Bacteriology

Lec 9 Nutrition of microorganisms

Ways of food entrance:

Entrance of food substances into all plant cells, and most animal cells, is by passage through the cell membrane and cell wall if present of nutrients in an aqueous solution by the processes of diffusion and osmosis. **This type of nutrition is to be osmotrophic.**

Phagotrophic cells

Animal cells are typically without cell walls, have the ability to ingest solid particles of food by drawing them into the cell through the cell membrane by the process called **phagocytosis.** Phagocytic cells are said to have a phagotrophic type of nutrition.

Pinocytosis:

Many kinds of animas cell, though lacking cell walls, are not phagocyte. However, they can engulf fluids, and possibly pass minute particles inward through the cell membrane by a process called **pinocytosis.**

A similar process called endocytosis, large, complex molecules such as proteins, nucleic acids, some phages, and possibly colloids like sulfur, taken into the mammalian cell via minute invaginations of the cytoplasm membrane.

Some of nutrients transport method need energy such as in anaerobic bacteria, while the other doesn't need it like in aerobic bacteria.

Carbon and energy sources for bacterial growth:

All living M.O require a source of energy. M. O that use energy (light) is called **phototrophs**. Microorganisms that uses an organic form of carbon are called **chemotroph**. Microorganisms that oxidize inorganic compounds are called **lithotrophs**. Microorganisms that use organic carbon are heterotrophs and Microorganisms that use CO_2 as a sole source of carbon for growth are called **autotrophs**. Thus, on the basis of carbon and energy sources for growth four major nutritional types of prokaryotes may be defined. (Table 1).

Nutrional types of prokaryotes

Nutritional type	Energy source	Carbon source	Examples
Photoautotroph photolithotroph	light	Co_2	*Cyanobacteria, Clorobium, Chromatium*
Photoheterotoph, photoorganotroph	light	Organic compounds	*Rhodospirillum*
Chemoautotrophs or lithotrophs(lithoautotrophs)	Inorganic compounds,e.g. H_2, NH_3,NO_2,H_2S.	CO_2	A few bacteria and many archaea
Chemoheterotrophs or heterotrophs,chemoorganotroph	Organic compounds	Organic compounds	Pathogenic bacteria, some archaea.

The common nutrients requirements:

Analysis of microbial cell composition shows that 95% or more of cell dry weight is made up few major elements (carbon, oxygen, hydrogen, nitrogen, sulfur, phosphorus, potassium, calcium, magnesium and iron).These are referred

to as macronutrients or macro elements because M.O require them in large amounts. The first six are components of carbohydrates, lipids, proteins, and nucleic acids. The remaining four exist in the cell as cat ions and play a variety of roles.

Potassium (K^{+}):

It is required for activity by a number of enzymes including some of those involved in proteins synthesis.

Calcium (Ca^{++}):

It has many functions and the most important one is the contribution to heat resistance of bacterial end spore formation.

Magnesium (Mg^{+}):

It serves as a cofactor for many enzymes also makes a complex with ATP, stabilizes ribosome and cell membrane.

Iron (Fe^{++} or Fe^{+++}):

It issued in synthesis of cytochromes, as a cofactor for enzymes and electron carrying proteins. All M.O require a number of **micro molecules** or trace elements in addition to **macromolecules.**

Most cells need the trace elements Mn, Zn, Co, Ni and Cu, but in small amounts. They are often adequate for growth. These microelements are normally a part of enzymes and cofactors and they aid in the catalysis of reaction and maintenance to proteins structure such as zinc, which is found at the active side of some enzymes, manganese aids many enzymes catalyzing activity, cobalt a

component of vitamin B_{12}.

Nutritional types of microorganisms:

There are two sources of energy available to organisms:

1-Light energy

2-The energy derived from oxidizing organic or inorganic molecules.

Phototrophs:

Microorganismsuse light as an energy source, such as *Chlorobium, Chromatium*, and *Rhodospirillum*

Chemotrophs:

Microorganisms obtain energy from the oxidation of chemical compounds.

Lithotrophs:

Microorganisms use reduced inorganic substances as an electron source.

Organotrophs:

Microorganisms extract electrons or hydrogen from organic compounds.

Mixotrophs:

Bacteria that depending on inorganic energy sources and organic carbon sources.

Requirements of nitrogen, phosphorus, and sulfur

Carbon:

The sole inorganic source of carbon is Co_2(M.O called **autotrophs**) while glucose and amino acids are the sole source of organic carbon, which is needed for anabolism and release energy and M.O called**heterotroph.**

Mixotrophs:

Bacteria that depending on inorganic energy sources and organic carbon sources.

Nitrogen:

Is needed for the synthesis of amino acids, purine , pyrimidine , nucleic acids, enzymes, and vitamins.

Phosphorus:

Is present in nucleic acids, phospholipids, nucleotides like ATP, several cofactors, some proteins, and other cell components.

Sulfur:

Is needed for the synthesis of substances like amino acids (cysteine, and methionine),thiamine, biotin, and some carbohydrate.