Food Biotechnology

Code: 103232
ECTS Credits: 3

2024/2025

Degree	Type	Year
2501925 Food Science and Technology	OT	4

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no prerequisites for taking this course. However, and in order to ensure the proper achievement of the learning aims, it is recommended for the student to have basic knowledge about techniques related to this discipline such as the introduction to molecular biology (two seminars of Bioquimica-I).

Objectives and Contextualisation

This optional subject "Food biotechnology" (103232) is taught in the second half of the fourth year in the Degree in Food Science and Technology at the UAB.
The general aim of this subject is to provide the student with the transversal and specific capacities about the theoretical and practical aspects of the different biotechnological processes underlying the Food transformation, as well as those usually used by the food industry with the objective of improve production and modify the qualities of food.

A first extensive block describes the basic techniques broadly used in biotechnology, where recombinant DNA techniques play an important but not exclusive role. Later students focus in the study of the microorganisms of relevance in food biotechnology, mainly those involved in fermentative processes that participate in the production of food and beverages, as well as techniques for genetic manipulation of these microorganisms.

Next, we study strategies for the improvement of both, vegetal and animal organisms, with emphasis on those aspects that involve recombinant DNA technologies. Finally, we introduce specific aspects of food diagnosis. This course also integrates practical aspects that will place the student in contact with habitual techniques used in food biotechnology.

Competences

- Analyse, summarise, resolve problems and make professional decisions.
- Apply knowledge of the basic sciences to food science and technology.
- Apply the principles of biology and chemical engineering to describe, analyse, control and optimise the processes of food transformation and conservation.
- Apply the scientific method to resolving problems.
- Design experiments and interpret the results.
- Develop individual learning strategies and planning and organisation skills.
- Identify pathogenic, spoilage, and industrially-useful microorganisms, along with the conditions that are favourable or unfavourable to their growth in foods and in industrial and biotechnological processes.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Search for, manage and interpret information from different sources.
- Show sensitivity to environmental, sanitary and social issues.

Learning Outcomes

1. Analyse the importance of microorganisms in foods and understand the biotic and abiotic factors that affect their development in these substrates.
2. Analyse, summarise, resolve problems and make professional decisions.
3. Apply the scientific method to resolving problems.
4. Design experiments and interpret the results.
5. Develop individual learning strategies and planning and organisation skills.
6. Evaluate the behaviour of reactors depending on their operating mode.
7. Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
8. Recognise the importance of fermentation processes and appreciate the role of microorganisms in industrial processes.
9. Relate the characteristics of foods to their physical properties.
10. Search for, manage and interpret information from different sources.
11. Show sensitivity to environmental, sanitary and social issues.
12. Structure a project and use suitable tools to manage it.

Content

1. Introduction to food biotechnology. Concept and historical development. Applications of the biotechnology in food. The impact of recombinant DNA technology. Transgenic foods.

SECTION 1. BASIC TECHNIQUES AND PROCEDURES IN FOOD BIOTECHNOLOGY
2. - General techniques of recombinant DNA. Commonly used enzymes. DNA isolation and digestion by restriction enzymes, DNA and RNA hybridization. Dialysis of nucleic acids. DNA amplification using PCR, gen cloning, evaluation of gene expression. Real-time PCR, DNA microarrays.
3. - Databases (DNA, proteins, expression, etc.) and tools for sequence analysis.
4.- Expression of recombinant proteins. Expression in yeast and in bacteria: advantages and disadvantages. Other expression systems. Shuttle vectors and features.
5.- Techniques for the study of proteins. Techniques for protein identification. Techniques for immunodetection of proteins (RIA, ELISA). Proteomics in food biotechnology.

SECTION 2. BIOTECHNOLOGICAL IMPROVEMENT OF MICROORGANISMS IN PRODUCTION OF FOODS
6.- Biotechnology of fermented foods and genetic engineering of acid-lactic bacteria.
Lactic-acid bacteria, industrial yeasts and filamentous fungi. Lactic and alcoholic fermentation: food products derivatives. Metabolic microbial routes of interest in the food industry. Methods for genetic transformation of microorganisms of food interest and improvements in its industrial use.
7.- Genetic improvement of industrial yeasts. Classical genetic techniques. Transformation of yeasts. Strategies and applications in breweries, wines and baker yeasts.
8.- Applications of microorganisms in food biotechnology. Improvement of the organoleptic characteristics of foods. Probiotics. Production of aromas, dyes and sweeteners. Production of food enzymes. Immobilized enzymes Industrial aspects

