Bacterial Physiology: Culture Media

What is Culture Media?

Culture media is a gel or liquid that contains nutrients and is used to grow bacteria or microorganisms in a laboratory. They are also termed growth media. Different cell types are grown in various types of medium.

What Types of Culture Media?

The culture media are classified in many different ways:

1. **Based on the physical state**
   - Liquid media
   - Solid media
   - Semisolid media
2. **Based on the presence or absence of oxygen**
   - Anaerobic media
   - Aerobic media
3. **Based on nutritional factors**
   - Simple media
   - Synthetic media
   - Complex media
   - Special media

Simple Media

Simple culture media includes nutrient broth. One percent of meat extract and peptone water make up such broth. Nutrient broth becomes glucose broth when glucose is added to it. Likewise, it becomes nutrient agar when 2-3% agar is added. For diagnostic purposes, this is the simplest and most common medium used in laboratories. A semisolid medium that permits the propagation of motile bacteria can be produced by decreasing the concentration of agar—examples include peptone water, nutrient agar, and glucose broth.

Complex Media

Apart from simple media, all forms of media are collectively referred to as complex media. Complex media contain additional components that bring out specific qualities or provide the unique nutrients needed for the bacterium's growth—examples include MacConkey agar medium, chocolate agar, and blood agar.

Synthetic Media

A synthetic medium is a defined medium. A defined medium, also known as a chemically defined medium, is a medium in which no yeast, plant, or animal tissue is present, and all the chemicals used are known. These are made from only pure ingredients whose exact composition is known.

Special Media

♦ **Below is a list of standard selective media and the bacteria they're used to culture:**

- **Basal media:** These are routinely used simple media that contain carbon and nitrogen sources, which enhance the growth of many microorganisms.

  They are also known as general-purpose media and are considered non-selective media. The basal media do not require enrichment sources for the growth of non-fastidious bacteria and are suitable for growing ***Staphylococcus*** and ***Enterobacteriaceae***.

  They are generally used to isolate microorganisms in labs or sub-culturing processes. Examples are **nutrient broth**, **nutrient agar**, and **peptone water**.

- **Enriched media:** This type of media is prepared by adding additional substances, such as blood, serum, or egg yolk, to the basal medium. It's used to grow fastidious microorganisms as they require additional nutrients and growth-promoting substances.

  Examples are **chocolate agar**, **blood agar**, and **Loeffler's serum slope**.

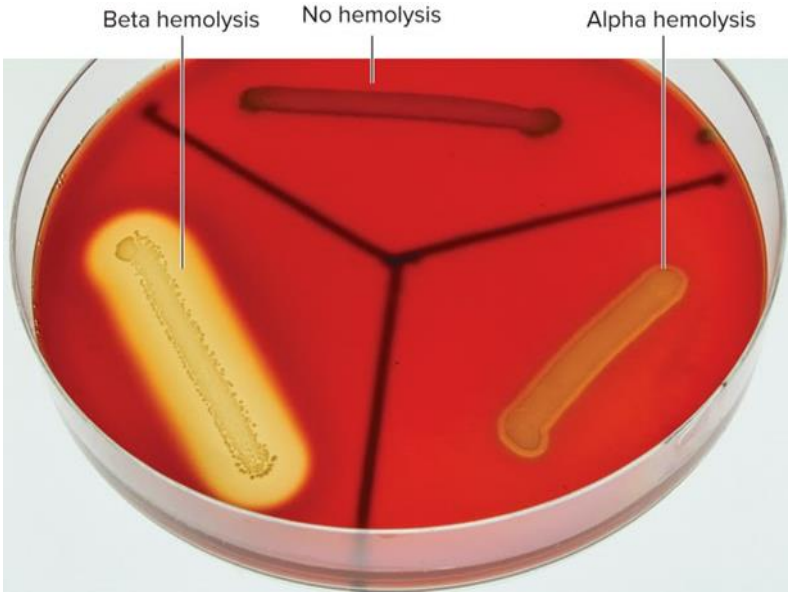
Chocolate media is used to grow ***N. gonorrhoeae,*** while blood agar (prepared by adding 5-10% blood by volume to a blood agar base) is used to identify hemolytic bacteria.



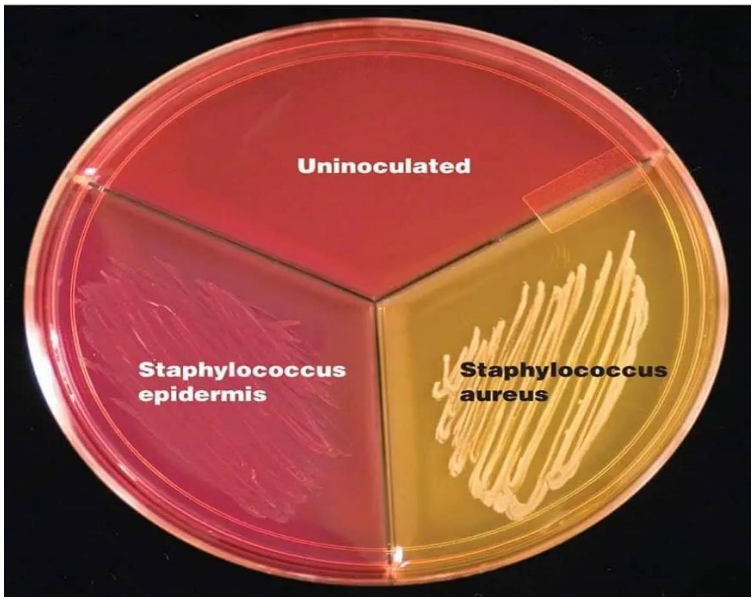
- **Differential or indicator media:** It contains specific indicators like dyes or metabolic substrates in the medium composition, which give different colors to colonies of different microbial species when they utilize or react with these components. It allows the growth of more than one microorganism. However, the bacterial colonies are differentiated based on their color when a chemical change occurs in the indicator, such as neutral red, phenol red, or methylene blue. Examples are:

  - **Blood agar:** In blood agar, three types of blood cell lysis or hemolysis are observed: alpha, beta, and gamma hemolysis. It allows the growth of many microorganisms. However, their ability to lyse blood cells differs, which helps distinguish the bacterial colonies.

