Universitat Autònoma de Barcelona

2019/2020

Biochemistry II

Code: 103265
ECTS Credits: 6

Degree	Type	Year	Semester
2501925 Food Science and Technology	FB	2	1

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: Yes

Teachers

Carlos Santolaria Bello

Prerequisites

Although there are no official prerequisites, it is advisable for the student to review the basic contents of Biology, Chemistry and to have a sufficient level of Biochemistry I.

Objectives and Contextualisation

This subject should allow the student to understand that biological processes, especially those related to food and metabolism, have a chemical base and can be explained in these terms. The student must know the basics of metabolism that allow him/her to understand the biochemical foundations of Nutrition, with special emphasis on the metabolism of different types of biomolecules. Likewise, he must to know and understand the basic biochemical processes of some important processes in food technology.

The specific training objectives are to know and understand:

- The energy metabolism of carbohydrates.

- The metabolism of lipid reserves, lipoproteins, cholesterol and complex lipids.

- The metabolism of nitrogen compounds: amino acids, porphyrins and nucleotides.

- The main mechanisms for the integration of metabolism, hormonal regulation and molecular bases of adaptations and metabolic alterations.

- The foundations and applications of the main biochemical techniques and methodologies

Competences

- Adopt an ethical stance and attach importance to quality in work.

- Analyse, summarise, resolve problems and make professional decisions.
- Apply knowledge of the basic sciences to food science and technology.
- Apply the scientific method to resolving problems.
- Communicate effectively with both professional and non-professional audiences, orally and in writing, in the first language and/or in English.
- Develop individual learning strategies and planning and organisation skills.
- Display knowledge of nutrients, of their bioavailability and function in the organism, and the bases of nutritional balance.
- Display knowledge of the physical, chemical, biochemical and biological properties of raw materials and foods.
- Search for, manage and interpret information from different sources.
- Stay abreast of new knowledge, adapt to new situations and develop creativity.
- Use IT resources for communication, the search for information within the field of study, data processing and calculations.

Learning Outcomes

1. Adopt an ethical stance and attach importance to quality in work.
2. Analyse, summarise, resolve problems and make professional decisions.
3. Apply the fundamental principles and the applications of biochemistry to food biotechnology.
4. Apply the scientific method to resolving problems.
5. Communicate effectively with both professional and non-professional audiences, orally and in writing, in the first language and/or in English.
6. Describe the reactions of reaction, kinetics and enzyme regulation.
7. Determine the biochemical mechanisms of xenobiotic detoxification.
8. Develop individual learning strategies and planning and organisation skills.
9. Establish the metabolic role of vitamins, oligoelements and other essential nutrients.
10. Explain the principal metabolic pathways of glucids, lipids and proteins.
11. Explain the structures and properties of the principal biological molecules.
12. Integrate the different metabolic elements in a global vision of the organism.
13. Search for, manage and interpret information from different sources.
14. Stay abreast of new knowledge, adapt to new situations and develop creativity
15. Use IT resources for communication, the search for information within the field of study, data processing and calculations.

Content

METABOLISM AND METABOLIC REGULATION

Unit 1.- Study of the regulation of the metabolic pathways. Localization of regulation sites. Study of the properties of the enzymes involved. Crossing points. Creation and verification of a regulatory theory.

Unit 2. Biochemical study of carbohydrates. Generalities. Families of monosaccharide. Natural oligosaccharides. Reserve and structural polysaccharides.

Unit 3.- Glycolysis. Overview and phases. Steps of the process of pyruvate formation from glucose.

Unit 4.- Formation of acetyl CoA from pyruvate and tricarboxylic acids cycle. Anaplerotic reactions. The glyoxylic acid Cycle. Synthesis and degradation of disaccharides. Metabolic pathways for fructose and galactose.

Unit 5.- Oxidation-Reduction and electronic transport. Red-ox potentials and free energy change. Route for electronic transport: the respiratory chain. Inhibitors. The mitochondria and oxidative phosphorylation. Coupling of oxidative phosphorylation to electronic transport. The mechanism of oxidative phosphorylation.

Unit 6. Fermentations. Alcoholic fermentation. Lactic fermentation. Applications in food technology.

Unit 7.- Lactate formation and gluconeogenesis. Use of energy by the muscle. Anaerobic glycolysis. Destination of lactate. Gluconeogenesis. Other precursors. Distinctive reactions of gluconeogenesis.

Unit 8.- The pentose Phosphate pathway. The generation of reducing power. Biosynthesis of glucuronic acid.

Unit 9.- Metabolism of glycogen. Glycogen as a form of glucose storage. The degradation and synthesis of glycogen and its control.

Unit 10.- Biochemical study of lipids. Fatty acids. Waxes. Triglycerides. Phosphoglycerides. Sphingolipids and glucolipids. Cholesterol.

