MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

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COLLEGE OF SCIENCE

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LECTURE (4)

((OVERVIEW OF PROTIENS))

Overview of Proteins – Detailed Lecture

Introduction:

Proteins are complex biomolecules that play a fundamental role in all biological processes. They are composed of amino acids and perform diverse functions such as structural support, catalysis, transport, and defense.

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1. Definition and Characteristics of Proteins

1.1 Definition of Proteins

Proteins are polymers composed of basic units called **amino acids**, linked together by **peptide bonds** to form long chains with specific three-dimensional structures.

1.2 Characteristics of Proteins

- Contain **carbon (C), hydrogen (H), oxygen (O), nitrogen (N)**, and sometimes **sulfur (S) and phosphorus (P)**.
- Have a **specific three-dimensional structure** that determines their function.
- Can be **hydrophilic (water-loving) or hydrophobic (water-repelling)** depending on their amino acid composition.
- Function under a wide range of **pH and temperature conditions**, but they are **sensitive to extreme environmental changes**.

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2. Structure of Proteins

2.1 Amino Acids

- Proteins are made up of **20 essential amino acids**, each differing in their **R-group (side chain)**.
- Amino acids are classified into:

- **Essential amino acids**: Cannot be synthesized by the body and must be obtained from the diet (e.g., leucine, valine).
- **Non-essential amino acids**: Can be synthesized by the body (e.g., alanine, glutamine).

2.2 Peptide Bond

- A **peptide bond** forms when the **amine group (NH_2)** of one amino acid links to the **carboxyl group (COOH)** of another amino acid, releasing a molecule of water (H_2O).

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3. Levels of Protein Structure

3.1 Primary Structure

- The **linear sequence of amino acids** in a polypeptide chain.
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3.2 Secondary Structure

- Formed due to **hydrogen bonding** between amino acids. Common structures include:
  - **Alpha-helix (α-helix)**
  - **Beta-pleated sheets (β-sheets)**
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3.3 Tertiary Structure

- The **three-dimensional folding** of a single polypeptide chain, determining the protein's function.
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3.4 Quaternary Structure

- Formed when multiple polypeptide chains **interact** to create a functional protein (e.g., hemoglobin).

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4. Functions of Proteins

4.1 Structural Proteins

- Provide **strength and support** to cells and tissues (e.g., **collagen in bones and skin**).

4.2 Enzymatic Proteins

- **Catalyze biochemical reactions** (e.g., **lipase, amylase**).

4.3 Transport Proteins

- Carry **molecules** within the body (e.g., **hemoglobin transports oxygen**).

4.4 Defensive Proteins

- Involved in the **immune system** (e.g., **antibodies**).

4.5 Hormonal Proteins

- Regulate **biological activities** (e.g., **insulin controls blood sugar levels**).

4.6 Motor Proteins

- Aid in **cellular and muscle movement** (e.g., **actin, myosin**).

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5. Protein Metabolism

- **Anabolism**: The synthesis of proteins from amino acids within cells.
- **Catabolism**: The breakdown of proteins into amino acids when needed for **energy** or in cases of protein deficiency.

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6. Protein Degradation and Deficiency Diseases

6.1 Protein Degradation

- Carried out by **proteases** (protein-degrading enzymes), such as **pepsin** in the stomach.

6.2 Protein Deficiency Diseases

- **Kwashiorkor**: Caused by protein malnutrition, leading to **edema, weak immunity, and muscle wasting**.
- **Marasmus**: Severe **caloric and protein deficiency**, leading to **muscle loss and stunted growth**.
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7. Dietary Sources of Proteins

- **Animal sources**: Meat, fish, eggs, dairy products.
- **Plant sources**: Legumes, lentils, nuts, grains.
