
	PROCESO PARA EL DESARROLLO DE LAS ENSEÑANZAS DE LA ESCUELA DE INGENIERÍAS AGRARIAS		 Escuela de Ingenierías Agrarias
		CÓDIGO: P/CL009_D002	

COURSE SYLLABUS

Academic Year: 2023/2024

Identification and characteristics of the course			
Code	502221	ECTS Credits	6
Course title (English)	Food Chemistry and Biochemistry		
Course title (Spanish)	Química y Bioquímica de los Alimentos		
Degree programs	Degree in Science and Food Technology		
Faculty/School	School of Agricultural Engineering		
Semester	Second (4th)	Course type (compulsory/optional)	Compulsory
Module	Food science		
Subject matter	Food chemistry and biochemistry		
Lecturer/s			
Name	Room	E-mail	Web page
Lourdes Martín Cáceres	703 Jerte Valley Building	martinlu@unex.es	https://www.unex.es/conoce-la-uex/centros/eia/centro/profesores
Ana Isabel Carrapiso Martínez	712 Jerte Valley Building	acarrapi@unex.es	https://www.unex.es/conoce-la-uex/centros/eia/centro/profesores
José Manuel Martínez Torres	702 Jerte Valley Building	jmtorres@unex.es	https://www.unex.es/conoce-la-uex/centros/eia/centro/profesores
Subject Area	Food Technology		
Department	Animal Production and Food Science		
Coordinator (Only if there is more than one lecturer)	Lourdes Martín Cáceres		

Competencies^{1*}

Specific competencies

- CECA1. Ability to know, understand and use the principles of chemical and biochemical reactions in food.

^{1*} The sections concerning competencies, course outline, teaching activities, teaching methodology, learning outcomes and assessment methods must conform to those included in the ANECA verified document of the degree program.

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- CECA2. Ability to know, understand and use the principles of food components and their physico-chemical, nutritional, functional and sensory properties.
- CECA3. Acquire skills and abilities in food analysis.

Contents

Course outline*

Food components. Chemical and biochemical changes in foods during processing and storage. Food additives.

Course contents

Title of unit 1: **Water in food.**
 Contents of unit 1: Importance of water in food. Molecular structure and physicochemical properties of water. Water activity. Methods of determination. Sorption isotherms. Hysteresis.

Title of unit 2: **Molecular mobility.**
 Contents of unit 2: Molecular mobility. State diagrams: phase transition in foods. Technological importance of molecular mobility in industrial processes.

Title of unit 3: **Functional properties of carbohydrates.**
 Contents of unit 3: Characteristics of carbohydrate foods. Functional properties of mono-and oligosaccharides.

Title of unit 4: **Starch in food.**
 Contents of unit 4: Starch: structure and properties. Starch gel formation. Factors influencing the formation of gels. Stability of the starch gels. Modified starches.

Title of unit 5: **Structural polysaccharides and their roles in food.**
 Contents of unit 5: Pectins. Cellulose and other cell wall components. Gums. Polysaccharides derived from seaweed.



Title of unit 6: **Non-enzymatic browning.**
 Contents of unit 6: Non-enzymatic browning reactions. Caramelization. Maillard reaction. Mechanisms and control.

Title of unit 7: **Carbohydrates in fruits and vegetables.**
 Contents of unit 7: Metabolism of fruits and vegetables. Chemical modifications of carbohydrates. Postharvest control conditions.

Title of unit 8: **Functional properties of lipids.**
 Contents of unit 8: Characteristics of food lipids. Functional properties of lipids: crystal formation and fusion.

Title of unit 9: **Formation of emulsions in food.**
 Contents of unit 9: Emulsions. Formation and breaking of emulsions. Emulsifiers: stabilizing functions and HLB value.

Title of unit 10: **Changes of lipids in foods.**
 Contents of unit 10: Changes in lipids during processing and storage of food: lipolysis, autoxidation and enzymatic rancidity. Frying oil chemistry.

