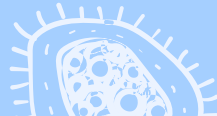




Lecture 4 Part-1

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





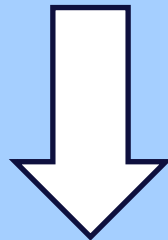
Bacterial Taxonomy

Strain

Individual member within a species

Staph. aureus

(Species)



MRSA

(Strain)





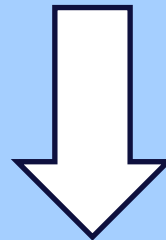
Bacterial Taxonomy

Species

A collection of strains that share many
stable properties

Staph. aureus

(Species)



MRSA

(Strain)

VRSA

(Strain)





Bacterial Taxonomy

Genus

Species

S. epidermidis

Staphylococci

Species

S. aureus

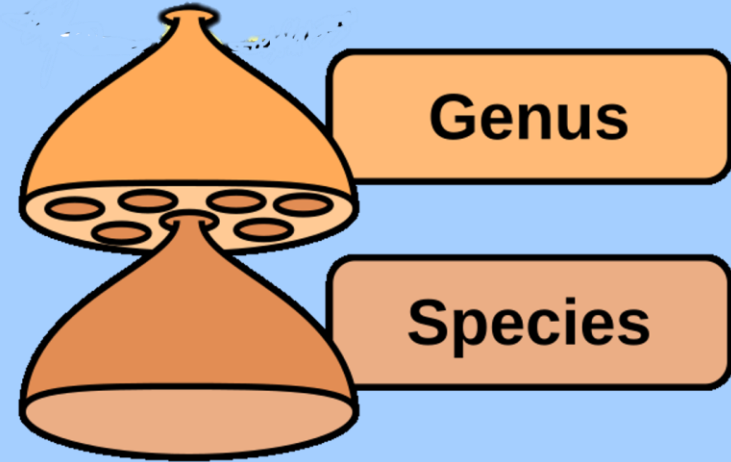
**One or more species
that share common properties**





