Streptococcus:-

They are spherical, gram-positive cocci arrange in long or short chain, also form pairs diplococcic (Streptococcus pneumoniae) lancet shape (head to head) due to cell division in one plane only. They are non-motile, non-spore forming, catalase negative help to distinguish them from Staphylococcus. Some species are encapsulated. Streptococcus spp. are mostly residents of mouth and throat and may act as opportunistic pathogens and few spp. (Streptococcus pyogenes and Streptococcus agalactiae) as primary pathogen.

Enterococcus spp. were formerly classified in the genus Streptococcus e.g. Streptococcus faecalis (Enterococcus faecalis) but DNA-rRNA homology studies show that they differ from Streptococcus.

Classification:-

1- Serological grouping:

The most reliable classification of Streptococcus is Lancefield which is classify Streptococcus in serological groups (A-H) (K-U) according to the cell wall antigenic polysaccharide and other capsular antigen

- group A  ➔  Streptococcus pyogenes
- group B  ➔  Streptococcus agalactiae
- group D  ➔  Enterococcus faecalis
In *Streptococcus pneumoniae*, because it is surface carbohydrate antigens do not correspond to specific Lancefield group, it is discussed separately.

2- According to hemolytic activity on blood agar:

Alpha-hemolysis → *Streptococcus pneumoniae*, viridance *Streptococcus*

Beta-hemolysis → *Streptococcus pyogenes*, *Streptococcus agalactiae*

Gamma-hemolysis → *Enterococcus faecalis*

**Culture characters:-**

It is a best grow on nutrient agar with blood or serum so it called fastidious. The colony of *Streptococcus* on blood agar as discoid 1-2mm in diameter (like head of pin) most strains are facultative anaerobic and few are obligate anaerobic.
Optimum temperature 37°C range 22-42°C except *Enterococcus faecalis* that can grow between 15-45°C and grow in 6.5% NaCl.

**Biochemical tests:**

1- Hemolysis test:-

One of the most important c.c.c. for identification of *Streptococcus* is the type of hemolysis (alpha, beta, and gamma).

2- Bile solubility test:-

This test is used to identify *Streptococcus pneumoniae* from other spp.

a- Plate method:-

Place a drop of 2% sodium deoxy cholate on some colonies and reincubation at 37°C, the colonies will disappear within 30min.

b- Tube method:-

Add a drop of 10% sodium deoxy cholate to broth culture and reincubation at 37°C, the colonies will lysis within 15min.
3- Sensitivity to Bacitracin and Optochin:-

Each disk of drug is placed on blood agar and incubate with *Streptococcus* after incubation, an inhibition surrounding the growth indicate positive result.

optochin disk  
bacitracin disk

4- Growth on 6.5% NaCl:-

All enterococci can be able to tolerate and grow in high concentration of sodium chloride (6.5%). Incubate nutrient broth containing 6.5% NaCl and incubate for 72hr. after that, turbidity of the medium indicate the growth of organism.
Positive=growth and cloudy broth ; Negative = no growth and clear

**Differential reaction of Streptococcus spp.**

<table>
<thead>
<tr>
<th>Streptococcus spp</th>
<th>hemolysis</th>
<th>Bacitracin solibility</th>
<th>6.5% NaCl</th>
<th>optochin</th>
<th>CAMP</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>St. pyogenes</em></td>
<td>beta</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>St. agalactiae</em></td>
<td>beta</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><em>En. faecalis</em></td>
<td>gamma</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Viridans <em>St.</em></td>
<td>alpha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>St. pneumoniae</em></td>
<td>alpha</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Serological test (ASO test):-**

Antistreptolysin O (ASO) is antibody that appear in human following infection with *Streptococcus* that produce streptolysin O. This antibody blockes hemolysis by streptolysin O(SLO).

This test is used to detection of *St. pyogenes* antigen. Prepare a serial dilution of patient serum in normal saline. An 0.5 ml of SLO antigen is added to each tube of serum dilution and incubated at 37°C for 15min. The titer of ASO above 1:200 indicate positive result.