

General Characteristics of Staphylococcus:

- 1- The staphylococci are gram-positive cocci, spherical cells, usually arranged in grape-like irregular clusters, Single cocci, pairs, tetrads, and chains.
- 2- Staphylococci are non-motile and do not form spores.
- 3- Oxidase negative and Catalase positive which differentiates them from the streptococci.

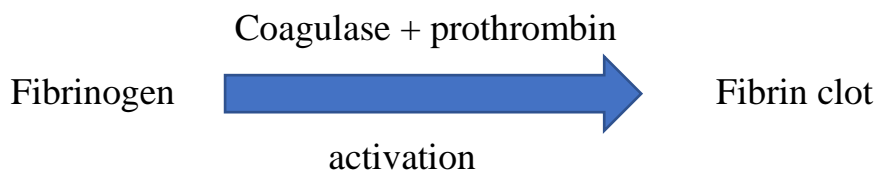
Micrococcus species often resemble staphylococci. They are found free-living in the environment and form regular packets of four or eight cocci. Their colonies can be yellow, red, or orange.

Pathogenesis:

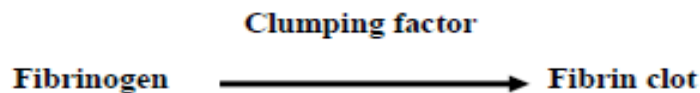
- S. epidermidis*: may be etiological agent for skin lesion and endocarditis.
- S. saprophyticus*: has been implicated in some urinary tract infection (UTI).
- S. aureus*: are often causes differet diseases: Skin infection, Abscess formation (pus-producing lesion), Boils, acne and impetigo, bacteremia, sepsis, endocarditis, meningitis osteomyelitis and cystitis. Enteritis due to enterotoxins contamination of food. Toxic shock syndrome.

Enzymes and Toxins:

- Catalase.**
- Coagulase and Clumping factor:** *S aureus* produces coagulase, an enzyme-like protein that clots oxalated or citrated plasma. Coagulase binds to prothrombin; together they become enzymatically active and initiate fibrin polymerization. Coagulase may deposit fibrin on the surface of staphylococci, perhaps altering their ingestion by phagocytic cells or their destruction within such cells.



Clumping factor: is a surface *S aureus* compound that is responsible for adherence of the organisms to fibrinogen and fibrin. When mixed with plasma, *S aureus* forms clumps.



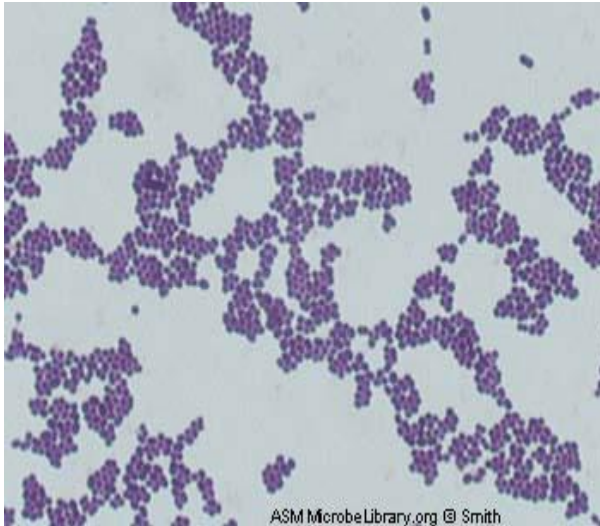
- Nuclease (DNase):** extracellular enzyme which hydrolyse DNA or RNA to nucleotides which dissolve in acid. The enzyme act on phosphodiester bonds. DNase enzyme is medically important specially for *S. epidermidis* because it determines the pathogenicity of the strain. All strain of *S. aureus* produce DNase.
- Hyaluronidase, or spreading factor.
- Staphylokinase
- Proteinases: (gelatinase)
- Lipases.
- β -lactamase:** which cause cleavage of β -lactam ring in the β -lactam antibiotics.
- Haemolysin:** lysis of RBCs.
- Lecocidin:** lysis of WBCs.
- Enterotoxin:** causes enteritis and food poisoning.
- Toxic Shock syndrome toxin and Exfoliative toxin**

Specimens: Surface swab pus, blood, stool, sputum or tracheal aspirate, or spinal fluid for culture, depending upon the localization of the process.