Nomenclature

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

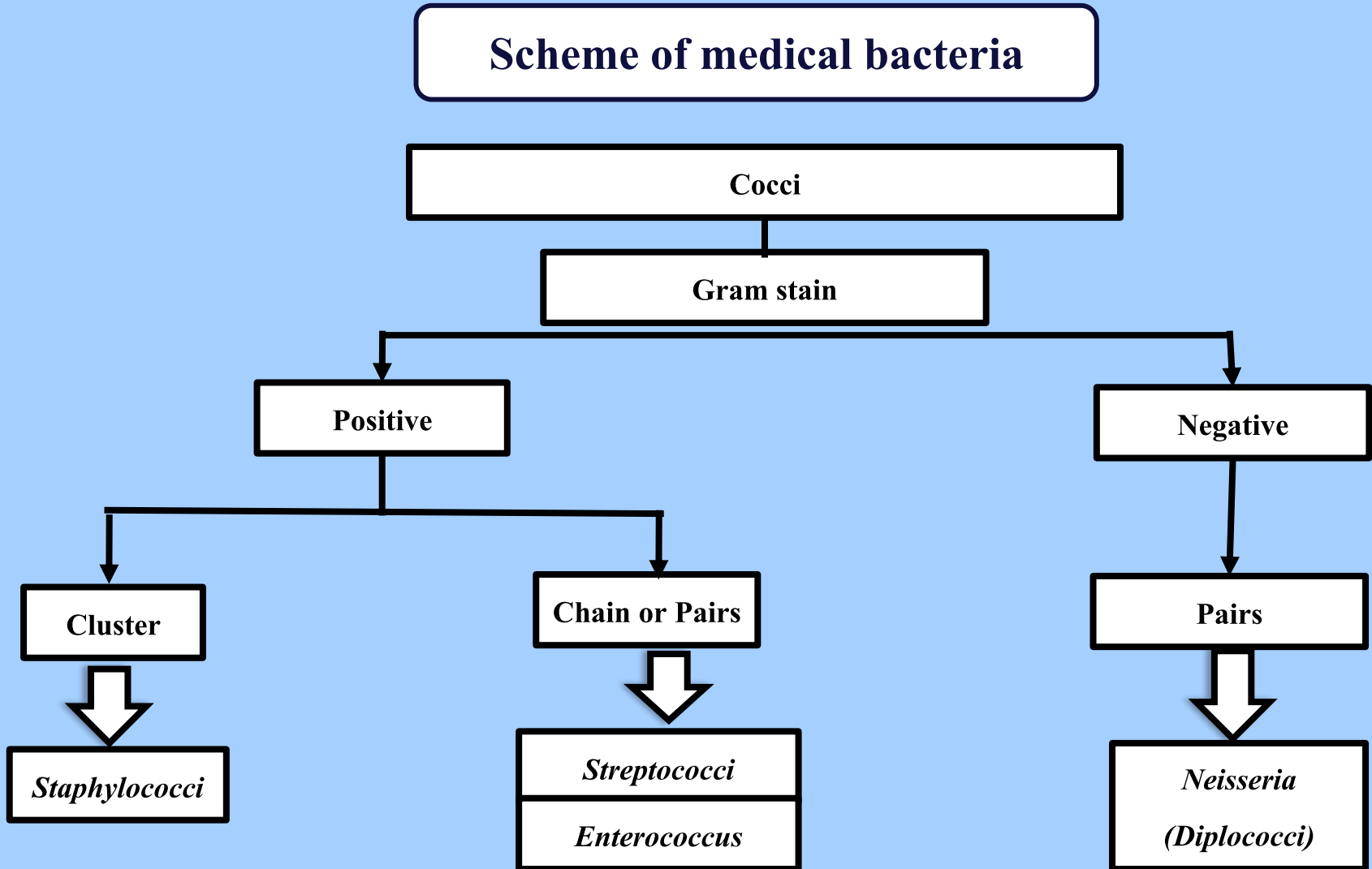
Pairs

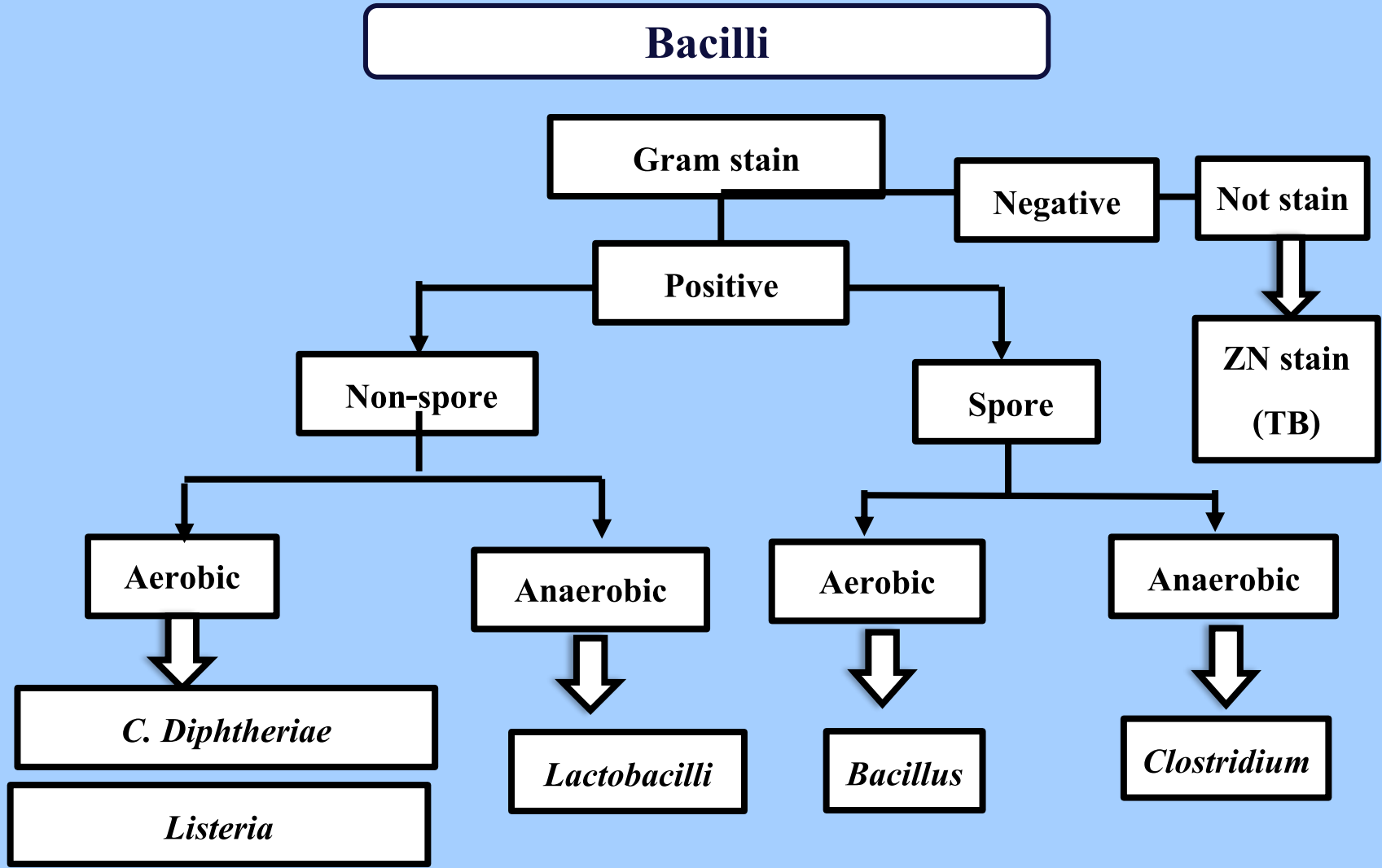
Staphylococci

Streptococci

Enterococcus

Neisseria
(*Diplococci*)





