

SYLLABUS - BIOCHEMISTRY (GM)

Intermediary metabolism - anabolic, catabolic, amphibolic pathways; localization of pathways in the cell. The cell and its compartmentation, the role of biological membranes in metabolism, transport across membranes (passive and active); lipid and protein composition of membranes.

Biological oxidation; redox potential; enzymes involved in oxidation and reduction; reactions catalyzed by dehydrogenases, oxidases, peroxidases and oxygenases; removing of H_2O_2 from the biologic system. Macroergic compounds.

Respiratory chain, oxidative phosphorylation, inhibitors of the respiratory chain. The action of uncouplers; chemiosmotic theory. Alternative pathways of biolog. oxidation.

Citric acid cycle, central role of Acetyl CoA, localization of CAC in the cell, regulation of the cycle, anaplerotic reactions.

Carbohydrate metabolism - general view; glycolysis - reactions, intermediates, enzymes and coenzymes in glycolysis; coupling of glycolysis with other pathways. Glycolysis in erythrocytes, alcoholic fermentation. Gluconeogenesis - reactions, enzymes, coenzymes; bypasses. Pentose phosphate pathway - reactions, enzymes, major functions. Metabolism of glycogen - glycogenesis and glycogenolysis, regulation of the processes. Uronic acid pathway - the role and function; metabolism of galactose and fructose; metabolism of aminosugars.

Lipid metabolism - general view; the role of lipids in the organism; Fat digestion, absorption and transport; mobilization of stored fat; lipoproteins. Cellular metabolism of lipids as a basic source of energy; fatty acid oxidation - localization; β -oxidation - steps, enzymes, coenzymes, metabolite; β -oxidation of odd numbered FA and unsaturated FA; oxidation of FA and ATP production; ketogenesis and ketones bodies.

Biosynthesis of FA; localization and main steps, the role of malonyl-CoA and acetyl-CoA, FA synthase complex; reducing equivalents (NADPH) in biosynthesis; elongation of FA chain; biosynthesis of unsaturated FA; Synthesis of acylglycerols & phospholipids; cerebrosides and sphingolipids. Synthesis, classification and biological functions of glycolipids. Metabolism of prostaglandins, thromboxanes and leukotriens, (synthesis, inactivation and biological importance).

Biosynthesis of cholesterol and its role in organism - cholesterol transport and utilization in human; other isoprene compounds. Bile acids and salts, steroid hormones biosynthesis. Synthesis of vitamin D from cholesterol. Biomedical consequences of lipid metabolism; disorders in metabolic pathways, metabolic diseases. Lipoproteins – structure and properties. Biosynthesis of complex lipids. Disorders in metabolism of complex lipids. Connections between lipid and saccharide metabolism. Relationship between cholesterol and atherosclerosis. Clinical approach in treatment of atherosclerosis. Lipoproteinemias, congenital adrenal hyperplasia.

Pathobiochemistry of sugar and lipid metabolism - disorders in glucose metabolism; galactosemia, pentosuria, fructosuria, glycogenesis; disorders in fatty acids metabolism; ketonemia, ketonuria, lipid myoptia; atherosclerosis; lipoproteins role in pathological processes.

Protein and amino acid metabolism - nitrogen balance (positive, negative); intracellular degradation of proteins, amino acids (essential, nonessential); transamination, oxidative deamination, decarboxylation, NH_3 formation - the urea cycle reactions; catabolism of carbon skeletons of amino acids; glycolytic and ketogenic amino acids; disorders in amino acid metabolism. Metabolic transformation of individual amino acids. Synthesis of nonessential amino acids.

Metabolism of nucleotides - purine and pyrimidine synthesis; catabolic reaction of purines and pyrimidines - metabolic disorders (gout, Lesh-Nyhan syndrome, hyper- and hypo- uricemias, urolithiasis). Regulation of nucleotide production, synthesis of deoxyribonucleotides. Inhibitors of purine and pyrimidine biosynthesis. Salvage pathways.