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Title of unit 11: Lipid modification treatments. Contents of unit 11: Physico-chemical treatments for lipid modification in the food industry: hydrogenation, transesterification and fractionation. Fat replacers.
Title of unit 12: Functional properties of proteins. Contents of unit 12: Characteristics of amino acids and protein structure in food. Types of bonds in proteins. Functional properties.
Title of unit 13: Food protein systems. Contents of unit 13: Bread dough, milk and meat; effect of treatments on protein systems.
Title of unit 14: Food enzymes. Contents of unit 14: Food enzymes. Types and applications. Immobilized enzymes and their use in the food industry. Enzymes as indicators of treatment.
Title of unit 15: Pigments in foods I. Contents of unit 15: General concepts. Myoglobin and Hemoglobin. Meat color. Chemistry of myoglobin. Effect of storage and processing on the colour of meat.
Title of unit 16: Pigments in foods II. Contents of unit 16: Chlorophyll. Effects of processing on chlorophylls. Carotenoids. Anthocyanins. Structure. Colour changes and chemical reactions of anthocyanins. Betalains. Flavonoids.
Title of unit 17: Enzymatic browning. Contents of unit 17: Enzymatic browning reaction. Factors influencing enzymatic browning. Measures to minimize enzymatic browning.
Title of unit 18: Food additives. Contents of unit 18: General concept of food additive. Classification. Legislation.
Title of unit 19: Additives that prolong the shelf-life. Contents of unit 19: Preservatives: sulfites; nitrites; organic acids and related products; antibiotics; other preservatives. Antioxidants.
Title of unit 20: Additives that enhance flavor, aroma and color. Contents of unit 20: Sweeteners. Acids. Aromas. Flavour enhancers. Colours.
Title of unit 21: Additives that improve texture. Contents of unit 21: Thickeners, gelling agents and stabilizers. Emulsifiers. Humectants. Anti-caking agents. Firming agents. Emulsifying salts. Bulking agents. Flour treatment agents.
Title of unit 22: Other additives. Contents of unit 22: Acidity regulators. Contrast enhancers. Raising agents. Anti-foaming agents. Glazing agents. Packaging gases and propellants. Carriers.
Practical sessions
Laboratory practices SDGs (SDG 12) are taken into account, minimizing the generation of waste and adapting its treatment to recycle.
Description of practical activities 1: Determination of water activity. Contents P1: Determination of water activity in food.

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<p>Description of practical activities 2: Evaluation of polysaccharides. Contents P2: Determination of soluble solid content. Evaluation of chemically modified starch. Assessing the strength of pectin gels. Preparation of alginate and other polysaccharides gels.</p>
<p>Description of practical activities 3: Browning reactions. Contents P3: Non-enzymatic browning reaction. Fehlings test for reducing sugars. Enzymatic browning reaction.</p>
<p>Description of practical activities 4: Determination of lipids. Contents P4: Fat extraction and quantification by method of Folch. Peroxide, acidity and iodine values and slip point. Determination of TBA.</p>
<p>Description of practical activities 5: Evaluation of pigments. Contents P5: Evaluation of the effect of pH on anthocyanins. Pigment separation from green leafy vegetables.</p>
<p>Description of practical activities 6: Evaluation of food dispersions. Contents P6: Albumin foam stability. Use of emulsifiers.</p>
<p>Seminar It consists on a presentation about food additives. The fundamental aspects of the food additives regarding their category, function, action mechanism and particularities should be briefly explained.</p>

Educational activities *								
Student workload (hours per lesson)		Lectures	Practical sessions				Monitoring activity	Homework
Lesson	Total	L	HI	LAB	COM	SEM	SGT	PS
1-2	14	4					1	9
3-7	18	7						11
8-11	13	4					1	8
12-13	12,5	4					0,5	8
14	11	2					1	8
15-16	12	3					1	8
17	9	1						8
18-22	20,5	8,5						12
P1	6			4				2
P2	6			4				2
P3	6			4				2
P4	3			2				1
P5	6			4				2
P6	6			4				2
Seminar	5					2,5		2,5

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Assessment 2**	2	2						
TOTAL ECTS	150	35,5		22		2,5	4,5	85,5

L: Lectures (100 students)
 HI: Hospital internships (7 students)
 LAB: Lab sessions or field practice (15 students)
 COM: Computer room or language laboratory practice (30 students)
 SEM: Problem-solving classes, seminars or case studies (40 students)
 SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
 PS: Personal study, individual or group work and reading of bibliography

Teaching Methodology*

- **Expository classes with discussion of theoretical content.** They are taught in 3 hours a week from the beginning to the middle of the term and 2 hours a week from the middle of the term until the end of the course. In the last minutes of each large group expository class, small evaluations can be made of what has been discussed in the class.
- **Laboratory practices.** They are carried out in 6 sessions (5 sessions of 4 hours and 1 session of 2 hours). In the laboratory, management of chemical products and solvents are in accordance with the SDGs. Students must prepare a Practice Report.
- **Development and presentation of seminars.** Groups of 2-3 students prepare a paper on the proposed topic, which must be presented.
- **Use of the virtual classroom.** Students have the presentations used in the expository classes and the practical protocols in the virtual area. It also provides a space that allows communication through forums, announcements, etc.
- **Study of the subject.** This is the personal work that students must undertake.
- **Search and management of scientific bibliography.** Adequate bibliographic sources are required to consult aspects related to the contents of the subject and, especially, to prepare the seminar.