Gram negative bacilli

☐ *Enterobacteriaceae*

☐ *Vibrio*

☐ *Campylobacter*

☐ *Helicobacter*

☐ *Pseudomonas*

☐ *Haemophilus*

☐ *Bordetella*

☐ *Brucella*

☐ *Legionella*

☐ Gram –ve anaerobes

Spiral

☐ *Treponema*

☐ *Borrelia*

☐ *Leptospira*



Miscellaneous group

- ☐ No cell wall
- ☐ Not stain by gram
- ☐ Obligate intracellular

- ☐ Mycoplasma
- ☐ Chlamydia
- ☐ Rickettsia
- ☐ Coxiella
- ☐ Actinomycetes

Systematic Bacteriology

Morphology & Culture

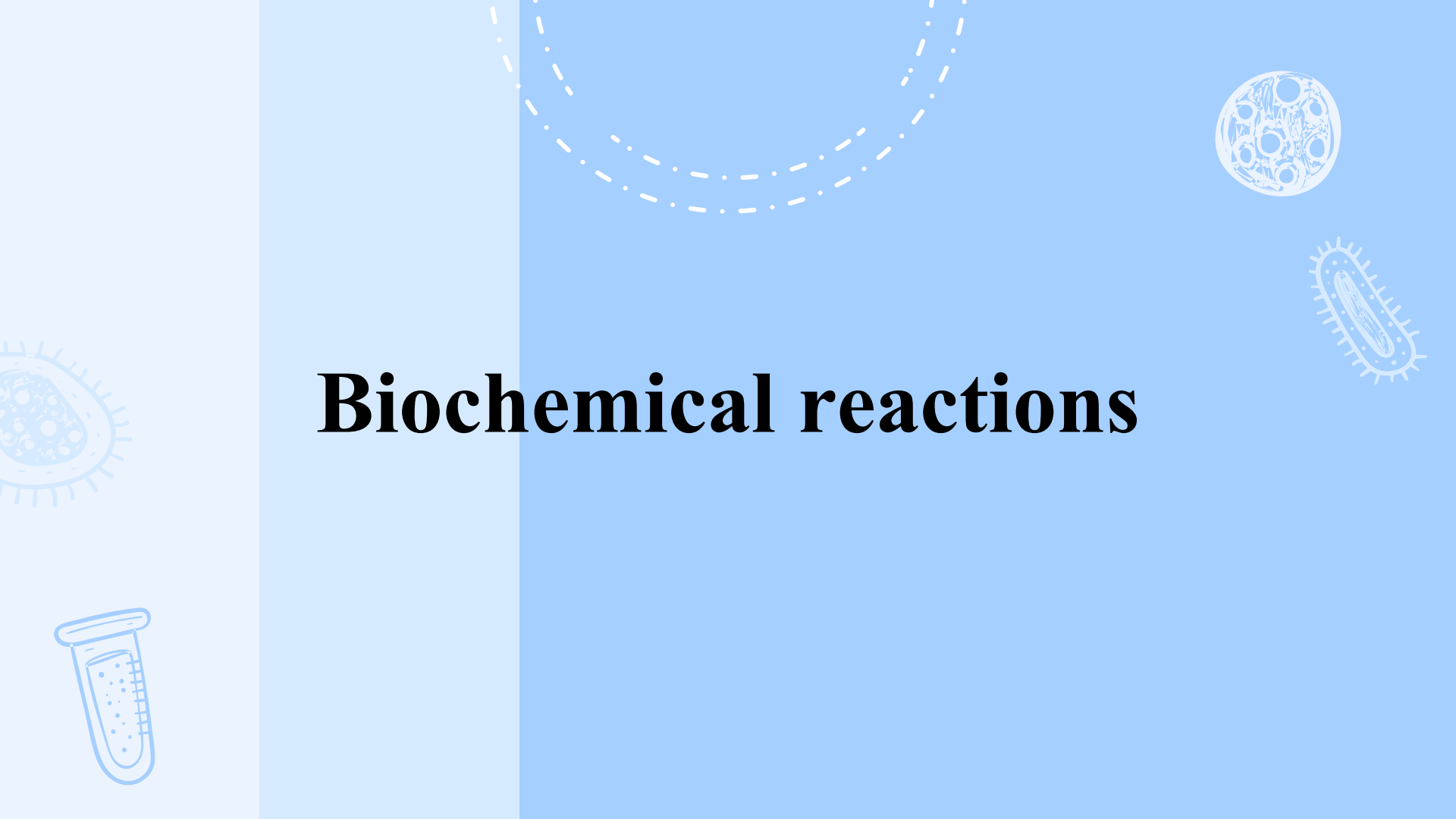
Virulence factor & Pathogenesis

Diseases

Lab. diagnosis

Treatment & Prevention

Biochemical reactions



1) Indole test

Bacteria

**Peptone
(TRYPTOPHAN)**

break down

(Tryptophanase)

Indole



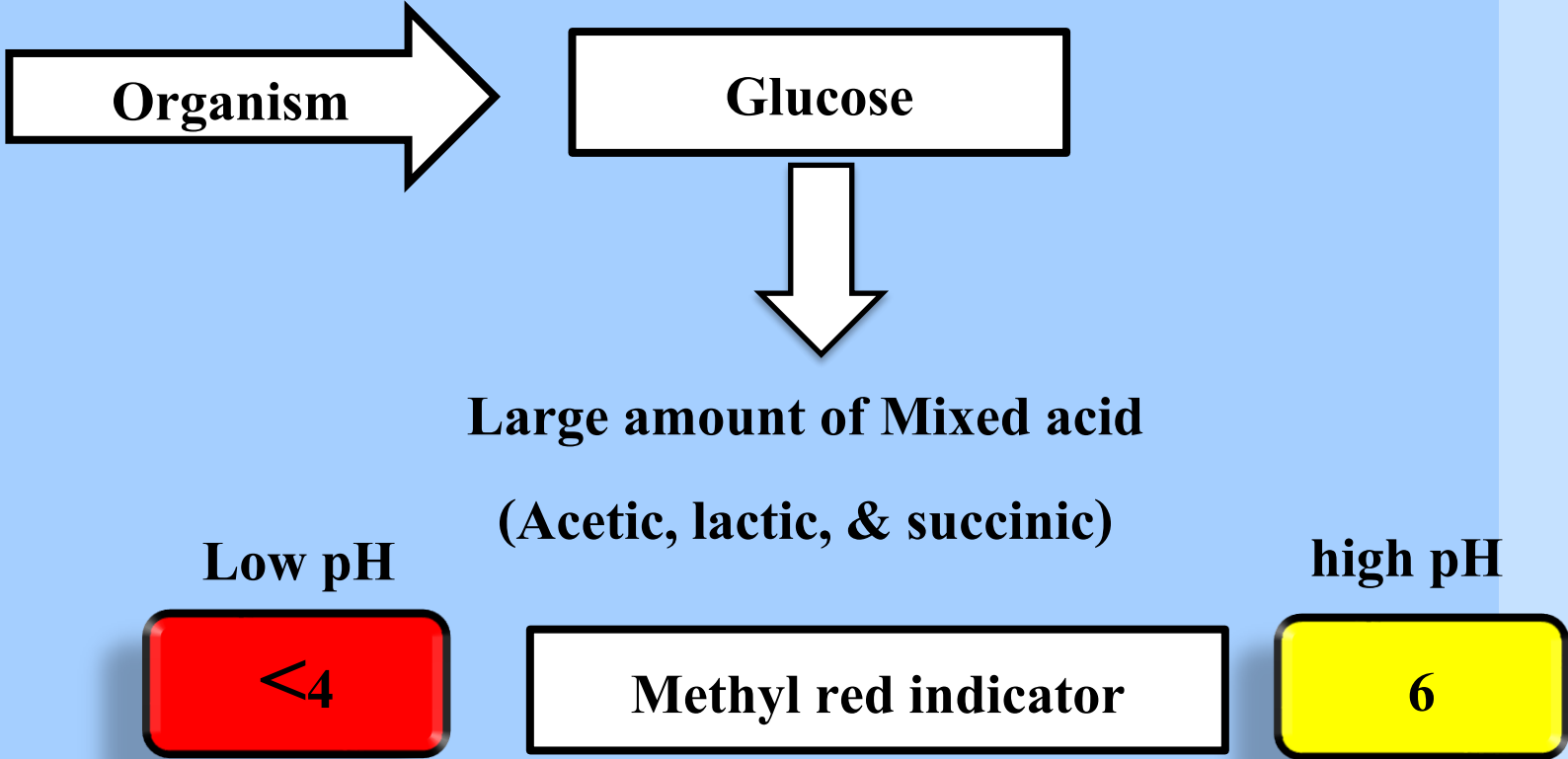
Kovac's R.

Red



2) Methyl red test

Organism



```
graph TD; Organism[Organism] --> Glucose[Glucose]; Glucose --> Acid[Large amount of Mixed acid<br/>(Acetic, lactic, & succinic)]; Acid --> Indicator[Methyl red indicator]; Indicator --> LowPH[Low pH<br/><4]; Indicator --> HighPH[high pH<br/>6];
```

The diagram illustrates the Methyl red test process. It begins with an 'Organism' box, which has a right-pointing arrow leading to a 'Glucose' box. From the 'Glucose' box, a downward-pointing arrow leads to the text 'Large amount of Mixed acid (Acetic, lactic, & succinic)'. Below this text is a box labeled 'Methyl red indicator'. From this indicator box, two arrows branch out: one to the left pointing to a red box containing '<4' under the label 'Low pH', and one to the right pointing to a yellow box containing '6' under the label 'high pH'.

