Tárgytematika / Course Description

Food chemistry

MENB_ÉTTA008

Tárgyfelelős neve / Teacher's name: dr. Ajtony Zsolt
Félév / Semester: 2022/23/1
Beszámolási forma / Assesment: Vizsga
Tárgy heti óraszáma / Teaching hours(week): 2/2/0
Tárgy féléves óraszáma / Teaching hours(sem.): 0/0/0

OKTATÁS CÉLJA / AIM OF THE COURSE

Objectives
The aim of the course is to provide the students with a deep understanding of how food components contribute to the overall quality of foods and to enable students to evaluate and explain how the highly complex nature of food may result in a multitude of desired and undesired reactions which are controlled by a variety of parameters.

TANTÁRGY TARTALMA / DESCRIPTION

1. Water and minerals .
Water. Structure. Water molecule. Liquid water and ice (free or bound). Auto-dissociation of water, dissociation constant, water-ion product constant. The hardness of the water. Drinking waters, mineral waters. State of water in food. Effect on storage life. Water activity.
Minerals. Main elements: sodium, potassium, magnesium, calcium, chlorine, phosphorous, sulfur. Trace and ultra-trace elements: iron, copper, zinc, manganese, cobalt, chromium, selenium, molybdenum, nickel, fluorine, iodine, tin, aluminum, silicon, boron, arsenic
2. Carbohydrates. Monosaccharides
Monosaccharides. Chemical reactions of monosaccharides: reaction with carbonyl compounds, oxidation, reduction, glycoside formation, ether formation, intra- and intermolecular water elimination, endiol formation, reactions in the presence of acids and alkalies, caramelization, reaction with amino compounds (*Maillard* reaction). Monosaccharides are more important for the food industry. Monosaccharide derivatives, glucaric acids, and glycosides.
3. Carbohydrates. Oligo- and polysaccharides
Oligosaccharides. Disaccharides: maltose, isomaltose, cellobiose, lactose, saccharose. Trisaccharides: raffinose.
Polysaccharides. Homo- and heteropolysaccharides. Starch: amylose, amylopectin, gelatinization, retrogradation. Modified starch, starch derivatives. Starch esters, starch ethers, cross-linked starch. Dextrins, pirodextrins, cyclodextrins, glycogen, cellulose and its derivatives, lichenin, dextran, inulin, graminin, levan, mannans, pectin, alginates, chitin, xylan, hemicellulose, xanthan, carrageen, agar, gum arabic. Carbohydrates-protein derivatives.
4. Amino acids, peptides

Amino acids. Structures and properties of amino acids. Solubility, optical activity, isoelectric point. Chemical reactions of amino acids: decarboxylation, ester formation, reaction with nitrous acid, formaldehyde; ninhydrin, dinitro-fluorobenzene, dansyl chloride.
Peptides. Formation of peptides. Structure of the peptide bond. Carnosine, glutathione. Hormonal peptides: oxytocin, vasopressin, adrenocortical hormone, insulin, bradykinin, parathormone, calcitonin, lipotropic hormone, prolactin, FSH, TSH, glucagon, protease inhibitors, endorphin. Antibiotical peptides.
5. Proteins and their structures
Classification of proteins. Function, solubility, molecular mass, and form.
Structure of proteins: primary (amino acid sequence), secondary (alpha-helix, beta-sheet) tertiary (globular), quaternary (polymer).
Chemical reactions of proteins. Precipitation reaction, color reactions: biuret, ninhydrin, xanthoprotein, lead sufide, *Millon*, *Pauly*, *Sakaguchi*. Denaturation of proteins.
Functional properties of proteins.
6. Proteins in nature
Protein in nature. Skeletal proteins (collagen, gelatin, elastin, keratin, silk fibroin). Protamins and histones. Plant proteins, (wheat, legumes, oil-seeds, potato)
Transformation of food proteins during processing and storage. Heat treatment: denaturation, desulfuration, deamination, isomerization. DHA formation. Biochemical transformation of proteins.
7. Lipids
Classification of lipids, saponifiable, non saponifiable lipids.
Fatty acids, saturated, non-saturated. Physical (density, state of matter, boiling and melting point), and chemical properties (H-addition, O-addition, water-addition, halogen-addition) of fatty acids.
Acylglycerols/Acyl glycerides. Physical and chemical properties. Hydrolysis of the ester bond. Racidification of acylglycerols: hydrolytic, oxidative (aldehyde rancidification), microbial (ketone rancidification). Prooxidants.
Diollipids, phospho- and glycolipids, Fatty alcohols and *waxes*, *Sterols* (zoosterols, phytosterols, mycosterols). *Carotenoids*.
Properties of triacylglycerols. Natural origin, animal and plant fats. Biochemical degradation of lipids.
8. Vitamins
The physiologic role of vitamins. Provitamins, antivitamins. Classification of the vitamin.
Fat-soluble vitamins. Retinol (A), calciferol (D), alpha-tocopherol (E), phylloquinone (K_1). Biological roles, requirements, occurrence, stability, degradation.
Water-soluble vitamins. Thiamine (B_1), pyridoxine (B_2), riboflavin (B_6), nicotinamide (niacin), pantothenic acid, biotin, folic acid, cyanocobalamin (B_{12}), L-ascorbic acid (C). Biological roles, requirements, occurrence, stability, degradation.
9. Natural colorant . Carotenoids, quinones, flavonoids, pyrrole colorants.
Flavour and aroma compounds. *Basic tastes:* sweetness, sourness, saltiness, bitterness, savoriness (umami). *Further sensations and transmission*: pungency, coolness, numbness, Astringency, Fat taste. Smoking, Roasting. *Aroma compounds* of garlic, onion, kraut, Brussel spout, radish and horseradish, fruits, dairy products, roasted products, muscular tissue, fiches, rancid fat.
Other organic compounds. Alcohols, phenols, aldehydes, ketones, organic acids, esters, essential oils, alkaloids.
10. E nzymes I

