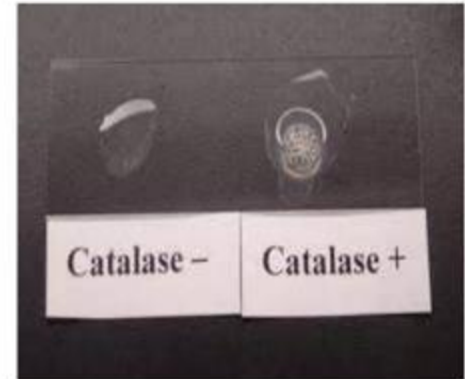
- Is used to differentiate between staphylococci(catalase +ve) and streptococci(catalase -ve).

- Principle:



- Procedure

- Smear a colony of the organism to a slide
- Drop H_2O_2 onto smear
- Observe



Coagulase test

Coagulase test:

Some bacteria produce coagulase enzyme

Coagulase enzyme converts fibrinogen to fibrin (plasma clot)

Detected by slide or test tube method

Coagulase test

is used to differentiate *Staphylococcus aureus* from coagulase-negative staphylococci.

fibrinogen $\xrightarrow{\text{coagulase}}$ fibrin
(clot formation)