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)**

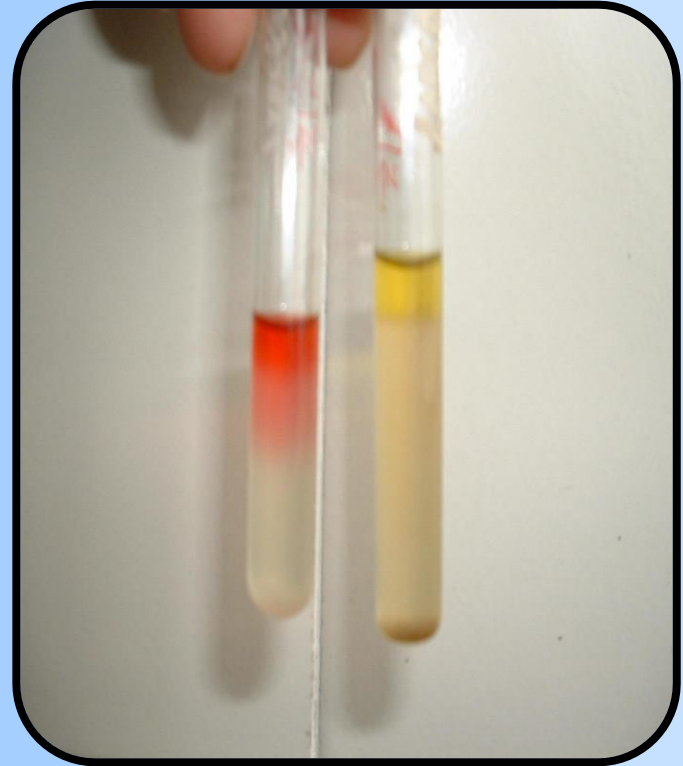
Incubate at 37°C for 48h

(Large Acid) Mixed

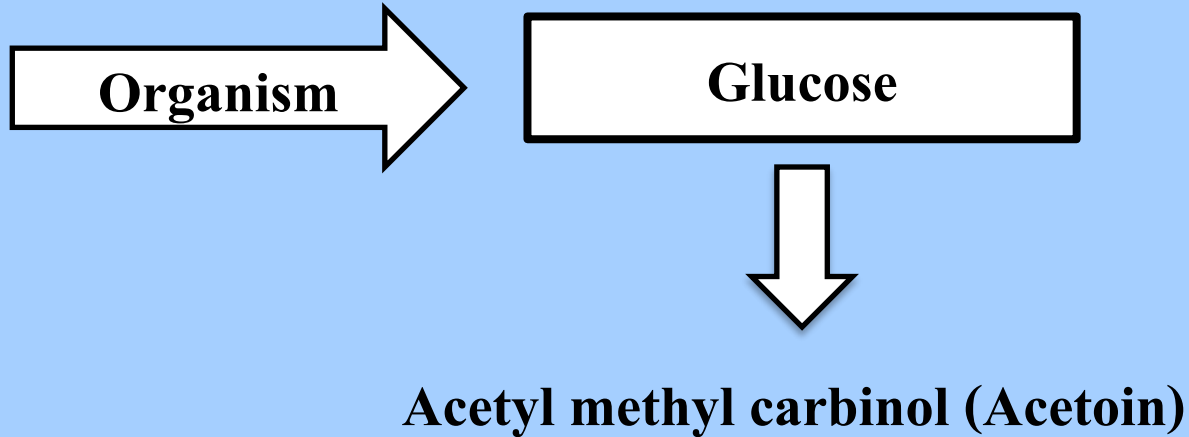
pH



MR indicator



3) Voges-Proskauer test (V.P)



3) Voges-Proskauer test (V.P)

Bacteria

**Peptone
(Glucose)**

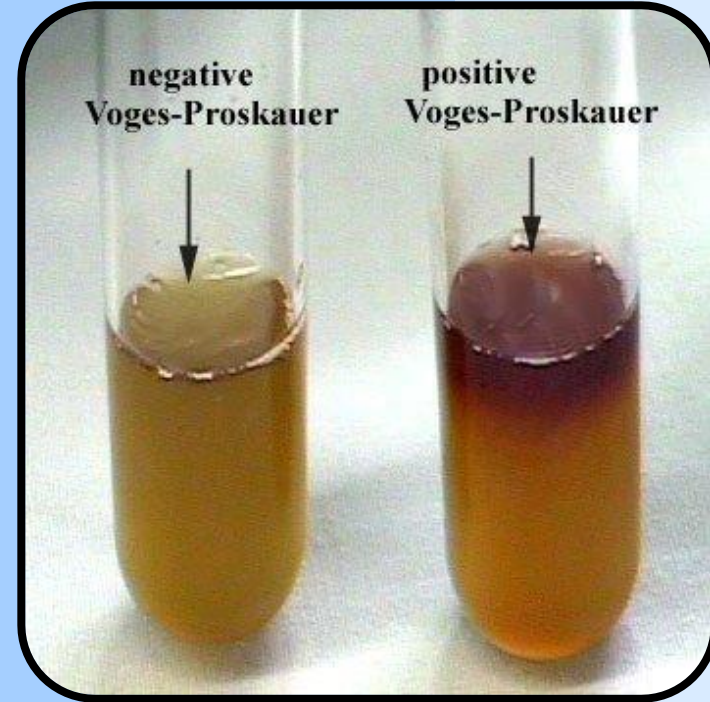
Incubate at 37°C for 48h

Ferment glucose (Acetyl methyl carbinol)

