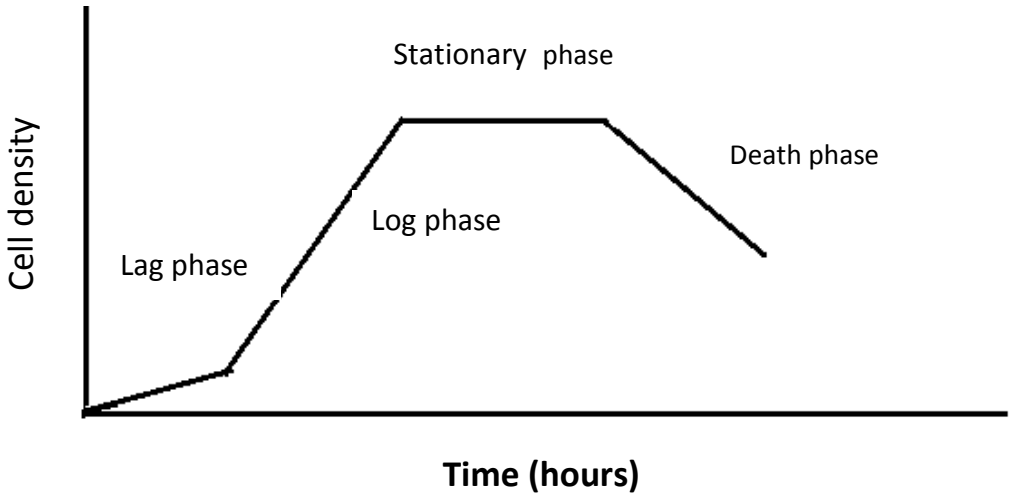
Bacterial Nutrition and growth

Nutrition is a process by which chemical substances called *nutrients* are acquired from the environment and used in cellular activities such as metabolism and growth .Most **organic** nutrients are molecules that contain a basic framework of carbon and hydrogen .In contrast, an **inorganic** nutrient is composed of an element or elements other than carbon and hydrogen such as carbohydrates, lipids, proteins, and nucleic acids and inorganic compounds are metals and their salts ; Zinc ,phosphor, magnesium, calcium, potassium sodium ,sulfur, copper, and others gases (oxygen, carbon dioxide), water and vitamins. In laboratory bacteria can be cultured by providing the specific nutrient(media) that promote bacterial growth, the media must contain water, carbon, energy, nitrogen, minerals, growth factors.

Bacterial growth occur when microbes are provided with nutrients and the required environmental factors, they become metabolically active and grow. Growth takes place on two levels the cell increases its size; and the number of cells in the population increases. The division of a bacterial cell occurs mainly through ***binary,*** or ***transverse, fission***. The time required for a complete fission cycle—from parent cell to two new daughter cells—is called the ***generation time***.



Culture media for bacterial growth

The survival and growth of microorganisms depend on available nutrients and a favorable growth environment. In the laboratory, the nutrient preparations that are used for culturing microorganisms are called ***media*** (singular, medium) so, we can define media ,is the food that we use for culturing bacteria, molds, and other microorganisms. .Some microbes require only a very few simple inorganic compounds for growth; others need a complex list of specific inorganic and organic compounds. At least 500 different types of media are used in culturing and identifying microorganisms**.**

Types of Media

Media fall into three general categories based on their properties: physical state, chemical composition, and functional type.

A. Physical form of Media

Three physical forms are used: ***liquid,*** *or* ***brothmedia; semisolid media*****;** and ***solid media.*** The major difference among these media is that solid and semisolid media contain a solidifying agent (usually **agar**), whereas a liquid medium does not.

- ***Liquid media(broth*****)** that do not solidify at temperatures above freezing . Growth occurs throughout the container and can then present a discrete, cloudy appearance. These media are used for the propagation of large numbers of organisms Such as *nutrient broth***.**
- ***Solid media*** provide a firm surface on which cells can form discrete colonies and are useful for isolating and culturing bacteria such as; *Nutrient agar, blood agar*.
- ***Semisolid media*** fall in between liquid and solid media. Although they are similar to solid media in that they contain solidifying agents such as agar or gelatin, Semisolid media are used to determine the motility of bacteria such as *sulfur indole motility (SIM) medium*.

agar, *a polysaccharide isolated from the red alga Gelidium, it used to harden the media and it is not a nutrient for the bacteria.*

B. Chemical Content of Media

Media with a chemically defined composition are termed ***synthetic*** which made up of an exact formula Such media contain pure chemical nutrients. ***Non-synthetic,*** or ***complex medium.*** The composition of this type of medium is not known by an exact chemical formula. Substances that can make it non-synthetic are extracts from animal or plant ,tissues, blood, serum, meat extracts such as ; Nutrient broth, blood agar, and MacConkey agar, , are all complex non-synthetic media .They present a rich mixture of nutrients for microbes with complex nutritional needs.

