THE CONTENT OF EDUCATION OF THE SUBJECT „MEDICAL CHEMISTRY FOR DENTISTRY “ (the 1st year, Summer term) 2020/2021

1. WEEK

Lecture: RNDr. Andrezálová, PhD./ Prof. Ing. Z. Ďuračková, PhD.

Chemical composition of living systems. Biogenic elements
- physiological functions of biogenic elements in organism
- free radicals
- elements and their compounds significant from the toxicological viewpoint

Structure and chemical composition of tooth (inorganic components of tooth – hydroxyapatite, calcium fluoride).

Seminar:

Information about study. Organization of laboratory practices.
The conditions for acceptation of education from Medical Chemistry for dentistry.
Safety rules.

2. WEEK

Lecture: Assoc. Prof. PharmDr. Jakuš, PhD.

Dental materials

Composition and physicochemical properties of dental materials
- ceramics, metaloceramics and dental porcelain
- classical dental cements (zinc oxide phosphate cements, zinc oxide-eugenol cements, silicate cements, calcium alkaline cements) and glass ionomer cements
- dental alloys – gold alloys, silver alloys, titan alloys (dental implants), noble-minded alloys, compensation alloys, stainless steel, dental amalgams (alloys of metals with mercury), toxicity of amalgam
- dental abrasive and polishing materials
- dental plasters (gypsum-calcium sulphate hemihydrate)
- modelling materials (waxes)
- impression materials (silicones and alginates)
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Seminar:

Physicochemical methods
- spectrophotometry and its using in biochemical laboratory - analytical curve, molar absorption coefficient
- centrifugation

Practical exercise:

Determination of Fe^{2+} ions concentration in serum using analytical curve

3. WEEK

Lecture: Assoc. Prof. Ing. Žitňanová, PhD./ Assoc. Prof. PharmDr. Jakuš, PhD.

Dispersive systems in the relation to organism

- solutions, colloidal dispersive systems, heterodispersive systems, their properties

cell as a colloidal and heterodispersive system

Seminar:

Biogenic elements

- biogenic elements as components of important bioorganic and bioinorganic compounds and their chemical forms in the organism
- biological importance of ionic forms of biogenic elements, elements and their compounds important from toxicological viewpoint
- biological importance of trace elements in radical reactions, reactive metabolites of oxygen and nitrogen

Practical exercise:

Proof of elements in amalgam.

4. WEEK

Lecture: RNDr. Országhová, PhD./ Assoc. Prof. PharmDr. Jakuš, PhD.

Equilibrium of chemical and biochemical reactions. Protolytic (acid-basic) equilibrium in organism (in blood). Organism as thermodynamic system energetic sources, conversion and utilization of energy in living systems, significance and transmission of free energy in organism, entropy and biological system.

Seminar:

Solutions

- expression and calculation of the solution concentration
- colligative properties of solutions – osmosis and dialysis, osmotic pressure and colloidal pressure – biological importance
- electrolyte content of body fluids
- osmotic fragility of red blood cells
- main cations and anions of blood, calculation of osmotic pressure, osmolarity and ionic strength of solution

Practical exercise:

Examination of hypotonic hemolysis of erythrocytes

5. WEEK

Lecture: Prof. Ing. Z. Ďuračková, PhD./ RNDr. Országhová, PhD.

Organic compounds

Characteristics of structures and biochemically important reactions of bioorganic compounds.

- relation between structure, properties and biological function of organic compounds
- toxicologically important organic compounds
- organic components of tooth and saliva
- effective substances in dental hygiene

Seminar:

The theory of acids and bases.

- biochemical importance of protolytic reactions, „K“ and „pK“ values of weak acids and bases, „pH“ and its significance for the organism

- buffers, their composition and effect, the capacity of buffers, biochemically important buffer systems, acid-bases equilibrium
- the principle of spectrophotometric and colorimetric measurement of pH
- importance of pH for formation of tooth decay

Practical exercise:
Calculation of solutions concentrations, osmolarity and ionic strength.
Calculation of pH of strong and weak acids and bases solutions, buffers

6. WEEK

Lecture: Prof. Ing. Z. Ďuračková, PhD./ Assoc. Prof. RNDr. J.Muchová, PhD.
Structure, properties and biological functions of saccharides
- biochemically important reactions of monosaccharides (oxidation-reduction, formation of important esters, amino saccharides, deoxy saccharides, ascorbic acid, glucuronic acid).
- polysaccharides, classification and structure
- heteroglycans (mucopolysaccharides, glycoproteins, proteoglycans)
- saccharides as danger factor of tooth decay
- importance of diet on quality of tooth tissue

Seminar:
EASTER

7. WEEK

Lecture: Assoc. Prof. RNDr. J.Muchová, PhD./ Prof. Ing. Z. Ďuračková, PhD.
Structure and biological function of lipids and their derivatives
- structure of complex lipids, glycerophospholipids, sphingophospholipids, ceramide, glycolipids – their biological function, structure of biological membranes
- arachidonic acid and their oxidative derivates, prostaglandins – structure and biological function
- stomatological waxes