    For example, ***S. pyogenes*** completely lyse blood cells (**beta hemolysis**), thus causing total clearing of the media around its colonies. ***S. pneumoniae*** partially lyse red blood cells, resulting in a greenish-colored medium, while **gamma-hemolytic** microorganisms like ***Enterococcus faecalis***, ***Staphylococcus saprophyticus***, and ***Staphylococcus epidermidis*** can't lyse red blood cells, thus causing no color change in the medium.



- **Mannitol salts agar:** The fermentation of mannitol by ***Staphylococcus aureus*** causes the media to change to yellow; however, coagulase-negative staphylococci that don't cause fermentation appear pink.



- **MacConkey agar:** It differentiates the gram-negative bacteria based on their lactose metabolism. The lactose-fermenting bacteria, such as ***Escherichia coli***, ***Klebsiella*** spp., ***Citrobacter***, and ***Enterobacter***, form pink to red colonies, while the lactose non-fermenters, including ***Salmonella*** and ***Shigella***, do not.



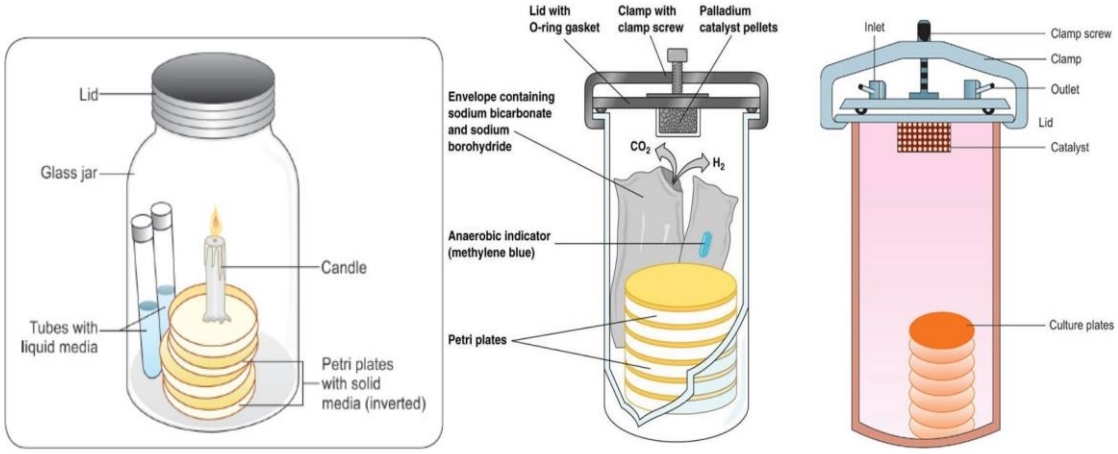
- **Transport media** are essential for clinical specimens, which must be transferred immediately to laboratories to maintain the viability of potential pathogens and prevent the overgrowth of commensal or contaminating microorganisms.



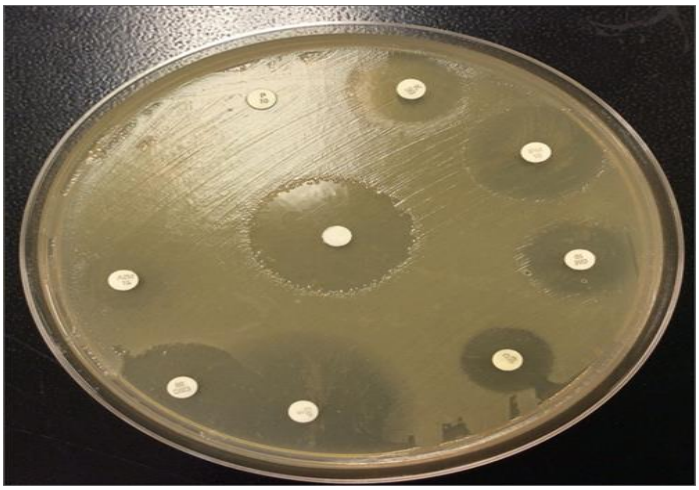
- **Anaerobic media:** This media is designed for anaerobic bacteria, which require low oxygen levels, additional nutrients, and a reduced oxidation-reduction potential. It is supplemented with hemin and vitamin K nutrients, and oxygen is removed by boiling it in a water bath and sealing it with paraffin film.

  Examples are: Robertson Cooked Meat (RCM) medium, which is commonly used to grow ***Clostridium*** spp.

Cultivation of Anaerobic Bacteria



- **Assay media** is used for assays of amino acids, vitamins, and antibiotics. For example, antibiotic assay media is used to determine the antibiotic potency of microorganisms.



- **Storage media:** It's used to store microorganisms for an extended period. Examples are chalk, cooked meat broth, and egg saline medium.