

Classification of genus *Staphylococcus*

1-According to pigment produced by microorganism

S. aureus.....golden yellow

S. citrus.....yellow pigment

S. albuswhite pigment

This classification is old and failed because there is no strict demarcation between species where *S. aureus* may give white colonies

2-According to the pathogenicity of the species

Mostly pathogenic (*S. aureus*)

Cause disease in many organs invade it as osteomyelitis .Pneumonia, food poisoning within 6 hours

Moderate pathogenic; (*S.epidermidis*)

Universal skin pathogen and cause human acnes

Less pathogenic : (*S. saprophaticus*)

Cause urinary tract infection (pylonephritis, cystitis....).

Differential diagnosis between 3 species

	<i>S. aureus</i>	<i>S. epidermidis</i>	<i>S. saprophaticus</i>
1-Coagulase -free -bound	+ +	- -	- -
2-Mannitol fermentation	+	-	Or different-
3-Tellurite reduction	+	-	-
4-Phosphatase test	+	+	-
5-Hemolysis of blood agar	+	-	-
6-cell wall composition -SPA	+	-	-
- Novobiocin sensitivity	S	S	R

S. aureus

General character:

Pathogenicity in human

The most common pyogenic organism

May cause abscess, pyemia or septicemia depending individual immunity-pneumonia –conjunctivitis- pylonephritis- osteomyelitis-endocarditis – food poisoning within 6 hours-TSS (Toxic shock syndrome)-nosocomial infection.

-50% of normal individuals *S. aureus* present in the nose

Morphology

1- Gram positive

- 2- Cocci arranged either (grape like cluster)
- 3- Non motile organism-non sporulating.
- 4- Capsulated or not.

Culture character

Facultative anaerobic- optimum temp.37°C

Produce golden yellow colonies

In broth media ; uniform turbidity

On blood agar; hemolysis

Selective media

- Mannitol salt agar (salt7.5%)
- Phenol ethyl alcohol agar (PEAagar)

"highly selective in case of highly contaminated samples as intestinal sample".

Biochemical reaction

1-Catalase test positive

2- Coagulase test positive

3- Mannitol fermentation.

Resistant character

- 1- Resist dryness for a month.
- 2- Highly sensitive to gentian violet so, it used for selective isolation in case of mastitis.

Virulence markers

- 1- Cell surface of protein help adherence between *S. aureus* and host cell
- 2- Capsules and protein A (antiphagocytosis)
- 3- Extracellular product
 - Toxins

Leucocidins

Kill leucocytes, macrophage, pleomorph cells

Heamolysin

Cause lysis of RBCs

Enterotoxins

Produced by 30-50% of staphylococcus

Caused food poisoning

Resist boiling and digestive enzyme (trypsin ,pepsin)

Symptoms appear after 6-8 hours as diarrhea and vomiting

Exfoliatin or epidermolytic toxin

Causes lysis of epidermis leading to vesicle formation due to separation of epidermis from subcutaneous tissues

If the area of vesicle become complete separation from the subcutaneous tissue it known as ritter's disease

After separation of epidermis from the subcutaneous tissue the fluid content of the vesicle will dried so it known as Staphylococcus scalded skin syndrome (ssssyndrome).

Toxic shock syndrome (Tss)

Systemic disturbance as heart failure, lower blood pressure with diarrhea and vomiting

This condition is common in young women using tampon.

-Enzyme

Hyaluridase

Known as spreading factor

It cause lysis of the cement substance between cells helping spreading of infection.

Coagulase

Marker of pathogenic strains

Cause coagulation of plasma

Its two types free and bound coagulase lead to deposit of fibrin around the microorganism ,so inhibit the ability of phagocytic cell to engulf it.

Staphylokinase (fibrinolysin)

Cause lysis of fibrin

Used for treatment of recent thrombi in the first 5 hrs after thrombus formation

DNase

Cause digestion of DNA leading to impairment the biological function of the leukocytes and polymorph cells

Detection:

Using DNA agar media commercially prepared (straw yellow colour)

If DNase positive –digest DNA surrounding the colony and this is confirmed by flooding the plate with diluted HCL which cause precipitation of undigested DNA.

So DNase positive..is clear zone appear around the colony

Phosphatase

Cause digestion of phosphate

Detected by phenol phthaline phosphate agar

Some non pathogenic strains are phosphatase test positive.

Pencillinase (β -lactamase)

Cause inactivation of penicillin

75% of this strain are resistance to penicillin.

Called β -lactamase because of the destruction of β –lactam ring of the penicillin.

Laboratory diagnosis

1- Sampling

According to the site of infection

e.g. Blood in cause of pyemia and septicemia

Abcess- pus....

2- Film preparation (direct microscopic examination)

See morphology

3- Cultivation

See culture character

4- Biochemical identification

5- Commercial kits

Using depending on SPA

6- Bacteriophage typing

Bacteriophage are group of virus attacking staph. Due the high specific relation between the virus and the bacteria causing lysis of the colony.

There are 24 bacteriophage.

Uses of bacteriophage

1-used in epidemic causes such as food poisoning .

2-not important in lab. Diagnosis.

Method :

1- Using glass plate after bottom with 24 squares

2- Cultivatr staph on the plate colony

3- Add drop of the bacteriophage of each type on the specific square

4- Then observe lysis after 24 hrs.