α -naphthol + 40% KOH

Diacetyl

Red



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 indecator

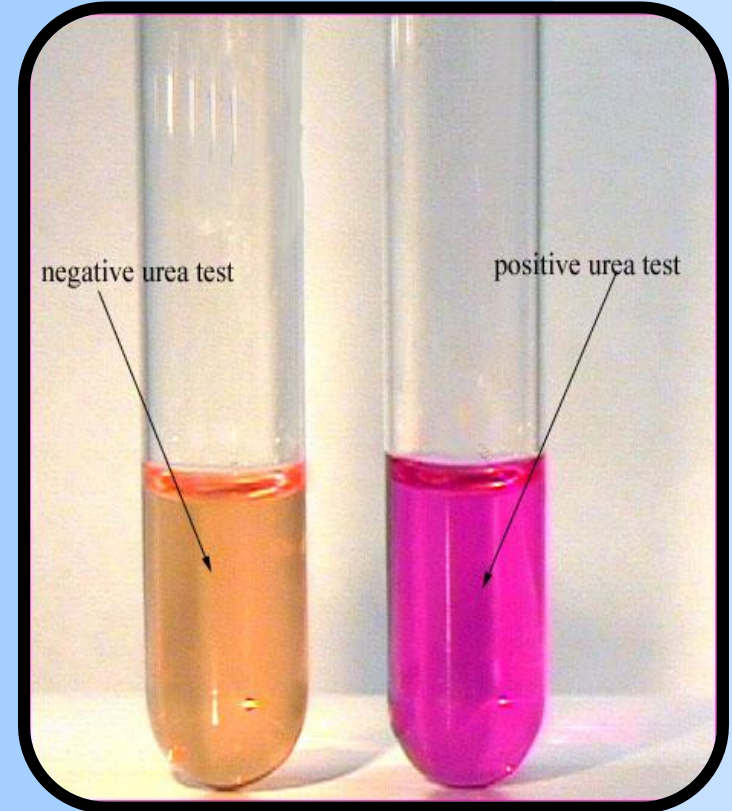
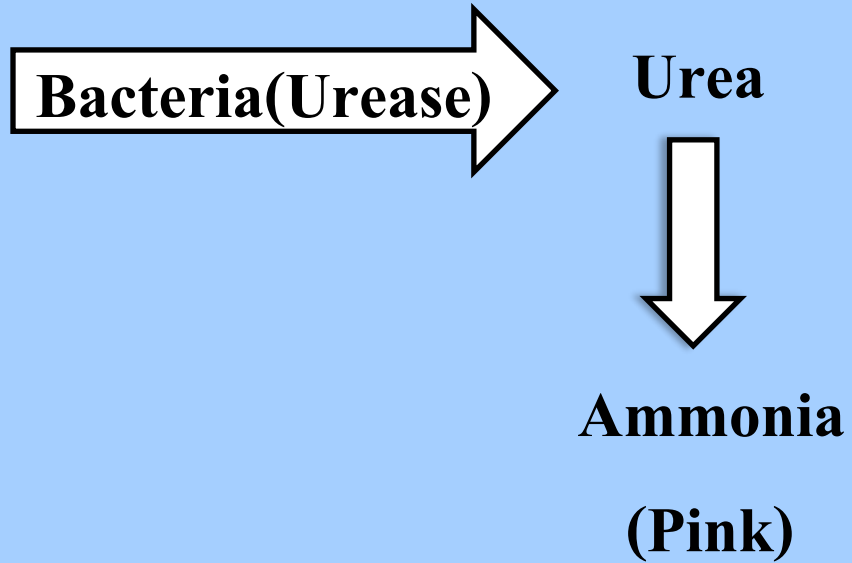
Acid

