

Bacteriology

Lec 10

Nutrition of microorganisms

Growth factors:

An autotroph or a heterotroph may require small amounts of certain organic compounds for growth because they are essential substances that the organism is unable to synthesize from available nutrients. Such compounds are called **growth factors**. This is required in small amounts by cells because they play a specific role in biosynthesis. Growth factors are organized into **three categories**:

1-Purines and pyrimidines:

Required for synthesis of nucleic acids(DNA and RNA).

2-Amino acids:

Required for the synthesis of proteins.

3-Vitamins:

Needed as coenzymes and functional groups of certain enzymes.

Some bacteria (e.g. *E. coli*) do not require any growth factors: they can synthesize all essential purines ,pyrimidines , amino acids and vitamins, other bacteria (e.g.*Lactobacillus*) require purines , pyrimidines , vitamins and several amino acids in order to grow. These compounds must be added to culture media that are used to grow these bacteria.

The growth factors are not metabolized directly as sources of carbon or energy; rather they are assimilated by cells to fulfill their specific role in metabolism

Mutant strains of bacteria that require some growth factor not needed by the wild type (parent) strain are referred to as **auxotroph**. Thus, a strain of *E. coli* that requires the amino acid tryptophan in order to grow would be called a tryptophan auxotroph. Some vitamins that are frequently required by certain bacteria as growth factors are listed in the following:

- 1- **Folic acid**: synthesis of thymine, purine bases, serine, methionine and pantothenate
- 2- **Biotin**: Biosynthetic reactions that require CO₂ fixation
- 3- **Nicotinic acid**: electron carrier in dehydrogenation reaction
- 4- **Pantothenic acid**: deamination, transamination, oxidation of keto acids and acyl group carriers in metabolism.
- 5- **Riboflavin (B2)**: oxidation reactions
- 6- **Pyridoxine (B6)**: decarboxylation and racemation of amino acids.
- 7- **Thiamine (B1)**: decarboxylation of keto acids and transaminase reactions.
- 8- **Vitamin (B12)**: Transfer of methyl groups
- 9- **Vitamin K**: electron transport processes.

Mineral salts:

Microorganisms need mineral salts in a small quantity of inorganic ions (cations and anions) such as:

1-Macronutrients elements:

They are needed for activation of enzymes, enzymes cofactor, and controlling the osmotic pressure inside the cell. They include Mg^{+2} , Ca^{+2} , Na^{+} , and Cl^{-} . Macronutrients are required in con. 0.1-1 mM.

2-Micronutrients elements:

They are required in con. About 10^{-3} - 10^{-5} mM, such as Co^{+2} .

There is a group of M.O, which needed Na^+ and Cl^+ in high concentration Called **Halophiles that can be classified into:**

1-Slightly halophiles:

Those who needed a small quantity of NaCl (2-5%), including most of marine bacteria.

2-Moderately halophiles:

NaCl is needed in a range about (5-10%) such as *Pseudomonas*, *Lactobacillus*.

3-Extremely halophiles:

NaCl is needed in a range about (20-30%) such as *Halobacterium* and *Micrococcus*. NaCl is necessary to stabilize the binding of cell wall proteins to each other

The effect of oxygen:

Oxygen is a universal component of cells and is always provided in large amounts by H_2O . Prokaryotes display a wide range of responses to molecular O_2 . (Table 2).

Group	Aerobic	Anaerobic	O_2 effect
Obligate aerobe	Growth	No growth	Required (utilized for aerobic respiration)
Microaerophile	Growth if level not too high	No growth	Required but at levels below 0.2 atm
Obligate anaerobe	No growth	Growth	
Facultative anaerobe (Facultative aerobe)	Growth	Growth	Not required for growth but utilized when available

Aerotolerant anaerobe	Growth	Growth	Not required and not utilized
-----------------------	--------	--------	-------------------------------

Uptake of nutrients by the cell

Microorganisms used several different transport mechanisms, the most important of them are:

1-Facilitated diffusion:

A few substances can cross the cytoplasm membrane by passive diffusion. In this process molecules move from a region of higher concentration to one of lower con.

2-Active transport:

It is transport of solute to higher concentration or against the concentration gradient with the use of metabolic energy in input.

3-Group translocation:

A substrate is becoming phosphorylated during the transport process.