Department of biology

2025-2026

((Microbial Physiology))

Stage (-3-)

LEC- ((4))

Controlled factors for bacterial growth

By

Asst.Lec. Dhuha .S Al-khafaji

Controlled factors for bacterial growth and culture media

The growth of microorganisms is greatly affected by the chemical and physical nature of their surroundings. Prokaryotes are present or grow anywhere life can exist. The environments in which some prokaryotes grow would kill most other organisms, the major physical factors which affect microbial growth are solutes and water activity, pH, temperature, oxygen level, pressure and radiation .

A. Temperature : Bacteria have a minimum, optimum, and maximum temperature for growth and can be divided into 3 groups based on their optimum growth temperature :

1. Psychrophiles are cold-loving bacteria. Their optimum growth temperature is between -5˚C and 15˚C. They are usually found in the Arctic and Antarctic regions and in streams fed by glaciers.

2. Mesophiles are bacteria that grow best at moderate temperatures. Their optimum growth temperature is between 25˚C and 45˚C. Most bacteria are mesophilic and include common soil bacteria and bacteria that live in and on the body.

3. Thermophiles are heat-loving bacteria , their optimum growth temperature is between 45˚C and 70˚C and are commonly found in hot springs and in compost heaps.

4. Hyperthermophiles are bacteria that grow at very high temperatures. Their optimum growth temperature is between 70˚C and 110˚C. They are usually members of the Archaea and are found growing near hydrothermal vents at great depths in the ocean.

B. Oxygen requirements : Bacteria show a great deal of variation in their requirements for gaseous oxygen. Most can be placed in one of the following groups:

1. Obligate aerobes are organisms that grow only in the presence of oxygen. They obtain their energy through aerobic respiration .

2. Microaerophils are organisms that require a low concentration of oxygen (2% to 10%) for growth, but higher concentrations are inhibitory. They obtain their energy through aerobic respiration .

3. Obligate anaerobes are organisms that grow only in the absence of oxygen and, in fact, are often inhibited or killed by its presence. They obtain their energy through anaerobic respiration or fermentation .

4. Aerotolerant anaerobes , like obligate anaerobes, cannot use oxygen to transform energy but can grow in its presence. They obtain energy only by fermentation and are known as obligate fermenters.

5. Facultative anaerobes are organisms that grow with or without oxygen, but generally better with oxygen. They obtain their energy through aerobic respiration if oxygen is present, but use fermentation or anaerobic respiration if it is absent. Most bacteria are facultative anaerobes.

C. pH : Microorganisms can be placed in one of the following groups based on their optimum pH requirements:

1. Neutrophiles grow best at a pH range of 5 to 8. 2. Acidophiles grow best at a pH below 5.5.

3. Alkaliphiles grow best at a pH above 8.5.

D. Osmosis : Osmosis is the diffusion of water across a membrane from an area of higher water concentration (lower solute concentration) to lower water concentration (higher solute concentration). Osmosis is powered by the potential energy of a concentration gradient and does not require the expenditure of metabolic energy.

E. Water activity (a_w) : is the amount of water available to microorganisms and this can be reduced by interaction with solute molecules (osmotic effect). Water activity is inversely related to osmotic pressure; if a solution has high osmotic

pressure, it's a w is low. Microorganisms differ greatly in their ability to adapt to habitats with low water activity. In a low a w habitat, the microorganisms must expend extra effort to grow as it should maintain a high solute concentration to retain water.

Bacterial Culture Media: classification, types and uses :

Culture media contains nutrients and physical growth parameters necessary for microbial growth. All microorganisms cannot grow in a single culture medium and in fact many can't grow in any known culture medium. **Classification of culture media used in Microbiology laboratory on the basis of consistency**

1.Solid medium: solid medium contains agar at a concentration of 1.5-2.0% or some other, mostly inert solidifying agent. Solid medium has physical structure and allows bacteria to grow in physically informative or useful ways (e.g. as colonies or in streaks). Solid medium is useful for **isolating bacteria** or for determining the colony characteristics of the isolate.

2.Semisolid media : They are prepared with agar at concentrations of 0.5% or less. They have soft custard like consistency and are useful for the cultivation of microaerophilic bacteria or for determination of bacterial motility.

3.Liquid (Broth) medium : These media contains specific amounts of nutrients but don't have trace of gelling agents such

as gelatin or agar. Broth medium serves various purposes such as propagation of large number of organisms, fermentation studies, and various other tests. e.g. sugar fermentation tests, MR-VR broth .

Classification of culture media based on the basis of composition

1.Synthetic or chemically defined medium : A chemically defined medium is one prepared from purified ingredients and therefore whose exact composition is known.

2.Non synthetic or chemically undefined medium : Non-synthetic medium contains at least one component that is neither purified nor completely characterized nor even completely consistent from batch to batch. Often these are partially digested proteins from various organism sources. Nutrient broth, for example, is derived from cultures of yeasts.

Classification of Bacterial Culture Media based on the basis of purpose/ functional use/ application

1.General purpose media/ Basic media : Basal media are basically simple media that supports most non-fastidious bacteria. Peptone water, nutrient broth and nutrient agar are considered as basal medium. These media are generally used for the primary isolation of microorganisms.

2. Enriched medium (Added growth factors): Addition of extra nutrients in the form of blood, serum, egg yolk etc, to basal medium makes them enriched media. Enriched media are used to grow nutritionally exacting (fastidious) bacteria. Blood agar, chocolate agar, etc are few of the enriched media. Blood agar is prepared by adding 5-10% (by volume) blood to a blood agar base. Chocolate agar is also known as heated blood agar or lysed blood agar.

3. Selective media : is designed to suppress the growth of some microorganisms while allowing the growth of others. Selective medium are agar based (solid) medium so that individual colonies may be isolated. Various approaches to make a medium selective include addition of antibiotics, dyes, chemicals, alteration of pH or a combination of these , examples of selective media include: Mannitol Salt Agar and Salt Milk Agar used to recover *S.aureus* contains 10% NaCl .

4.Differential/ indicator medium: differential appearance Certain media are designed in such a way that different bacteria can be recognized on the basis of their colony colour. Various approaches include incorporation of dyes, metabolic substrates etc, so that those bacteria that utilize them appear as differently coloured colonies. Such media are called differential media or indicator media. Differential media allow the growth of more than one microorganism of interest but with morphologically

distinguishable colonies. Examples of differential media TCBS (*Vibrio cholerae* produces yellow colonies due to fermentation of sucrose)

5.Transport media: clinical specimens must be transported to the laboratory immediately after collection to prevent overgrowth of contaminating organisms or commensals. This can be achieved by using transport media. Such media prevent drying (desiccation) of specimen, maintain the pathogen to commensal ratio and inhibit overgrowth of unwanted bacteria . Some of these media (Stuart's & Amie's) are semi-solid in consistency. Addition of charcoal serves to neutralize inhibitory factors.

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