Seminar:
Biologically important reactions of organic compounds
- biochemically important reactions of alcohols, carbonyl compounds, carboxylic acids and their substitutional and functional derivatives
- organic acids in blood and urine
- ketone bodies and their importance

formation of urea and its importance

8. WEEK

Lecture: Prof. Ing. Z. Ďuračková, PhD.
Amino acids (AA) and peptides
- biochemically important reactions of AA
- characteristics of peptide bond, effect of peptide bond to conformation of proteins
- biologically important peptides and polypeptides (carnosine, anserine, glutathione, proteohormons, antibiotics, toxins)

Proteins

- physicochemical properties of proteins (electrical properties, isoelectric point, salting out, denaturation) and biological functions, colloidal character of proteins
- holoproteins - biological function
- heteroproteins - their classification and characteristics of individual groups
- structural proteins, proteins of the blood plasma, hemocoagulation system, fibronectin, complement system, inhibitors of proteinases
- immunoglobulins – structure and biological function
- proteins of join tissue – collagen, elastin, noncollagen proteins binding calcium

Seminar:

Saccharides

Repetition of basic knowledge of saccharides:

- classification of saccharides
- monosaccharides (structure, optical activity)
- reactions of monosaccharides (oxidation, reduction, methylation, esterification, reaction with nonoxidative mineral acids), the origin of hemiacetals, detoxication function of glucuronic acid
- derivatives of monosaccharides and their biological importance
- the formation of Schiff bases in nonenzymatic glycation of proteins, glucose toxicity
- oligosaccharides (disaccharides, glycosidic bond)
- polysaccharides (homopolysaccharides, heteropolysaccharides)

Practical exercise:

Detection of glucose in urine

Enzymatic determination of glucose concentration in serum

9. WEEK

Lecture: **Assoc. Prof. Ing. Žitňanová, PhD./ Assoc. Prof. RNDr. J.Muchová, PhD.**.

Enzymology – introduction

General characterization of the enzymes

Mechanism of the effects of the enzymes – influence on activation energy of reaction. The kinetics of the enzymes reaction.

- the active (catalytic) sites of the enzymes, the importance of the apoenzyme for the activity of the enzymes
- the specificity and substrate effects of the enzymes
- the influence of the basic factors on the activity of the enzymes
- significance of Michaelis-Menten (K_m) constant for the catalytic activity of the enzymes
- calculation and graphical evaluation of K_m constant

Seminar:

- Physico-chemical properties of lipids and their application in the construction and function of biomembranes. Peroxidation of membrane lipids.
- Steroids - basic structure, nomenclature, distribution according to functional meaning and according to the number of carbon atoms
- - basic hydrocarbons of steroids (C18 - C29), sterols
- - provitamins and vitamins D. Bile acids, cholanic acid. Steroid hormones. Mineralocorticoids and glucocorticoids. Sex hormones. Androgens and gynecogens (estrogens and progestogens).

Practical exercise: Determination of total serum lipids.

10. WEEK

Lecture: **Assoc. Prof. Ing. Žitňanová, PhD./ Assoc. Prof. RNDr. J.Muchová, PhD.**

Activation and inhibition of the enzymes
- alteration of the proenzyme to active enzyme
- inhibition - competitive, noncompetitive, uncompetitive and allosteric
- the allosteric enzymes – their regulation effects in metabolism and function of the cell
- induction and repression of enzymes – their regulation function in metabolic processes in the cells

Enzyme nomenclature

Enzymes in the oral cavity, their function and diagnostic importance

Seminar:

Amino acids and proteins
- basic structure, physicochemical properties of proteinogenic amino acids, amphoteric character, isoelectric point
- biochemical reactions of the amino acids (decarboxylation, deamination, transamination, acylation, reactions of the amino acid determination)
- biologically important peptides
- structure and properties of the proteins (salting-out of proteins, denaturation, colloidal properties, isoelectric point), their using in the separation and purification of proteins
- nonenzymatic glycation of proteins, glycohemoglobin, toxicity of glucose

Practical exercise:

TLC chromatography of amino acids

11. WEEK

Lecture: **Prof. Ing. Z. Ďuračková, PhD./Assoc. Prof. RNDr. J.Muchová, PhD.**

Nucleotides and nucleic acids, nucleoproteins
- Biologically important nucleotides

Oxidative stress
- effect of oxidative stress on structure and function of biologically important macromolecules
- free radicals, their physiological and pathological importance
- antioxidant systems in the organism – their classification and function in protection of organism from damage by reactive metabolites of oxygen

Seminar:
- factors affecting the activity of enzymes (pH, temperature, concentration of enzyme and substrate)
- expression and calculation of enzymes activity

12. WEEK

13. DISSECTION

13. WEEK

Substitutions of the laboratory practices and the lectures. Acceptation of practical education from Medical Chemistry for Dentistry.