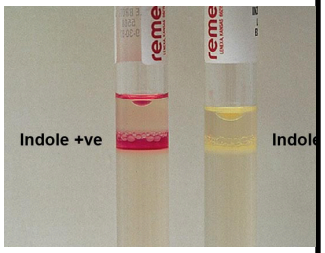
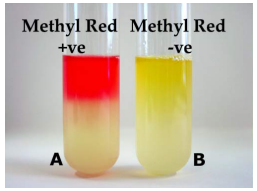
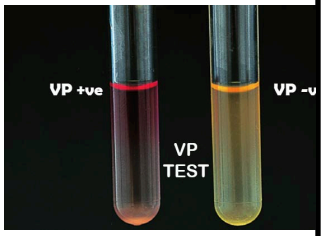
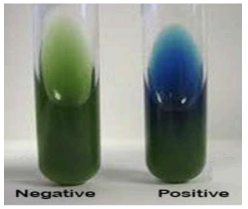
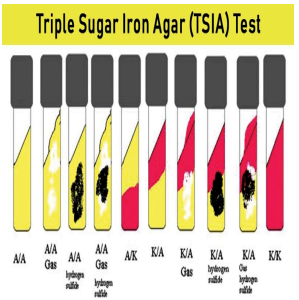
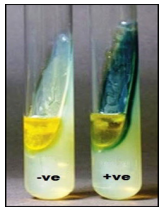
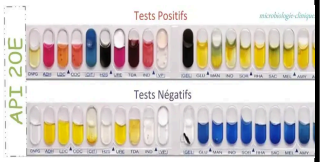
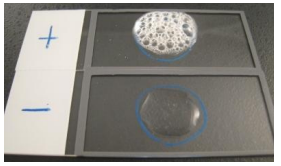
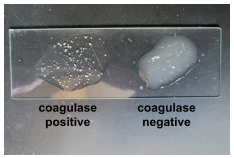
Biochemical Test	Mechanism	+	-	Picture
1) Indole test	Culture of bacteria is inoculated into a medium containing tryptophan + peptone. If the bacteria has tryptophanase, it will break down tryptophan and produce indole. We add a reagent called Kovac's Reagent and observe the color change (if any) to determine whether or not this bacteria has tryptophanase.	Red/pink: indicates indole production	No color: indicates no indole production	
2) Methyl red	Medium contains glucose + peptone, and we test the bacteria's ability to ferment this glucose by using a methyl red indicator. If the bacteria can ferment glucose, it would produce a large amount of mixed acids (acetic, lactic, and succinic), which lead to a decrease in pH.	Red: low pH (<4) indicates that the bacteria possesses the ability to ferment glucose	Yellow: high pH (5.5-6) indicates that the bacteria does not have this ability	
3) Voges-Proskauer	Peptone & glucose-containing medium to test if the organism can ferment the glucose and produce acetyl methyl carbinol (Acetoin). Incubate then add alpha naphthol indicator + 40% KOH, which produces diacetyl, turning the solution red. **NOTE:** bacteria with a + methyl red has a - VP, and vice versa. VP product (acetoin) is less acidic than methyl red products (acetic/succinic/lactic acids).	Red: indicates that diacetyl is present & that bacteria can ferment glucose to acetoin.	No color change (remains yellow or brown solution); the bacteria does not have the ability to convert glucose to acetoin.	
4) Citrate utilization	Bacteria on a medium that contains sodium citrate, which is the sole carbon source. If the bacteria contains citrase and can therefore utilize citrate, it will turn it into pyruvate and alkaline byproducts such as sodium carbonate. Sodium carbonate forms from the liberated CO2 and sodium mixing together. The increase in pH causes the bromothymol blue (indicator) to turn blue.	Blue (alkaline): bacteria can utilize citrate.	Green (neutral): no color change; bacteria cannot utilize citrate.	
5) Urease test	Bacteria is inoculated into a urea-containing medium. If the bacteria produces urease, it will hydrolyze into ammonia and carbon dioxide. Ammonia production is alkaline. Increase in pH makes the phenol red (indicator) turn pink.	Pink (alkaline): bacteria can produce urease/hydrolyze urea.	Yellow (neutral/acidic): no urease activity.	

