L. Rydygier Collegium Medicum in Bydgoszcz
DEPARTMENT OF MEDICAL BIOLOGY AND BIOCHEMISTRY
tel. 52/585-37-55, email: kizbioch@cm.umk.pl

KEYPOINTS FOR COLLOQUIUMS - BIOCHEMISTRY - I SEMESTER 2024/2025

Colloquium I

1. Structure and characteristics of proteinaceous amino acids. Classification of amino acids according to the structure and properties of their side chains (e.g., polar, nonpolar, aliphatic, aromatic, containing specific functional groups, neutral, acidic, basic). Amphoteric properties of amino acids, zwitterions. Structure of some amino acid derivatives (such as selenocysteine, 4-hydroxyproline, 5-hydroxylysine). Structure of some non-protein amino acids of physiological importance (homocysteine, homoserine, ornithine, citrulline, β-alanine, γ-aminobutyric acid, β-aminoisobutyric acid). Structure and properties of a peptide bond. Structure and function of biologically important peptides (glutathione, peptide hormones, peptide antibiotics). Structure and biosynthesis of insulin.
2. Proteins - classification, characteristics of the I°, II°, III° and IV° structure, their properties and functions. Definition of V° structure of proteins. Detailed structure of α-helix and β-sheet. Amino acids that stabilize, destabilize and "break" α-helix. Types of bonds involved in the formation of the protein conformation (hydrogen, ion, electrostatic, hydrophobic, van der Waals bonds). Post-translational modification of proteins. Structure of ribonuclease. Denaturation and renaturation of ribonuclease. Structure and synthesis of collagen. Structure of normal and pathological prion proteins. Prion diseases as an example of the medical significance of proper folding of the polypeptide chain.
3. Correlation between protein structure and its function - myoglobin, hemoglobin and immunoglobulins. The physiological role of hemoglobin and myoglobin. The mechanism of oxygen biding by myoglobin and hemoglobin molecules. Changes in the structure of hemoglobin occurring at various stages of human development. Glycosylated hemoglobin. Hemoglobinopathies.
4. Functions performed by blood. Organic and inorganic components of plasma. Structure and functions of erythrocytes. Buffering properties of blood - carbonate buffer and the role of hemoglobin in buffering (Bohr and Halden effect). The physiological role of hemoglobin and myoglobin in the transport and storage of oxygen, the oxygen dissociation curve. The mechanism of oxygen binding by myoglobin and hemoglobin (the role of distal and proximal histidine, cooperativity). Influence of temperature, pH, CO_2 and 2,3-BPG on the oxygen dissociation curve for Hb. Characteristics and functions of blood plasma proteins. Acute phase reactants. Proteins involved in the metabolism and transport of copper and iron.

Colloquium II

1. The enzyme - structure, properties, the enzyme-substrate complex formation. The specificity of the enzyme for the substrate and the type of catalyzed reaction. Definition of isoenzyme, coenzyme, cofactor. Physical and chemical properties of isoenzymes. The significance of isoenzymes in medical diagnostics. Classification of enzymes. Units of enzymatic activity.
2. Kinetics and mechanism of enzymatic reaction of Michaelis-Menten: initial and maximum rate of enzymatic reaction, Michaelis constant, Michaelis-Menten equation, Lineweaver-Burk plot. Kinetics of allosteric enzymes (activators and allosteric inhibitors, examples of allosteric enzymes, concerted and sequential model of allosteric protein). The effect of physical and chemical factors on enzyme activity (temperature, pH, concentration of enzyme, substrate and product). Regulation of enzyme activity: regulation by feedback and its examples in the human body; covalent modification of enzymes: phosphorylation and specific, limited proteolysis (proenzymes, zymogens, autocatalysis). Types of inhibition with examples of inhibitors used in medicine: acetylsalicylic acid, penicillin, fluorouracil, methotrexate, allopurinol.
3. Vitamins soluble in water and lipids - structure and importance in metabolic processes. The structure of coenzymes and functions performed by coenzymes in enzymatic reactions.
4. The role of enzymes in the digestion of carbohydrates, lipids, proteins and nucleic acids. Composition and role of digestive juices. The mechanism of the synthesis of hydrochloric acid by the parietal cells of the stomach. Functions of hydrochloric acid. The role of bile acids in the digestive process. Biosynthesis of bile acids and regulation of this process. Enterohepatic circulation of bile acids. Molecular mechanisms of absorption of digestive products.