Learning outcomes *

- RA39. Demonstrate the knowledge of chemical and biochemical characteristics of food components, providing conclusions of the implication of these characteristics in the transformation of food.
- RA40. Explain in detail the functional properties of food components.

2** Insert as many rows as necessary. For instance, you can include one row for a partial exam and another for the final exam.

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- RA41. Evaluate the mechanism and consequences of the chemical and biochemical reactions involved in food spoilage.
- RA42. Explain the influence of technological treatments and storage on food components.
- RA43. Demonstrate an understanding of the use of authorized food additives in the food industry, the study of their mechanisms of action and their applications.
- RA44. Explain the activities carried out in the laboratory, demonstrating the ability to observe, interpret the results and obtain final conclusions.

Assessment methods *

Continuous evaluation system

To calculate the course ratings, the following percentages are used:

- **60%** of the final mark comes from the final evaluation through a theory exam, which consists of preferably short questions, although it can also include test questions. Test questions have four possible answers with only one correct; 2 wrong answers subtract 1 correct answer. At least 5 points up to 10 must be obtained in the theory exam.

Competences that are evaluated: CECA1.

- **20%** of final mark comes from laboratory practices evaluation. Attendance at the laboratory practices is compulsory. Students must prepare and deliver a Practice Report following the format of the files that are provided in the virtual classroom of the subject. The Practice Reports must be submitted by the deadline. To evaluate the practical part, the quality of the Practices Report and the development of the practices are taken into account.

In case not attending the practical classes or not reaching at least 5 point in laboratory practices ratings, students are required to do a Practice Exam, that coincides in time and place with the final theory exam. The Practice Exam consists of short questions about the laboratory practices that had been developed in the course.

It is required for passing the course to have passed the practical part. In the case of not passing the practical part, the final mark of the course will be no more than 4.5 points, despite the weighted average has been higher.

Competences that are evaluated: CECA3.

- **15%** of the final mark comes from the evaluation of the attendance in the expository classes, which comes from the rating of the small exams that are carried out in the last minutes of every class.

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Competences that are evaluated: CECA2.

- **5%** of the final mark derives from the seminar that students must do and present.

Competences that are evaluated: CECA2.

Alternative evaluation system with global final exam

The choice of the global final exam modality is up to the students, who may carry it out during the first quarter of the course period or until the last day of the period if it ends after that period. Applications will be made through a specific space created for this purpose on the subject Virtual Campus. In the absence of an express request by the student, the modality assigned will be the continuous evaluation system.

The alternative system involves taking a written Final Exam that has two parts:

- The first part (70%) evaluates the theoretical content of the course. It consists of preferably short questions, although it can also include test questions. Test questions have four possible answers of which only one is correct; 2 wrong answers subtract 1 correct answer.
- The second part (30%) consists of short questions about the laboratory practices that have been developed in the course.

Competences that are evaluated: CECA1, CECA2, CECA3.



Bibliography (basic and complementary)

Basic bibliography

- Damodaran, S., Parkin, K. L. Fennema, O. R. (2015). Fenemma, Química de los alimentos. Acribia, Zaragoza.

Complementary bibliography

- Badui, S. (2006). Química de los alimentos. Pearson Educación. México
- Baltes W. (2007). Química de los alimentos. Acribia, Zaragoza.
- Barros, C. (2009). Alimentos nuevos y nuevos ingredientes alimenticios y/o alimentarios según la Comunidad Europea. Visión Libros. Madrid.
- Coultate T. P. (2007). Manual de química y bioquímica de los alimentos. Acribia, Zaragoza
- Fayle S.E. (2005). La reacción de Maillard. Acribia, Zaragoza.
- Fisher C., Scout T.R. (2000). Flavores de los alimentos. Biología y química. Acribia, Zaragoza.
- Jeantet, R. et al (2010). Ciencia de los alimentos: bioquímica, microbiología, procesos, productos. Acribia. Zaragoza.

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- Multon J.L. (2001). Aditivos y auxiliares de la fabricación en industrias agroalimentarias. Acribia, Zaragoza.
- Sahin, S. (2009). Propiedades físicas de los alimentos. Acribia. Zaragoza.

Electronic resource, Digital library Uex

- Biochemistry of foods. 2013. Edited by N.A.M. Eskin and F. Shahidi.

Websites

Scientific and popular articles through <http://biblioteca.unex.es/>.

Other resources and complementary materials

- Power point presentations used in classroom are available on the course's virtual page (<http://campusvirtual.unex.es/portal/>).
- Laboratory practices protocols are available on the virtual classroom (<http://campusvirtual.unex.es/portal/>).
- Documents derived from legal regulations that affect the content of the course.