Catalysis, kinetics of the enzyme-catalyzed reaction, Michaelis–Menten equation. Nomenclature. *Specificity*, substrate specificity, reaction specificity. *Enzyme inhibitors*, irreversible, reversible inhibitors, competitive, uncompetitive, noncompetitive inhibition, mixed inhibition. Active site, lock and key hypothesis, induced fit hypothesis, conformational selection hypothesis.
11. E n z ymes II
EC-1 Oxidoreductases: Pyridin, flavin, hemin enzymes, oxygenases.
EC-2 Transferases: Phosphotransferases, glycosyltransferases, aminotransferases.
EC-3 Hydrolases: Esterases, glycosidases, proteases, amidases and amidases, acid anhydride hydrolases
EC-4 Lyases. C-C- lyases, C-O- lyases
EC-5 Isomerases. Sugar isomerases, other isomerases.
EC-6 Ligases, synthetases
12. Food Additives
Preservatives. Antioxidants. Sweeteners. Thickeners, stabilizers emulsifiers. Flavors, flavor enhancers. Colors.
13. Food contaminants
Toxic alkaloids. Toxic amino acid derivatives. Toxic constituents of the essential oils. Antinutritives. Bacterial toxins and mycotoxins. Insecticides, fungicides, and herbicides. Polycyclic aromatic hydrocarbons. Polychlorinated p-dibenzo dioxides and dibenzofurans. Acrylamides. Toxic trace elements.
14. Cleaning agent, disinfectants, and p ackaging materials .
Cleaning agents: inorganic (sodium hydroxide, sodium carbonate, trisodium phosphate, nitric acid, phosphoric acid), detergents (soaps, fatty alcohol sulfates, alkyl sulfonates)
Disinfectants: inorganic (containing chlorine, and iodine) and organic.
Packaging materials: Glass, metals (steel, aluminum), paper, plastics (polypropylene, polybutylene, polyvinyl chloride, polyvinylidene chlorine, polystyrene, polyesters, polyamides, others plastics (silicones, polytetrafluoroethylene))

LABORATORY EXERCISES:
Requirements
1. Students should have a closed work jacket, flawless rubber gloves, alcohol felt-tip pen, calculator, and wipes during the internship.
2. Only students who have received accident and fire prevention education may participate in the exercises. Students who have not attended the mandatory accident and fire prevention training due to the absence of the first laboratory internship and have not certified the relevant protocol with their signatures may perform further internships only if their deficiencies are remedied and reported orally.
3. An additional condition for participation in the internship is that the students have the basic knowledge necessary for the successful implementation of the internship, the tasks to be performed and the theory belonging to them.
4. A written report is required during laboratory exercises.
5. At the end of the internship, the protocol must be signed by the internship supervisor for certification.
6. The requirement is for signing at the end of the semester to complete eighty percent of the internships. The internship is considered completed if the student has submitted the written report on time and it has been approved by the instructor.
Topics

1. Accident and fire prevention education. Introduction to laboratory work.
2. Use of laboratory utensils, tools and equipment
3. Water and minerals
4. Carbohydrates I
5. Carbohydrates II
6. Proteins I
7. Proteins
8. Lipids
9. Vitamins
10. Colorant, flavoring
11. Organic compounds, Enzymes
12. Additives
13. Toxins, packaging materials, cleaning agents
14. Replacement practice.

SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESMENT'S METHOD

Exam: The written examination is will be scheduled in the exam period and will be closed-notes and closed-book.
Requirements: Completion of at least 80% of the laboratory exercises. More than 50% performance on the exam.

KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

Textbooks
1. Belitz, H.-D;·Grosch, W. ; Schieberle, P. (2009) Food Chemistry 4th revised and extended ed., Springer-Verlag Berlin, Heidelberg
2. Damaodaran, S; Parkin, K. L.; Fennema O. R. (Eds.) (2017) Fennema´s Food Chemistry Fifth Edition., CRC Press, Taylor & Francis Group
ORAL PRESENTATIONS