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Course Title : Microbiology

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Unit-IV

Nutritional Requirements of Bacteria

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Nutritional Requirements Of Bacteria.

Bacteria

- Bacteria are Unicellular Microorganisms.
- It exhibit typical Prokaryotic Cell Structure.

Nutrients

- Nutrients are substances required for the biosynthesis and energy production for microbial cell to grow.

Microbial Cell Composition

- Analysis of microbial cell composition show that over 95% of cell dry weight is made up of a few major elements:
- carbon ,oxygen, hydrogen, nitrogen, sulfur, phosphorus, potassium, calcium, magnesium and iron.

Common Nutrient Requirements

- Macro elements or Macronutrients
- Micronutrients
- Trace elements
- Growth Factors

Macronutrients

- The macro elements or macronutrients are required by microorganisms in relatively large amounts.
- The macro nutrients are C, O, H, N, S, and P.
- These elements are the components of carbohydrates, lipids, protein and nucleic acids.

Micronutrients

- In addition to macro elements, all microorganisms require several nutrients in small amounts.
- These are called micronutrients.
- These includes potassium, calcium, magnesium and iron.

- Micronutrients are normally a part of enzymes and cofactors, and they aid in the catalysis of reactions and maintenance of protein structure.

Potassium (K)

- Potassium (K) is required for activity by a number of enzymes, including some of those involved in protein synthesis.

Calcium (Ca_2)

- Calcium among other function contribute to the heat resistance of bacterial endospores.

Iron (Fe_2 and Fe_3)

- Iron (Fe_2 and Fe_3) is a part of cytochromes and a cofactor for enzymes and electron-carrying proteins.

Magnesium (Mg_2)

- Magnesium (Mg2) serves as a cofactor for many enzymes,
- complexes with ATP, and stabilizes ribosome's and cell membranes.

Trace Elements

- These are required by microorganism in very small amounts are called trace elements.
- These include magnesium, zinc, cobalt, molybdenum, nickel, and copper.

- Cells require such small amounts that contaminants from water, glassware, and regular media components often are adequate for growth.

Zinc (Zn_2)

- Zinc (Zn_2) is present at the active site of some enzymes but can also be involved in the association of regulatory and catalytic subunits.

Growth Factors

- Most microorganisms have the enzymes needed to synthesize all cell components using minerals and sources of energy.
- But some microorganisms lack one or more enzymes needed to manufacture these indispensable constituents.

- It must obtain these constituents from the environments is growth factors.

Major Growth Factors

- Amino acids,
- Purines and Pyrimidines
- Vitamins

Amino acids

- Amino acids are needed for protein synthesis.

Purines & Pyrimidines

- Purines and Pyrimidines for nucleic acid synthesis.

Vitamins

- Vitamins are small organic molecule that usually make up all or part of enzyme cofactors and are needed in only very small amounts to sustain growth.
- Some microorganisms require many vitamins;
- For example, *Enterococcus faecalis* needs eight different vitamins for growth

Function of some common vitamins in microorganisms

Vitamin	Functions	Examples of Microorganisms Requiring Vitamin
Biotin	Carboxylation (Co2fixation) one-carbon metabolism.	*Leuconostoc mesenteroides*(B) *Saccharromyces cerevisiae* (F)
Pyridoxine (B6)	Amino acid metabolisms (eg., transamination)	*Lactobacillus spp.* (B)
Riboflavin (B2)	Precursor of FAD and FMN --- carry electrons or hydrogen atoms	*Caulobacter vibrioides* (B)

Other Growth Factors

- Heme (from hemoglobin or cytochromes) is required by Haemophilus influenzae.
- Some mycoplasmas need cholesterol.

Classification of Bacteria Based on Nutrition

- ✓ Carbon source
- ✓ Energy source
- ✓ Electron source

Carbon source

- Autotrophs -- Co2 sole or principal biosynthetic carbon source.
- Heterotrophs – reduced, performed organic molecule from other organisms.

Energy source

- Phototrophs – light.
- Chemotrophs – oxidation of organic or inorganic compounds

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Electron source

- Lithotrophs – reduced inorganic molecules
- Organotrophs – organic molecules.

Bloom of Cyanobacteria

Photolithoautotrophic

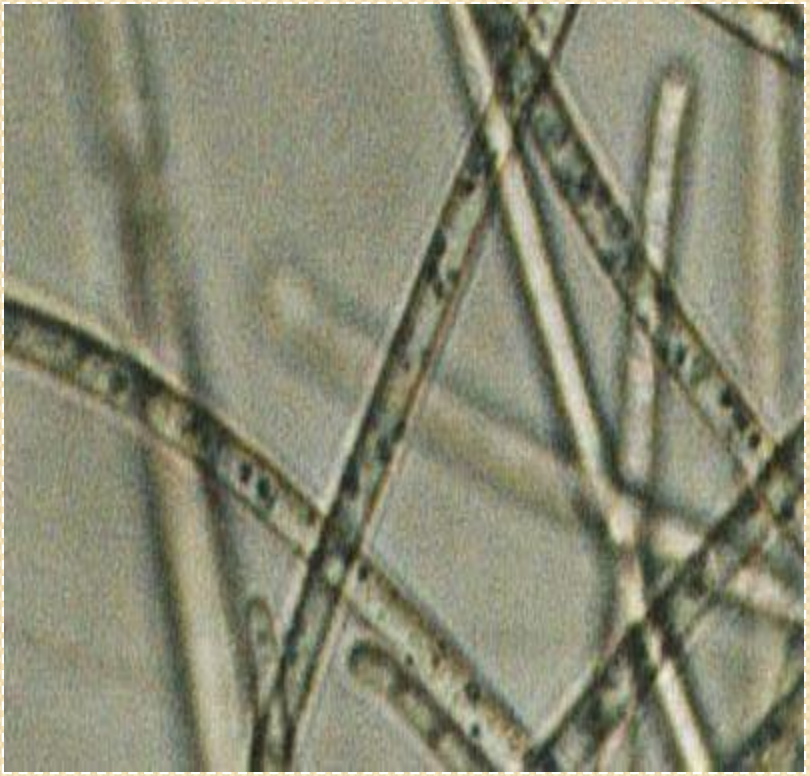
Purple sulfur Bacteria

Photoheterotrophic

Nitrobacteria winogradskyi

Chemolithoautotrophic

Beggiatoa alpha



Chemolithoheterotrophic

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THANK YOU