

## COURSE SYLLABUS

Academic Year: 2024/2025

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	Engineering in Agricultural and Food Industries		
Faculty/School	School of Agricultural Engineering		
Semester	(8th)	Course type (compulsory/optional)	Compulsory
Module	Food science		
Subject matter	Food chemistry and biochemistry		
Lecturer/s			
Name	Room	E-mail	Web page
<b>Lourdes Martín Cáceres</b>	703 Jerte Valley Building	martinlu@unex.es	<a href="https://www.unex.es/centros/eia/centro/profesores">https://www.unex.es/centros/eia/centro/profesores</a>
<b>José Manuel Martínez Torres</b>	702 Jerte Valley Building	jmtorres@unex.es	<a href="https://www.unex.es/centros/eia/centro/profesores">https://www.unex.es/centros/eia/centro/profesores</a>
Subject Area	Food Technology		
Department	Animal Production and Food Science		
Coordinator (Only if there is more than one lecturer)	<b>Lourdes Martín Cáceres</b>		

### Competencies



















#### Specific competencies

CETE1 - Ability to know, understand and use the principles of food engineering and technology. Food engineering and basic operations. Food Technology. Processes in the agro-food industries. Modelling and optimization. Quality and food safety management. Food analysis. Traceability.

### Contents

#### Course outline

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

<b>OBJETIVOS DE DESARROLLO SOSTENIBLE CONTEMPLADOS</b>						
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<b>Course contents</b>						
<p>Title of unit 1: <b>Water in food.</b>            Contents of unit 1: Importance of water in food. Molecular structure and physicochemical properties of water. Water activity. Methods of determination. Sorption isotherms. Hysteresis.</p>						
<p>Title of unit 2: <b>Molecular mobility.</b>            Contents of unit 2: Molecular mobility. State diagrams: phase transition in foods. Technological importance of molecular mobility in industrial processes.</p>						
<p>Title of unit 3: <b>Functional properties of carbohydrates.</b>            Contents of unit 3: Characteristics of carbohydrate foods. Functional properties of mono-and oligosaccharides.</p>						
<p>Title of unit 4: <b>Starch in food.</b>            Contents of unit 4: Starch: structure and properties. Starch gel formation. Factors influencing the formation of gels. Stability of the starch gels. Modified starches.</p>						
<p>Title of unit 5: <b>Structural polysaccharides and their roles in food.</b>            Contents of unit 5: Pectin. Cellulose and other cell wall components. Gums. Polysaccharides derived from seaweed.</p>						
<p>Title of unit 6: <b>Non-enzymatic browning.</b>            Contents of unit 6: Non-enzymatic browning reactions. Caramelization. Maillard reaction. Mechanisms and control.</p>						
<p>Title of unit 7: <b>Carbohydrates in fruits and vegetables.</b>            Contents of unit 7: Metabolism of fruits and vegetables. Chemical modifications of carbohydrates. Postharvest control conditions.</p>						
<p>Title of unit 8: <b>Functional properties of lipids.</b>            Contents of unit 8: Characteristics of food lipids. Functional properties of lipids: crystal formation and fusion.</p>						
<p>Title of unit 9: <b>Formation of emulsions in food.</b>            Contents of unit 9: Emulsions. Formation and breaking of emulsions. Emulsifiers: stabilizing functions and HLB value.</p>						
<p>Title of unit 10: <b>Changes of lipids in foods.</b>            Contents of unit 10: Changes in lipids during processing and storage of food: lipolysis, autoxidation and enzymatic rancidity.</p>						
<p>Title of unit 11: <b>Lipid modification treatments.</b>            Contents of unit 11: Physic-chemical treatments for lipid modification in the food industry: hydrogenation, interesterification and fractionation. Fat replacers.</p>						

<p>Title of unit 12: <b>Functional properties of proteins.</b>            Contents of unit 12: Characteristics of amino acids and protein structure in food. Types of bonds in proteins. Functional properties.</p>
<p>Title of unit 13: <b>Food protein systems.</b>            Contents of unit 13: Bread dough, milk and meat; effect of treatments on protein systems.</p>
<p>Title of unit 14: <b>Food enzymes.</b>            Contents of unit 14: Food enzymes. Types and applications. Immobilized enzymes and their use in the food industry. Enzymes as indicators of treatment.</p>
<p>Title of unit 15: <b>Pigments in foods I.</b>            Contents of unit 15: General concepts. Myoglobin and Haemoglobin. Meat colour. Chemistry of myoglobin. Effect of storage and processing on the colour of meat.</p>
<p>Title of unit 16: <b>Pigments in foods II.</b>            Contents of unit 16: Chlorophyll. Effects of processing on chlorophylls. Carotenoids. Anthocyanins. Structure. Colour changes and chemical reactions of anthocyanins. Betaines. Flavonoids.</p>
<p>Title of unit 17: <b>Enzymatic browning.</b>            Contents of unit 17: Enzymatic browning reaction. Factors influencing enzymatic browning. Measures to minimize enzymatic browning.</p>
<p>Title of unit 18: <b>Food additives.</b>            Contents of unit 18: General concept of food additive. Classification. Legislation.</p>
<p>Title of unit 19: <b>Additives that prolong the shelf-life.</b>            Contents of unit 19: Preservatives: sulphites; nitrites; organic acids and related products; antibiotics; other preservatives. Antioxidants.</p>
<p>Title of unit 20: <b>Additives that enhance flavour, aroma and colour.</b>            Contents of unit 20: Sweeteners. Acids. Aromas. Flavour enhancers. Colours.</p>
<p>Title of unit 21: <b>Additives that improve texture.</b>            Contents of unit 21: Thickeners, gelling agents and stabilizers. Emulsifiers. Humectants. Anti-caking agents. Firming agents. Emulsifying salts. Bulking agents. Flour treatment agents.</p>
<p>Title of unit 22: <b>Other additives.</b>            Contents of unit 22: Acidity regulators. Contrast enhancers. Raising agents. Anti-foaming agents. Glazing agents. Packaging gases and propellants. Carriers.</p>
<p><b>Practical sessions</b></p>
<p><b>Laboratory practices:</b></p>
<p>Description of practical activities 1: <b>Determination of water activity.</b>            Contents P1: Determination of water activity in food.</p>
<p>Description of practical activities 2: <b>Evaluation of polysaccharides.</b>            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: <b>Browning reactions.</b>            Contents P3: Non-enzymatic browning reaction. Fehling's test for reducing sugars. Enzymatic browning reaction.</p>
<p>Description of practical activities 4: <b>Determination of lipids.</b>            Contents P4: Fat extraction and quantification by method of Folch. Peroxide, acidity and iodine values and slip point. Determination of TBA.</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.