C. Functional type of media

- ***General-purpose media*** are designed to grow a broad spectrum of microbes that do not have special growth requirements. Examples include nutrient agar and broth, brain-heart infusion, and trypticase soy agar (TSA).
- ***enriched medium*** contains complex organic substances such as blood, serum, hemoglobin, or special growth factors such blood agar. Bacteria that require growth factors and complex nutrients are termed ***fastidious*** .
- ***selective medium*** contains one or more agents that inhibit the growth of a certain microbes but not another .Selective media are very important in primary isolation of a specific type of microorganism from samples containing mixtures of different species—for example, feces, saliva, skin, water, and soil. such as *Mannitol salt agar* used for isolation *the genus Staphylococcus* .
- ***Differential media*** : are media that contain substances that cause some bacteria to take on a different appearance (color,colony) from other species, allowing one to differentiate one species from another such as chromogenic agar and MacConkey agar.
- ***Transport media*** are used to keep and preserve specimens that have to be stay for a period of time before clinical analysis or to keep weak species that die rapidly such as pepton water.
- ***Assay media*** are used by technologists to test the effectiveness of antibiotic such as Muller-Hinton agar.

Media preparation

1. Measurement the amount of media be sensitive balance properly according to the label on the bottle of media powders.
2. Measure the distilled water needed for media preparation .
3. add media powder to the beaker of water. If the medium does not contain agar, the mixture usually goes into solution without heating.
4. If the medium contains agar**,** heat the mixture over a Bunsen burner or on an electric hot plate until it comes to a boil.
5. Adjustment of pH by pH paper or pH meter***(optional not necessary)*.**
6. Fill test tubes with a measured amount of medium.
7. Capping the tube with plastic caps if not found use cotton to close the tubes.
8. Sterilize the filled test tubes because Organisms on the walls of the tubes, in the distilled water, and in the dehydrated medium will begin to grow within a short period of time at room temperature, destroying the medium. Sterilization must be done in an autoclave. With labeling the rack of tubes with type of media ,date and the name of worker.
9. After sterilization remove the test tubes from autoclave and let the melted media to cool but not harden.
10. Pour the media according to desired way in culturing as in figure (**1**) then place the poured media in the incubator at 37C° in order to certain from the existence of contamination or not and keep the rest in refrigerator ,this temperatures will keep media for months.

Laboratory tools:

Materials:
Graduate cylinder , beaker, flask, glass stirring rod, bottles of dehydrated media Bunsen burner and tripod, or hot plate.

Example: the content of nutrient media.

Nutrient Agar (pH 7.0)
Peptone..... 5.0 g
Beef extract..... 3.0 g
Agar..... 15.0 g
Distilled water ..... 1.000.0 ml

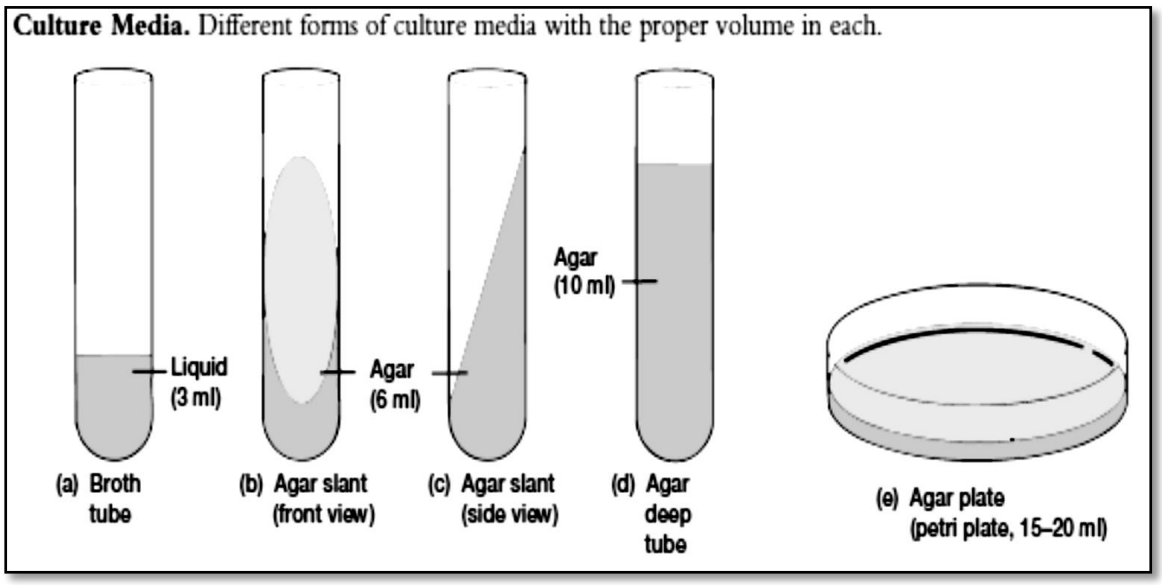


Figure (1) :media pouring way.

The media poured in Petri dish or test tube as in figure (1) according to the purpose of media preparation as the following:

- **agar slant** : the medium in the tube is allowed to harden in a slanted position.
- **agar deep tube** : the tube is allowed to harden in an upright position.
- **agar plate** :the agar is poured into a petri plate.
- **Agar pours** (the same as Agar deeps) containing about 15 to 16 ml of media are often used to prepare agar plates.
- **Broth media :**liquid media placed in tube about 3-5 ml used for transport the sample and for increase the amount of bacteria in sample.