Unit 11.- Oxidation of fatty acids. Mobilization of lipid reserves. The path of fatty acids oxidation. Metabolism of the ketone bodies.

Unit 12.- Biosynthesis of lipid reserves. Biosynthesis of saturated fatty acids. The formation of malonyl CoA. The fatty acid synthase complex. Essential fatty acids. Prostaglandins and leukotriens.

Unit 13.- The biosynthesis of cholesterol and its derivatives. The route to mevalonate and the formation of prenyl groups and synthesis of polyprenyl chains. Cholesterol formation. Bile acids and sex hormones. Importance of isoprenoids in plant metabolism and their interest in food technology.

Unit 14.- Digestion and absorption of lipids. Lipoproteins Composition and metabolism. Molecular bases of arteriosclerosis.

Unit 15.- Metabolism of structural lipids. Phosphatidylglycerides. Sphingolipids: sphingomyelin, cerebrosides and gangliosides. Phosphatidyl-inositol cycle. Generation of IP_3.

Unit 16.- Degradation of amino acids. Release and elimination of nitrogen. Desamination and transamination. Urea cycle.

Unit 17.- Catabolism of the carbon skeletons of the amino acids. Cetogenic and gluconeogenic amino acids The integration of the side chains into the different metabolic pathways. Aminoacidopathies. The pool of monocarbon groups and their relationship to the metabolism of amino acids and their regulation. Derivatives of folic acid and S-adenosylmethionine. Essential amino acids.

Unit 18.- Nitrogen fixation and general vision of amino acid biosynthesis and its regulation. Indispensable and not indispensable amino acids.

Unit 19.- The turnover of porphyrins. Nomenclature and synthesis of porphyrins. Degradation of hemoglobin. The bile pigments.

Unit 20.- The metabolism of nucleotides. Biosynthesis of nucleotides: purines and pyrimidines. Biosynthesis of deoxyribonucleotides. Degradation of purines and pyrimidines.

Unit 21.- Integration of metabolism: Overview of the relationships between the different organs and main metabolic adaptations. Fasting. Obesity. Diabetes

Unit 22. Biochemical mechanisms of detoxification of xenobiotics. Oxidative stress and mechanisms of antioxidant defense.

LABORATORY SESSIONS.

Session 1. Study of the metabolic cycle of yeast. Different use of carbon sources: fermentation and oxidation.

Session 2.- Determination of the levels of cholesterol in eggs.

Session 3.- Applications of the electrophoresis in the determination of the composition of proteins in several fish species and substitute products.

Session 4.- Simulation of metabolic pathways: gluconeogenesis.

SEMINARS

Seminar 1: Radioactive techniques

Seminar 2: Electrophoretic techniques

Seminar 3: Molecular Bases of Hormone Action I

Seminar 4: Molecular bases of hormonal action II.

Methodology

The methodology used in this subject to accomplish the learning process combines the theory classes, where the teacher exposes the most relevant aspects of each unit, and the active self-learning of the student on topics of interest.

The subject is based on the following activities:

. Face-to-face classes with ICT support, where the basic concepts of the subject are explained.

. Seminars and discussion of problems: Presentation by the teacher of specific topics and discussion in reduced groups.

. Laboratory sessions: Acquisition of laboratory work skills and experimental understanding of concepts explained in face-to-face classes and seminars.

. Independent student work, individually or in groups, leading to the preparation of topics proposed by the teacher or the student This work involves the search and selection of information from various sources of scientific information. Presentations are public, they must include multimedia material and ICT support and are followed by a discussion of the subject.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory Practical Course	12	0.48	10
Lectures	31	1.24	7, 10, 12
Seminars	4	0.16	12
Type: Supervised			

Self-learning topic, team working	21.5	0.86	7, 10, 12
Type: Autonomous			
Study and literature search	75	3	7, 10, 12

Assessment

The maximum score that can be obtained is 10 points. The subject will be passed with a global score of 5.0 or higher.

The evaluation system is organized in three modules. The final score is obtained with the sum of qualifications of the different modules, with the conditions that are described below.

Module 1. theory, seminars and problems.

Evaluation system: tests with multiple choice answers. Weight in the global rating:

- partial exam I: 35%

-partial exam II: 35%

- Skills evaluated: CE1, CE2, CE11, CT1, CT2, CT9

Students who wish to do so may opt for partial tests of the syllabus. There will be two partial tests along the course The first test includes topic 1 until about subject 10 (depending on the specific year calendar). Part 2 includes from topic 10 to the end of the program. To pass each test and get rid of matter, it is necessary to get a score of 5.0/10 or higher. Each test will consist of about 20-25 test questions per each partial. Seminar questions will also be included. The scheme (see Campus Virtual) includes the different possible situations:

1) Both partial are passed with a mark equal or superior to 5 (on 10): The final note is obtained by the sum of a) the average of both partial (weight: 70%), b) the mark of the practical exam (weight: 10%) and the mark obtained in the self-learning presentation (weight: 20%). If this sum is equal to or greater than 5, the subject will be *Passed*. If the sum is less than 5, the final grade will be Failed.