6

Alkaline

8

5) Urease test



6) TSI

0.1% glucose

1% lactose

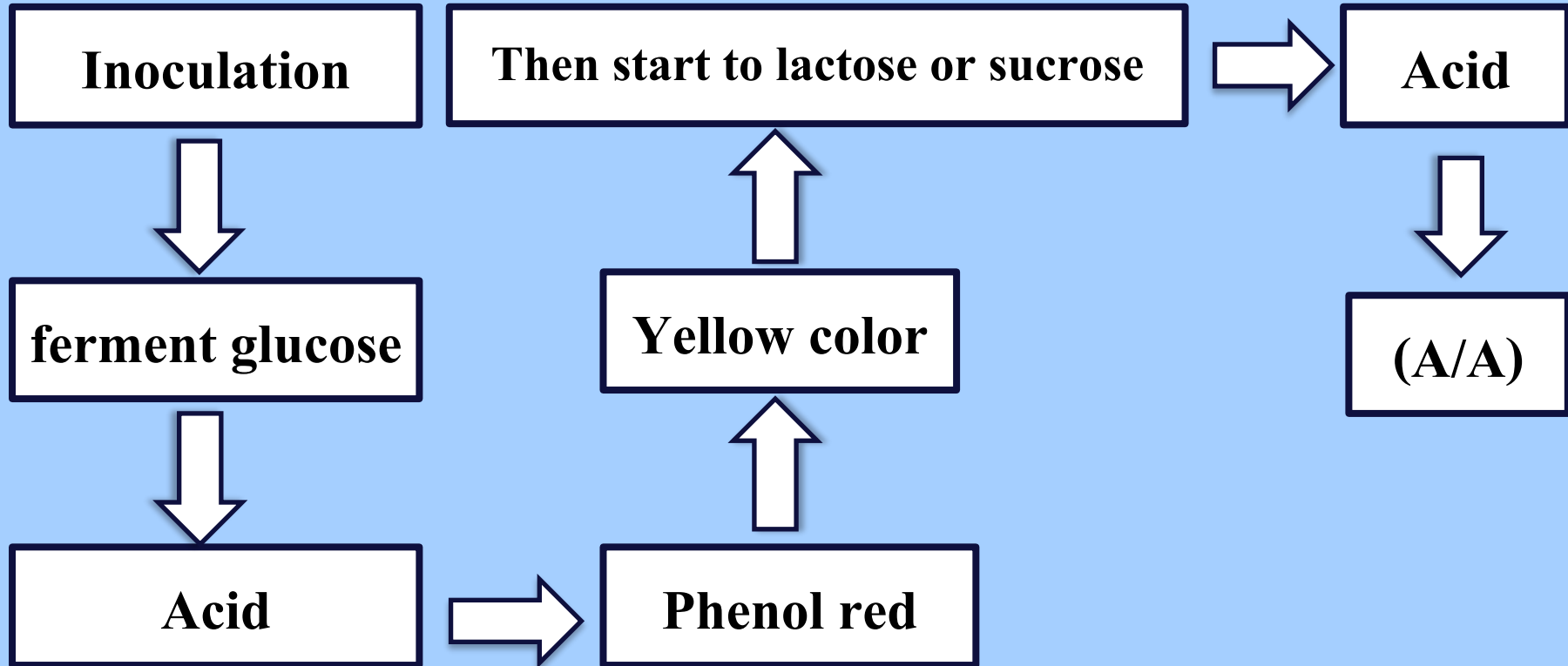
1% sucrose

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.**

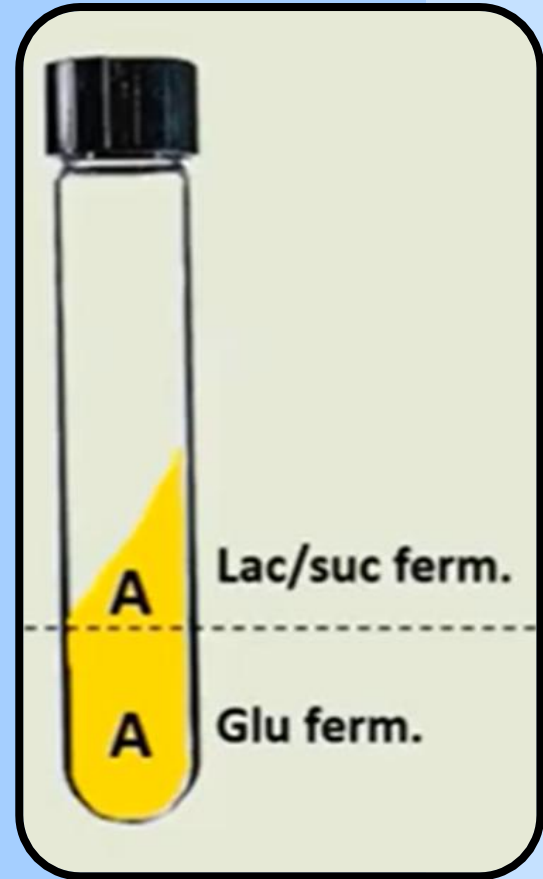


a) Acid over acid (A/A)

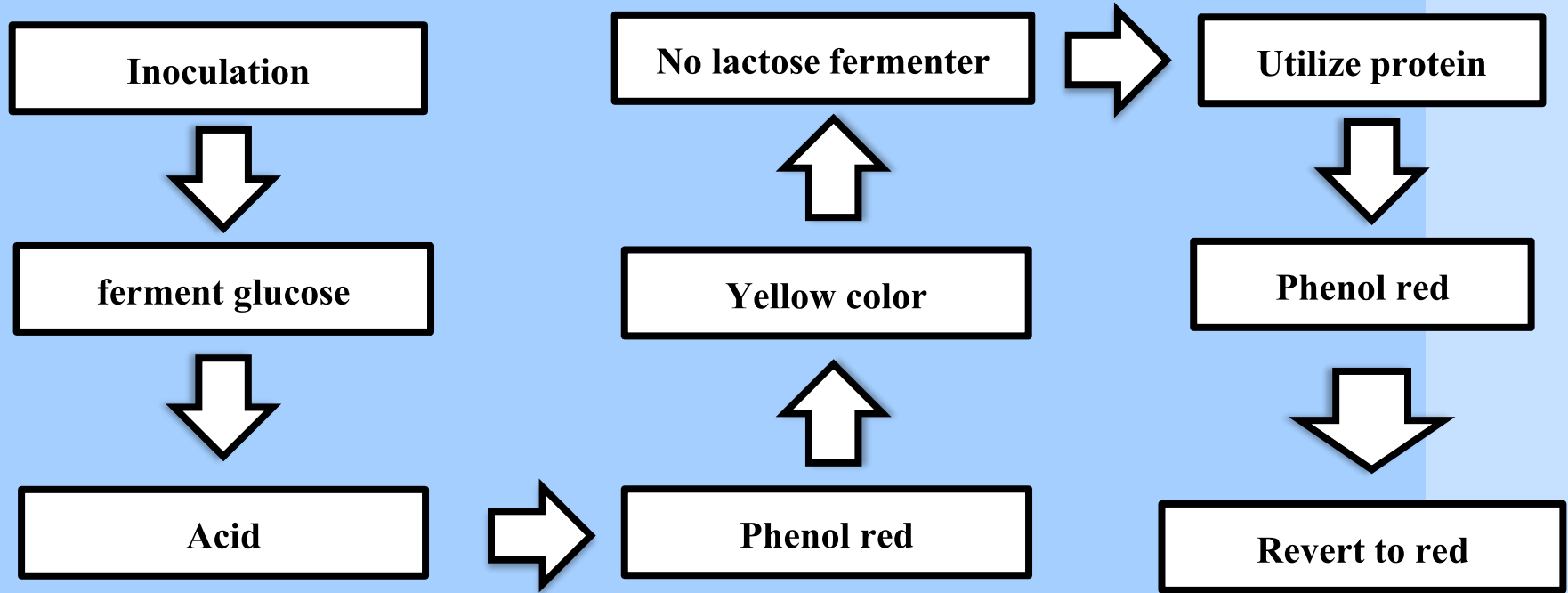
A/A

Glucose fermenter

Lactose fermenter



b) Alkaline over acid (K/A)



a) Alkaline over acid (K/A)

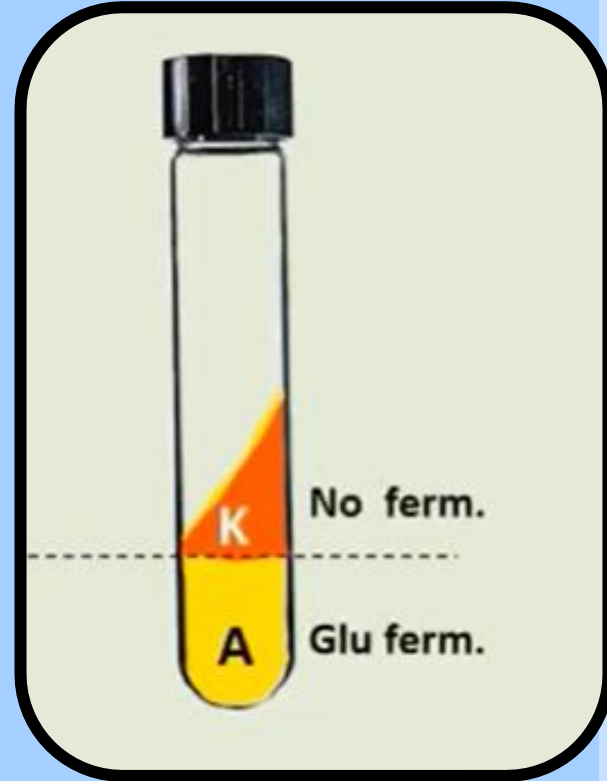


a) Alkaline over Alkaline (K/A)