Nucleic acids and proteosynthesis - properties of DNA molecule and its role in the cells; organization of genetic material (genes); replication and transcription of DNA; biosynthesis of tRNA, mRNA, rRNA; Proteosynthesis - activation of amino acids, initiation, elongation and termination of proteosynthesis; regulation and inhibition of proteosynthesis. Inhibitors of proteosynthesis. Genetic code, gene mutations, Methods of molecular biology (electrophoresis, hybridization, PCR, DNA sequence analysis, chem. synthesis of oligonucleotides).

Regulation and gene expression - posttranslation modification of proteins; translocation operons; induction and repression of the transcription; human genom, epigenetic process, gene mutation, proto oncogens and viruses, gene manipulation, the recombinant DNA technique, restriction endonucleases. Diagnostic application.

Relationships in intermediary metabolism - thermodynamic characterization of living cell, major metabolic control. mechanisms, connective points between metabolism of saccharides, lipids and proteins, feeding – starving cycle.

Biochemistry of blood - structure of the red blood cell; Specificity of metabolism of the RBC; Function of hemoglobin (transport O₂ and CO₂); Biosynthesis and degradation of heme and molecular disorders (porphyria, hyperbilirubinemia ...); plasma proteins and their physiological and biochemical functions; the salting-out and electrophoretical characterization of plasma proteins; blood clotting process, blood group substances; diseases associated with blood function.

Minerals and their role in organism - metabolism of Na⁺, K⁺, Mg²⁺, Ca²⁺, Fe, Cu, Zn, Mn, Co and Se; water balance, metabolism of osteous tissue. Acid-base balance, acidosis and alkalosis; blood buffer systems; the role of kidney and lungs in ABB.

Chemical communication in living systems; hormones control of metabolism - principles of hormone regulation; classification of hormones; mechanisms of hormone action, messengers; hierarchy of hormones; Hypothalamic releasing hormones; pituitary gland hormones.

Hormones of adrenal cortex and adrenal medulla, pancreatic hormones; thyroid hormones; parathyroid hormones; sex hormones; structural characterization, biological and pathological effects. Kinins, Mediators. Kidney hormones.

Biochemical processes in nerve cell, biochemistry of neurotransmitters and receptors; metabolism of muscle; the proteins of muscle - actin and myosin, tropomyosin, troponin system. The molecular function of muscle, molecular principle of macroscopic muscle movement. Biochemistry of visual system. Biochemical function of kidney. Biochemical principle of prion diseases. Metabolism of connective tissues. Oxidative stress.

Digestion and nutrition; basal metabolic rate. Dietary requirements. Components of natural diets (energy, essential, "inert" and toxic components). Special Nutritional Problems (obesity, starvation, alcoholism, vegetarians, pregnancy). Digestion and absorption of foodstuffs - dietary components; enzymatic processes involved in digestion, digestive secretories - saliva, gastric juice, bile, pancreatic juice; gastrointestinal hormones - gastric, secretin, cholecystokinin, somatostatine, vasoactive intestinal polypeptide, digestion and absorption mechanisms - carbohydrates, proteins, lipids. Role of vitamins and minerals; malabsorption syndrome; Clinical biochemistry – the interpretation of results.

Xenobiotics and their biotransformations, the role of liver cells in detoxification of xenobiotics, types of basic biotransformation reactions.

Molecular bases of immunochemistry - general characterization of immune system; B - and T - cells; immunoglobullins - structure and function, classification of immunoglobullins; antibodies, antigens and their interactions; antibody production; immune response; human immunodeficiency (AIDS); monoclonal antibodies; immunodiagnostic methods (ELISA); Biochemical bases of viral infection, neoplastic processes, prione diseases.

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Biochemical methods for analysis of proteins, nucleic acids, tetrapyrrols, enzymes (in blood serum), mineral substances; procedures for examination of urine (Laboratory manual). Role of clinical biochemistry