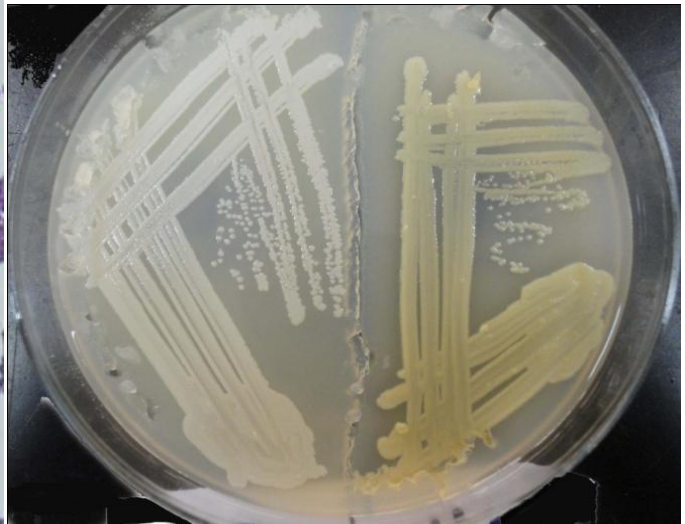
Laboratory diagnostic tests:

1. **Gram stain** (gram-positive cocci grape-like irregular clusters)
2. **Blood agar** (**for haemolysis**)
3. **Milk agar** (**for pigments production**)
4. **Staph 110** (selective media because it contains 7.5% NaCl).
5. **Mannitol salt agar** (**selective and differential media**) *selective* because it contains 7.5% NaCl. *Differential* because it contains **mannitol sugar and phenol red as pH indicator** which differentiated between mannitol fermented Staphylococci e.g. *S. aureus* and mannitol non-fermented e.g. *S. epidermidis*.
6. **Gelatin liquefaction test**
7. **Catalase & Oxidase test**
8. **Coagulase test:** Citrated rabbit (or human) plasma diluted 1:5 is mixed with an equal volume of broth culture or growth from colonies on agar and incubated at 37 °C. A tube of plasma mixed with sterile broth is included as a control. If clots form in 1–4 hours, the test is positive.
9. **DNase test:** Heavily spot-inoculate DNase agar plate with Staphylococci bacteria over a 0.5-cm area, Incubate for 18 to 24 hours at 35°C. Then flood the DNase test agar plate with 1 N HCl. A zone of clearing around the colony indicates a positive DNase test. This clearing occurs because the large DNA molecule has been degraded the enzyme, and the end products dissolve in the added acid.

Test	<i>S. aureus</i>	<i>S. epidermidis</i>	<i>S. saprophyticus</i>
Pigment	Yellow, Golden	White	White, Light yellow
Coagulase	+	-	-
DNase	+	-/weak	-
Haemolysis	β	-/weak	-
Catalase	+	+	+
Mannitol salt agar fermentation	+	-	+/-
Staph 110	+	+	+



Staphylococcus Gr+ve cocci
grape-like irregular clusters



Pigments production on Milk agar



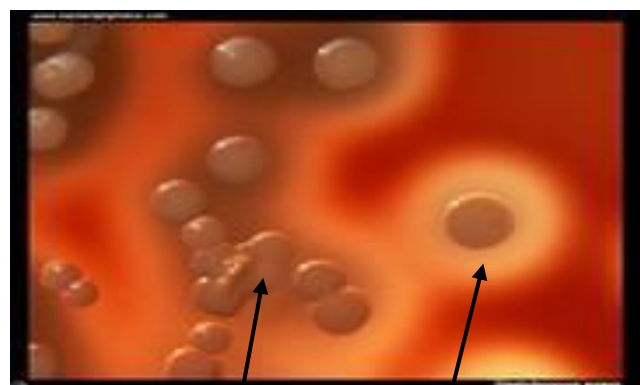
S. epidermidis & *S. aureus* on
Mannitol salt agar



S. aureus on Mannitol salt agar



(α , β and γ) Haemolysis on Blood agar



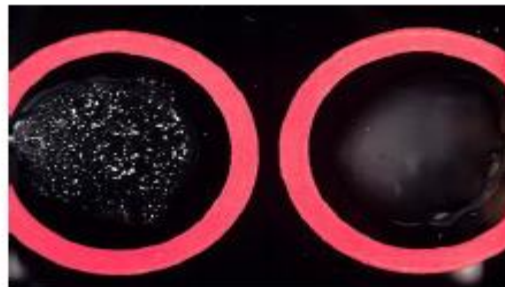
α - Haemolysis β -Haemolysis



Coagulase Test (tube test)



Positive Coagulase Test

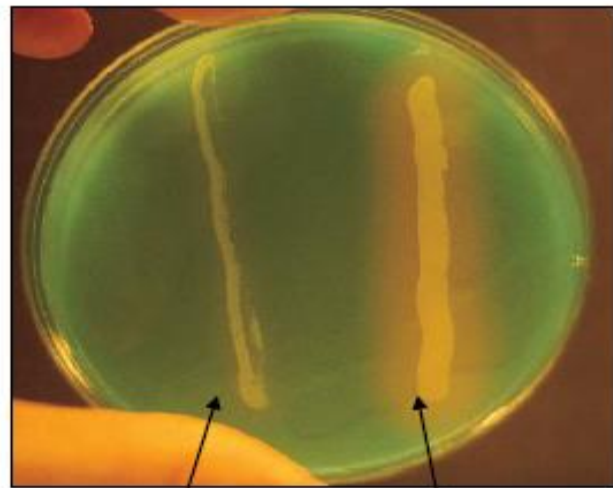


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Clumping factor



DNase Test



S. epidermidis *S. aureus*
DNase Test