K/A

Glucose fermenter

Non-lactose fermenter



a) Alkaline over Alkaline (K/K)

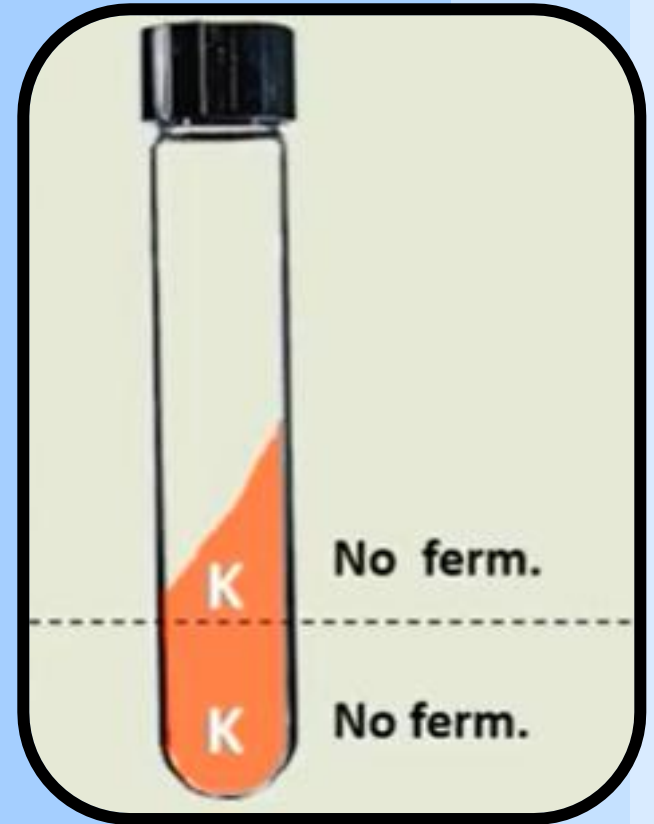
**If the organism can not use the glucose
in the medium. The color of the
medium remains red.**



a) Alkaline over Alkaline (K/K)

K/K

No sugar fermenter



H₂S production

Bacteria (Reduce)

Sulfur

Hydrogen sulfide
(H₂S)

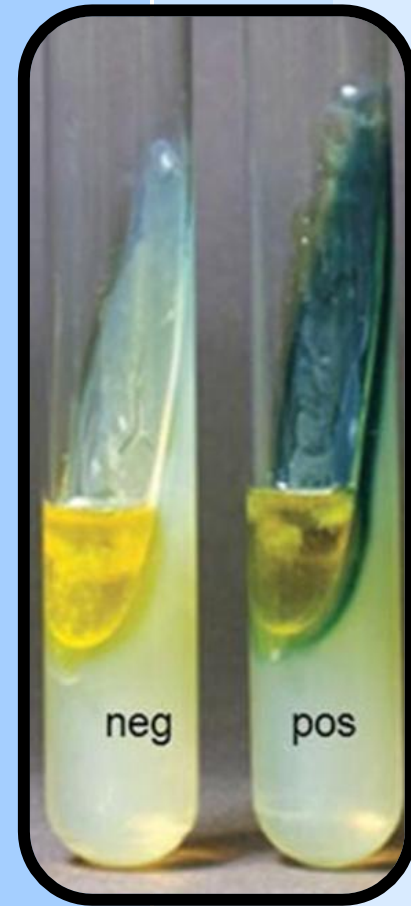
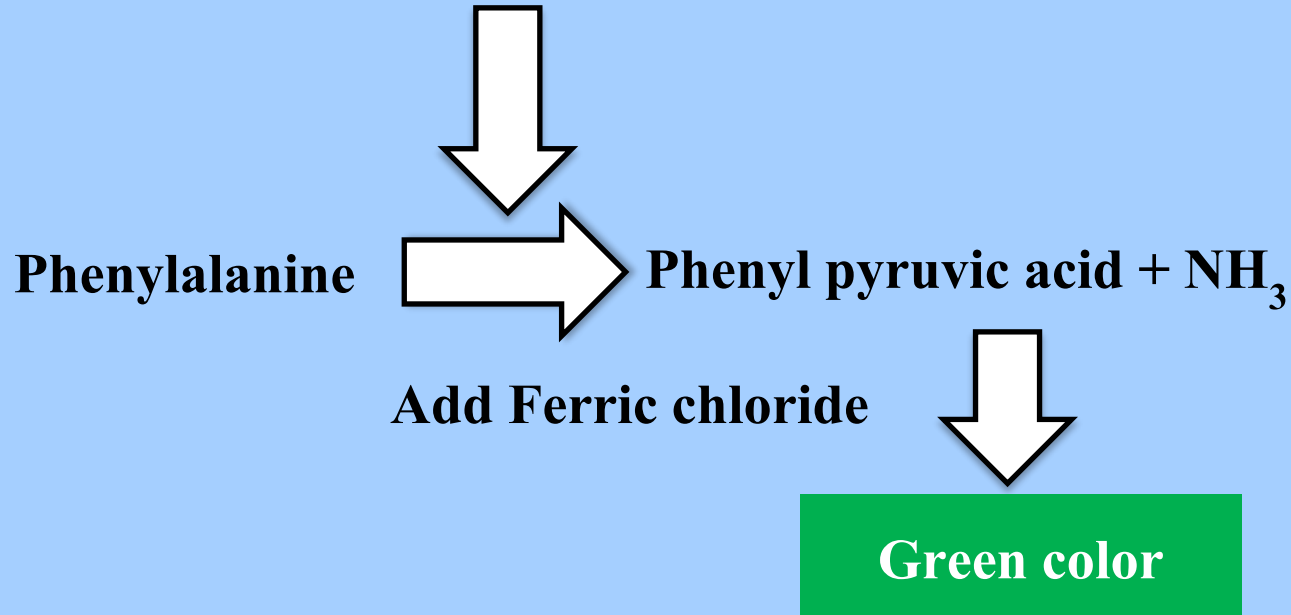
iron

Ferric sulfide
(Black)