Description of practical activities 6: **Evaluation of food dispersions.**  
 Contents P6: Albumin foam stability. Use of emulsifiers.

**Seminar**

It consists of an activity about food additives. The fundamental aspects of the food additives regarding their functional category, action mechanism and particularities should be briefly explained.

**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
<b>Assessment</b>	2	2						
<b>TOTAL ECTS</b>	<b>150</b>	<b>35,5</b>		<b>22</b>		<b>2,5</b>	<b>4,5</b>	<b>85,5</b>

L: Lectures (85 students)

HI: Hospital internships (7 students)

LAB: Lab sessions or field practice (15 students)

COM: Computer room or language laboratory practice (20 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 SDG 12 (Target 12.4). 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

- a. Demonstrate the knowledge of chemical and biochemical characteristics of food components, providing conclusions of the implication of these characteristics in the transformation of food.
- b. Explain in detail the functional properties of food components.
- c. Evaluate the mechanism and consequences of the chemical and biochemical reactions involved in food spoilage.
- d. Explain the influence of technological treatments and storage on food components.
- e. Demonstrate an understanding of the use of authorized food additives in the food industry, the study of their mechanisms of action and their applications.
- f. Explain the activities carried out in the laboratory, demonstrating the ability to observe, interpret the results and obtain final conclusions.

### Assessment methods

#### **A. Continuous Assessment System**

To calculate the grade for the course, a weighting with the following percentages is applied:

##### **A.1. Knowledge Assessment (60%)**

60% of the course grade comes from the theoretical exam, which consists preferably of short questions, although it may also include multiple-choice questions. The multiple-choice questions have four possible answers, of which only one is correct; for every two incorrect answers, one correct answer is deducted. The grade obtained in the theoretical exam must be at least 5 to be weighted with the rest of the assessments.

Competences that are evaluated: CETE1.

##### **A.2. Laboratory Practice Assessment (20%)**

20% of the grade corresponds to the evaluation of laboratory practices. This evaluation considers the development of practices and the quality of practice reports. Each student

must complete the reports in the format and by the deadline established on the course's virtual campus.

In case of non-attendance to practical classes, or failure to achieve at least a grade of 5 in the evaluation of the development and quality of the reports, the student can recover the laboratory practices through a Practice Exam, which consists of a written exam conducted on the same day and time as the final theoretical exam of the course. The Practice Exam consists of short questions about the laboratory practices developed during the course.

It is an indispensable requirement to pass the practical part to pass the course. In case of not passing the practical part, the final grade of the course will be a maximum of 4.5, even when the weighting with the rest of the course assessments is equal to or greater than 5.

Competences that are evaluated: CETE1.

### **A.3. Assessment of Attendance and Engagement in Lectures (15%)**

15% of the final grade corresponds to the assessment of attendance with engagement in lectures. This evaluation comes from mini assessments usually conducted in the last minutes of each class, based on what has been covered in that class.

This assessment is not recoverable if the student does not participate.

Competences that are evaluated: CETE1.

### **A.4. Seminar Activity Assessment (5%)**

5% of the final grade derives from the seminar activity. This activity is not recoverable if the student does not participate.

Competences that are evaluated: CETE1.

## **B. 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:

### **B.1. Evaluation of Theoretical Content (70%)**

This part of the exam evaluates the theoretical content of the course. It consists preferably of short questions, although it may also include multiple-choice questions. The multiple-choice questions have four possible answers, of which only one is correct; for every two incorrect answers, one correct answer is deducted.

### **B.2. Evaluation of Laboratory Practices (30%)**

This part of the exam consists of short questions about the laboratory practices developed during the course.

Competences that are evaluated: CETE1.

### Bibliography (basic and complementary)

#### **Basic bibliography**

-Damodaran, S., Parkin, K. L. Fennema, O. R. (2019). 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. (2020). Manual de química y bioquímica de los alimentos. Acribia, Zaragoza
- Fayle S.E. (2005). La reacción de Maillard. Acribia, Zaragoza.
- Jeantet, R. et al (2010). Ciencia de los alimentos: bioquímica, microbiología, procesos, productos. Acribia. Zaragoza.
- 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 searching 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.