2) The student passes only one of the two partials: At the "recovery exam" he/she will have to examine only of the partial failed . If in this recovery exam a grade equal to or greater than 3.5 (out of 10), is obtained, the final mark will be the sum of the average of the two partials (weight: 70%), the mark of the practical exam (weight: 10%) and the note from the self-learning (weight: 20%). If this amount is equal to or greater than 5, the score will be *Passed*. If the sum is less than 5, the final grade will be Failed. If in the recovery of the partial the student obtains a mark inferior to 3,5 (over 10), he/she will not be able to compensate with the passed partial and, therefore, the final mark will be Failed.

3) The student fails both partials: the student will have to carry out the recovery exam for all Module 1 (theory + seminars). The exam will be corrected as a unique test. The minimum mark in this exam must be 4 (out of 10). A mark lower than 4 means a *Fail* in the final qualification. If this mark is equal to or greater than 4 (out of10), the final score will be obtained by the sum of the recovery exam (weight: 70%), the mark of the

practical exam (weight: 10%) and the mark of the self-learning item (weight: 20%). If this sum is equal to or greater than 5, the subject will be Passed. If it is less than 5, the final mark will be Failed.

Module 2. laboratory practices:

Carrying out the laboratory practices is mandatory for passing the subject. The student not carrying out these lab practices will be qualified as Not assessable or Failed, depending on his/her situation.

- Assessment system: written test about the activities carried out during the practices in an independent exam

- Weight in the global rating: 10% (Maximum score: 1,0)

- Skills evaluated: CE1, CE2, CE11, CT2, CT8, CT9

Module 3. Self-learning.

Carrying out the work of self-learning is compulsory and, therefore, the student who does not carry out the presentation will be assessed as *Not assessable* or Failed, depending on his/her situation and regardless of the marks obtained in the exams.

Evaluation system: Oral Presentation and defense.

- The written and oral presentation, as well as the competence at the time of the topic discussion, will be evaluated.

- Weight in the global rating: 20% (Maximum score: 2.0)

- Skills evaluated: CE1, CE2, CE11, CT4, CT5, CT6, CT8, CT10

RECOVERY EXAM

The student who chooses not to carry out partial examinations will be examined for the whole syllabus of Module 1 in the recovery exam. The obtained mark (up to a maximum of 7.0 points) (Module 1) will be added to that obtained in Modules 2 and 3.

Any student, regardless of the score obtained in the partial tests, may choose to be examined for the whole program in the recovery exam to obtain a new note. In this case, the mark obtained in this last exam will be taken into account.

Not-assessable:

It will be considered that a student is not It will count if he/she has participated in assessment activities that represent 15% of the final score.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final and Partial tests	70%	3	0.12	3, 7, 9, 11, 10, 12
Laboratory exam	10%	1	0.04	2, 4, 6, 7, 10, 12
Self-learning presentation	20%	2.5	0.1	1, 13, 5, 8, 7, 10, 12, 14, 15

Bibliography

1.- Nelson, D.L., & Cox, M.M. Lehninger Principles of Biochemistry. 6 th ed. Freeman ed. 2013.

2.- Berg, J. M., Tymoczko, J. L. & Stryer, L. Bioquímica. 7th ed. Ed. Reverté. Barcelona, 2013. (8th ed., 2015 in English)

3.- Tymoczko, John L.; Berg, Jeremy M.; Stryer, Lubert L. Bioquímica. Curso Básico. Ed. Reverté. Barcelona, 2014 (Stryer's light versión, cheaper and sufficient for the topic)

4.- Voet, D., Voet, J.G & Pratt, C.W. Fundamentos de Bioquímica. 4 th ed. Ed. Panamericana. 2016.

5.- D. R. Ferrier. Biochemistry. 6 th ed. Lippincott's Illustrated Reviews. 2014.

6.- Mathews, Van Holde, Appling & Anthony-Cahill. Bioquímica. 4 th ed. Pearson Educación, 2014.

7.- DAMODARAN, S., PARKIN, K. L. y FENNEMA, O. R. Química de los Alimentos. 3 th ed. Ed. Acribia. 2010.

8.- Wong D.W.S . Mechanism and Theory in Food Chemistry, 2nd Ed. Springer, 2017

9.- Gil, A. Bases Fisiológicas y Bioquímicas de la Nutrición. 2 nd e. Editorial Panamericana. 2010.

10.-McKee, T; McKee, J.R.. Bioquímica, las bases moleculares de la vida. 4 th Ed. McGraw-Hill, 2009