7) Phenylalanine deaminase

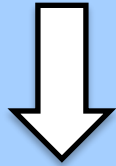
Phenylalanine deaminase



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

8) Ornithine decarboxylase

Ornithine decarboxylase

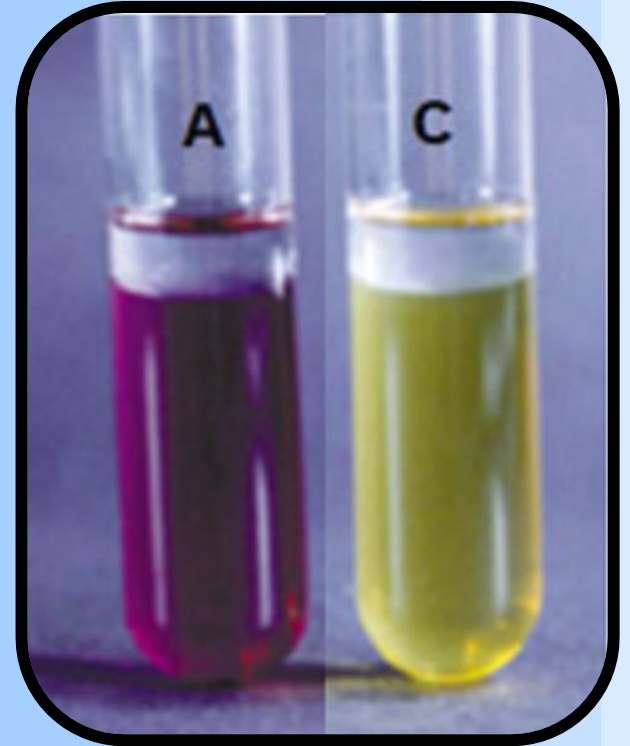


Ornithine

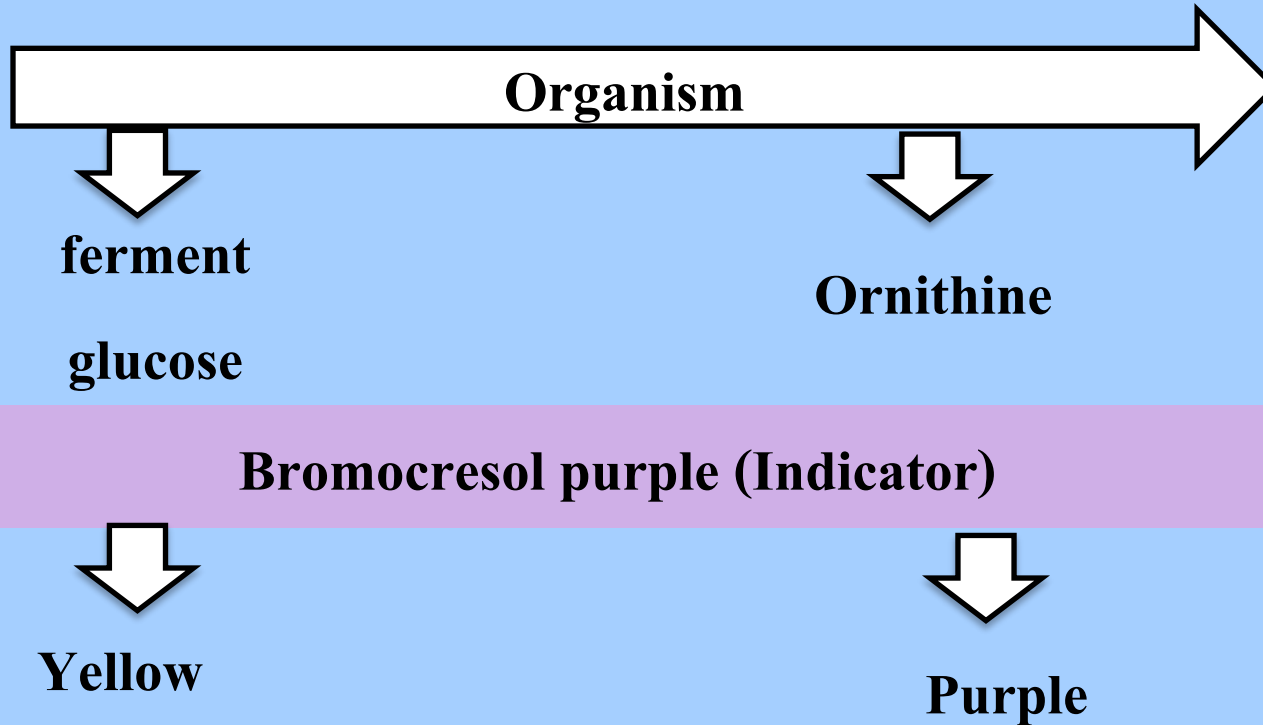
Source of carbon (energy for growth)

Providencia rettgeri & *Morganella morganii* (+ve)

P. rettgeri & *M. morganii*



8) Ornithine decarboxylase



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

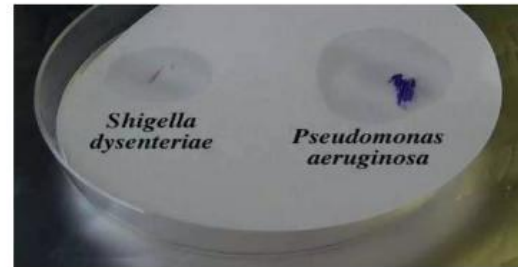


Oxidase test

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

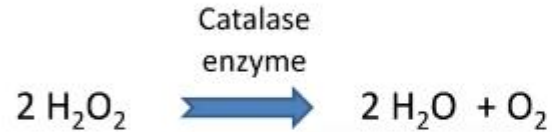
Some bacteria produce catalase enzyme

Addition of H_2O_2 lead to production of gas bubbles (O_2 production)

- Catalase test:

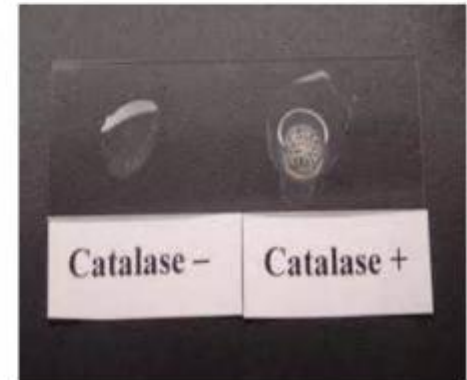
- Is used to differentiate between staphylococci(catalase +ve) and streptococci(catalase -ve).

- 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)

