Principles of Microbial Nutrition

Introduction

- Microbial nutrition refers to how microorganisms obtain and use nutrients for growth, energy production, reproduction, and survival.
- Microorganisms need nutrients for cell growth, metabolism, and reproduction.
- Microbial nutrition studies the types and use of these nutrients.

Definition

- Microbial nutrition is the process by which microorganisms obtain and utilize nutrients from their environment.

Nutritional Requirements of Microorganisms

1. Water

- Water is essential for microbial life.
- Most metabolic reactions occur in water.

Functions

- It dissolves nutrients.
- It acts as a medium for reactions.
- It helps transport materials.

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2. Carbon

- Carbon is needed to build cellular components.

Importance

- It is used in carbohydrates, proteins, lipids, and nucleic acids.

3. Nitrogen

- Nitrogen is needed for proteins and nucleic acids.

Sources

- Ammonia
- Nitrates
- Amino acids
- Atmospheric nitrogen in some microbes

4. Hydrogen and Oxygen

- Hydrogen and oxygen are needed in organic molecules.
- They are important in energy production.

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5. **Phosphorus**
   - Phosphorus is needed for ATP, nucleic acids, and membranes.
   - **Source:** Phosphates.
6. **Sulfur**
   - Sulfur is needed for some amino acids and vitamins.
   - **Sources:** Sulfates, Sulfur-containing compounds.
7. **Minerals (Trace Elements)**
   - Minerals are needed in small amounts.
   - **Examples:** Iron, Zinc, Copper, Magnesium, Manganese.

     Functions
     - They support enzyme activity.
     - They help metabolism.
     - They support cellular processes.
8. **Growth Factors**
   - Growth factors are organic compounds required in small amounts.
   - **Examples:** Vitamins, Amino acids, Purines.

Combined Nutritional Types

1. **Photoautotrophs**
   - They use light for energy.
   - They use carbon dioxide for carbon.
   - Example: Cyanobacteria.
2. **Chemoautotrophs**
   - They use inorganic chemicals for energy.
   - They use carbon dioxide for carbon.
   - Example: Nitrifying bacteria.
3. **Photoheterotrophs**
   - They use light for energy.
   - They use organic compounds for carbon.
4. **Chemoheterotrophs**
   - They use organic compounds for both energy and carbon.
   - Examples: Many bacteria, Fungi.

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5. Macronutrients

- Macronutrients are required in large amounts.
- Examples: Carbon, Nitrogen, Phosphorus, Sulfur.

6. Micronutrients

- Micronutrients are required in small amounts.
- Examples: Iron, Zinc.

7. Culture Media and Nutrition

- Microbes are grown in nutrient media.

Types of Media

1. Simple Media

- Simple media contain basic nutrients.

2. Complex Media

- Complex media contain rich nutrient mixtures.

3. Defined Media

- Defined media have a known exact composition.

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Nutrient Uptake Mechanisms

Microbes absorb nutrients through different methods.

A. Passive Diffusion

- Nutrients move from high to low concentration.

B. Active Transport

- Active transport requires energy.

C. Facilitated Diffusion

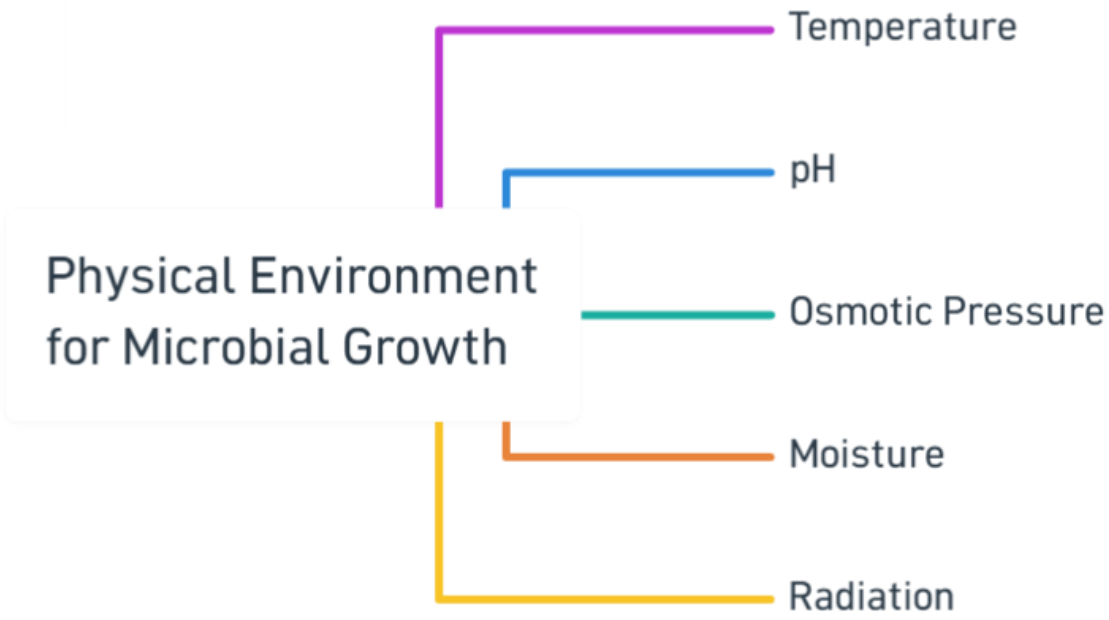
- Facilitated diffusion uses transport proteins.

Importance of Microbial Nutrition

- It supports microbial growth.
- It helps metabolism.
- It is essential in microbiology and biotechnology.

Physical Environment for Microbial Growth

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1. Temperature

- Temperature affects enzyme activity and metabolism.

Microbes Based on Temperature

A. Psychrophiles

- Psychrophiles grow in cold temperatures.

B. Mesophiles

- Mesophiles grow at moderate temperatures.
- **Example:** Many human pathogens.

C. Thermophiles

- Thermophiles grow at high temperatures.

D. Hyperthermophiles

- Hyperthermophiles grow at very high temperatures.

Effects of Improper Temperature

- Low temperature slows metabolism.
- High temperatures may destroy proteins.

2. pH

Definition

- pH indicates acidity or alkalinity.

Importance

- pH affects enzymes and membrane function.

Microbes Based on pH

A. Acidophiles

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- Acidophiles grow in acidic conditions.

B. Neutrophiles

- Neutrophiles prefer neutral pH.

C. Alkaliphiles

- Alkaliphiles grow in alkaline conditions.

3. Osmotic Pressure

Definition

- Osmotic pressure is the pressure caused by dissolved substances.

Effect on Microbes

- High salt or sugar may remove water from cells.

Halophiles

- Halophiles are salt-loving microorganisms.

4. Moisture

➢ Water is essential for microbial activity.

Low Moisture

- Low moisture limits microbial growth.

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5. Radiation

A. Ultraviolet Radiation

- Ultraviolet radiation can damage DNA.

B. Ionizing Radiation

- Ionizing radiation can destroy cells.

Chemical Environment for Microbial Growth

1. Oxygen Requirement

➢ Microbes differ in their oxygen needs.

A. Obligate Aerobes

- Obligate aerobes require oxygen.

B. Obligate Anaerobes

- Obligate anaerobes cannot tolerate oxygen.

C. Facultative Anaerobes

- Facultative anaerobes can grow with or without oxygen.

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