6) TSI	The Triple Sugar Iron test is used to identify and differentiate bacteria based on their carbohydrate fermentation and H_2S production. The agar contains glucose (0.1%), lactose (1%), and sucrose (1%), as well as ferrous sulfate. We use an inoculating needle to stab the TSI tube and streak the slant surface. The "butt"/bottom is the anaerobic environment, and the slant represents the aerobic environment. The tube is incubated for 18-24 hours to allow for fermentation and H_2S production. If the bacteria **ferments glucose**, acid production lowers the pH, turning the medium **yellow** (indicator: phenol red). If the bacteria can also ferment **lactose/sucrose**, the medium will turn **yellow** due to the decrease of pH (acid production). If **H_2S** is produced, a **black** precipitate will form. If a **break, or bubbles** appear, that signifies the bacteria's production of **gas**.	A/A Yellow on yellow Bacteria can ferment both sucrose/lactose and glucose K/A Red streak & yellow butt Bacteria can ferment glucose but no sucrose/lactose K/K Red on red Bacteria cannot ferment neither glucose nor sucrose/lactose.	Black Signifies the presence of ferric sulfide which is the product of H_2S reacting with iron (from the medium) Breaks or bubbles Bacteria is capable of producing gas	
7) Phenylalanine deaminase	Tests whether bacteria can produce phenylalanine deaminase, which catalyzes the deamination of phenylalanine to produce phenylpyruvic acid and ammonia. The agar plate where the inoculation occurred is incubated. Then, ferric chloride is added. If phenylalanine deaminase is present, it will catalyze the formation of phenyl pyruvic and ammonia, producing a green color.	Green *Proteus* The bacteria is phenylalanine deaminase positive.	Yellow (no change) *Salmonella/Shigella* The bacteria is phenylalanine deaminase negative.	
8) Ornithine decarboxylase	Ornithine is used as the source of carbon in this test. Glucose is also in the medium to provide an anaerobic environment. If the bacteria can ferment glucose, it will produce acids which will lower the pH, and turn yellow (*P. rettgeri)*. In this acidic environment, ornithine decarboxylase is expressed (if available). This enzyme converts ornithine into CO2 and other alkaline byproducts, increasing the pH and changing the medium color to purple (*M. morganii)*. Indicator is bromocresol purple.	Purple *M. morganii* Gram +	Yellow *P. rettgeri* Gram -	
9) API	Has strips that contain 20 small wells/microtubes filled with different substrates. Each well = biochemical test. It allows for the simultaneous testing of multiple biochemical reactions. Color changes recorded after 24 hours helps us identify the bacteria type. Ex. used to further identify the species of a certain genus to which a bacterium belongs.			

10) Oxidase	Some bacteria produce oxidase enzymes. We can detect this by adding a few drops of colorless oxidase reagent. If the colonies turn deep purple in color, they are oxidase positive (*Pseudomonas)*. If no color change occurs, the bacteria is oxidase negative (*Enterobacteriaceae)*.	Deep purple: oxidase + *Pseudomonas*	No color: oxidase - *Enterobacteriaceae*	
11) Catalase	Some bacteria produce catalase. This can be detected by the addition of hydrogen production. If it leads to gas bubble formation (O2), this signifies that we have *staphylococci*. If not, this bacteria is *streptococci.*	Bubble formation: Catalase + *Staphylococci*	No bubble formation: Catalse - *Streptococci*	
12) Coagulase	This test is used to distinguish *S. aureus* from the rest of the *Staphylococci* family. Some bacteria produce coagulase. This enzyme converts fibrinogen to fibrin (plasma clot).	Fibrin clot *S. aureus*	No clot formed Not *S. aureus*	

اللهم إني أستودعك ما قرأت وما حفظت، وما تعلمت، فرده عند حاجتي إليه، إنك على كل شيء قدير، حسبنا الله ونعم الوكيل.

يارب كن مع أهلنا في غزة واكلأهم برعايتك وحفظك ومعيّتك، يارب ليس لهم إلا أنت، أنت رب المستضعفين القادر على كل شيء، نجّهم من كل سوء يارب والطف بهم.

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