Lab8

Nutritional Requirements of Cells

Every organism must find in its environment all of the substances required for energy generation and cellular biosynthesis . The chemicals and elements of this environment that are utilized for bacterial growth are referred to as **nutrients** or **nutritional requirements** . Many bacteria can be grown the laboratory in **culture media** which are designed to provide all the essential nutrients in solution for bacterial growth .

The use of the nutrient is determined by two factors

1- The compound's ability to cell penetration through the cytoplasmic membrane determined by four factors
   a- Molecular weight
   b- Volume .
   c- Selection the cell membrane .
   d- The presence of enzymes permease .
2- Possession of cell special enzymes to convert the nutritional material to the building blocks or energy source .

Nutrients is divided into two

1- Essential Nutrients for Microorganisms

   Nutrients are materials that are acquired from the environment and are used for growth and metabolism . Microorganisms (or microbes) vary significantly in terms of the source , chemical form , and amount of essential elements they need . Some examples of these essential nutrients are carbon , oxygen , hydrogen , phosphorus , and sulfur .

2- Non essential nutrients assistance substances add to the cultural media such as minerals , salts and vitamins .

Effect of Carbon source on Bacterial growth

Carbon sources of the most important food sources that need its all living organisms , a carbon backbone of the composition of the cell contents as enters in the composition of proteins , carbohydrates and fats.

Effect of nitrogen source on Bacterial growth

Nitrogen important nutritional source of protein components, because he is in the synthesis of amino acids and nucleic acids and other present in nature of different cases

1- The freely in the atmosphere and this (NO_2) does not benefit the cell.
2- Oxidative in nitrates (NO_3) .
3- Reductive (NH_3),this exists in cells as amino acids .

In nature , nitrogen is fixed by some micro – organisms and by lightning . This natural fixation plays an important role in the nitrogen cycle . In a way that is not yet completely understood , nitrogen – fixing bacteria and algae use nitrogen gas to make ammonium compounds . These compounds are absorbed by plants .

1- The conversion of ammonia to nitrate is [erformed primarily by soil-living bacteria and other nitrifying bacteria. In the primary stage of nitrification , the oxidation of ammonium (NH_4^+) is performed by bacteria species , which converts ammonia to nitrites *Nitrosomonas* such as the (NO_2^-) .
2- Bacteria species such as *Nitrobacter* , are responsible for the oxidation of the nitrites (NO_2^-) into nitrates (NO_3^-) . It is important for the ammonia to be converted to nitrates because accumulated nitrites are toxic to plant life .
3- Bacteria that denitrify nitrates (NO_3^-) in the soil (called "denitrifying bacteria") .Example : *Pseudomonas denitrificans* .
4- Bacteria that "fix" nitrogen (called "nitrogen – fixing bacteria") .Examples : *Rhizobium* (which is symbiotic) and *Azotobacter* (which is free-living).

5- You also have bacteria that lysis nitrogenous waste (like urea) and the protein in dead organisms by urease enzyme , such as ==*Klebsiella*== , ==*Proteus*==. This type of bacteria is called putrefying bacteria .

Sometimes some of the peptides used as a source of nitrogen in the media such as peptone which is partially digested protein and reductant used by bacteria heterotrophic , it was noted that the use of some oligopeptide in cultural media caused infarcts of growth because contact with the charge on cells surfaces due to aggregation and death of cell .

==Effect of phosphorus source on bacterial growth==
Phosphorus is essential for the synthesis of nucleic acids (DNA , RNA) , AMP, ADP , ATP , coenzymes and phospholipids .
It is a major component for the development of the plasma membrane . Bacteria obtain phosphorus by cleaving ATP or ADP or from phosphate ions .
Phosphorus is essential for metabolic activities and the exchange of energy . Phosphorus is the major source of phosphorus mineral salts (==KH_2PO_4== , ==K_2HPO_4)== in addition to nucleic acids

==Effect of sulfur source on bacterial growth==
Sulfur enters in the composition of protein and amino acides as cysteine .some of the coenzyme (coenzyme A) and some vitamins and Thiamine , methionine , glutathione and biotin .

==Effect of mineral salts on bacterial growth==
Mineral salts are two types according to the quantity of used of them :

1- Macronutrient element

Elements are present in large amounts in media are the positive and negative ions , which act as stimulants to the enzymes are added as ions of inorganic salts .

Include magnesium (Mg) ion , which enters the phosphorylation reactions and interaction with the enzyme with substrate and in chlorophyll synthesis and contributes to the Union of ribosomes molecules and as activated

For the enzyme Hexokianase . In addition to magnesium ions there are K,Mn,Ca,Na,Cl, acts as the assistance factors of many enzymes and contributing to the osmotic pressure in the cell and also zinc ion that enters in the composition of the cnzyme alcohol dehydrogenase .

2- Micronutrient element

These salts are added to the Media in small amounts which ions need a cell is very trace amounts between (10- -10-5)mg , include (Co^2) ion that enters in the synthesis of vitamin B 12 .

Effect of Co-factors and vitamins on bacterial growth

Co-factors are chemical materials needed by the cell to the effectiveness of the enzymes in the cell may be in the form of

1- Metal magnesium (Mg) and ferric (Fe).
2- Complex organic compound called Co-enzyme and vitamins is organic section in Co-enzyme .

Microorganism which has the ability to form vitamins and growth factors required by the so called Prototrophic microorganism , but Microorganism which lost the ability to form vitamins and growth factors required by the so called Auxotrophic microorganism.