SECTION 3. VEGETAL BIOTECHNOLOGY
9.- Biotechnology of vegetables. Natural variability and improvement by conventional genetic techniques. Hybridization. Applications of *in vitro* cultivation of comestible vegetables.
10.- Production of transgenic plants and applications. Systems for genetic transformation in plants. Promoters of plant genes with a biotechnological interest. Transgenic plants resistant to herbicides, plant pathogens and abiotic stresses.
11.- Improvement of the organoleptic, nutritional and post-process properties. Nutrients and antinutrients. Modification of plant proteins. Biotechnological control of maturation and post-harvest processing.

SECTION 4. ANIMAL BIOTECHNOLOGICAL IMPROVEMENT
12.- Genetically modified animals: obtaining techniques and applications. Transgenic and methods, vectors, promoters of interest. Improved productivity. Generation of high value-added products in transgenic animals.

SECTION 5. BIOTECHNOLOGY AND DIAGNOSIS FOOD
13.- Techniques based on the DNA/RNA identification. Preparation of samples. PCR and related techniques. Massive DNA sequencing. DNA Microarrays. Examples for pathogens detection, WHO content.
14.- Techniques based on the identification of proteins. Use of antibodies: immunoassays. Luminescent techniques. Mass spectroscopy. Biosensors Nanobiotechnology.

PRACTICAL SESSIONS
P1.- Heterologous expression of a lipase in yeast *Pichia pastoris*.
P2.- Identification of genetically modified plants by the chain reaction of the polymerase (PCR).

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Expositive classes	20	0.8	1, 2, 3, 4, 8, 9
Laboratory practices	6	0.24	1, 2, 3, 4, 9
Type: Supervised			
Tutorship	2	0.08	1, 2, 3, 10, 5, 8, 9
Type: Autonomous			
Study and bibliography reading	44	1.76	1, 2, 3, 10, 11, 5, 4, 8, 9

Methodologies used in this subject to achieve the learning process combines classes theoretical, practical sessions in the laboratory and the resolution of exercises/problems.

1. Theoretical classes.
Presential classes with ICT support explaining the basic concepts of the subject. They will be participatory and will allow the student to acquire the basic and applied knowledge of the subject.

2. Laboratory practices.
Acquisition of work skills in the laboratory and experimental understanding of the concepts explained in the face-to-face classes

3. Self-learning assignment.
The autonomous work of the student will consist of the personal study of the material taught in the theoretical classes, encouraged to solve problems/short cases proposed during theory classes. The comprehensive reading of the recommended material and the search for relevant publications (scientific articles and reviews) will allow the student to assimilate and understand the theoretical contents addressed as well as to relate the concepts studied with its practical aspects and applied to food biotechnology.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises throughout the course	20	0	0	1, 2, 3, 6, 10, 11, 5, 4, 12, 7, 8, 9
Final exam of theoretical module	50	2	0.08	1, 2, 3, 11, 4, 7, 8, 9
Laboratory practices	30	1	0.04	1, 2, 3, 4, 7

This subject/module does not provide for the single assessment system. However, the only obligatory face-to-face activities are the practicals and the final exam.

The maximum score that can be obtained is 10 points. The subject will be passed with an overall score of 5.0 or higher.
The evaluation system is organized in three modules. The final qualification will be obtained by the sum of the qualifications of the three modules, with the conditions described below.
In case the final qualification is lower than 5.0, or if the student want to improve his/her qualification, the student should take the "final" test of the module 1. In this case, the final score will be obtained taking into account this last test score.

Module 1. Theory and problems.
- Evaluation system: test type exam with multiple choice answers.
- Weight in the global rating: up to 5 points
- Skills evaluated: E01, E05, E08, T03.
The thest type examinations will take from 1:30 to two hours of duration and it will consists in approximately 30 questions where the acquisition of the different competencies will be evaluated.

Module 2. Completion of different exercises throughout the course.
- Assessment system: short exercises and problems proposed during theory classes. There will be for individually work and others to do it in small groups. The Moodle available applications may be used.
- Weight in the global rating: up to 2 points.
- Skills evaluated: E01, E05, E08, T01, T02, T03, T04, T08, T12.

Module 3. Laboratory practices.
- Assessment system: written test about the activities carried out during the practices in an independent exam that will be programmed immediately after finishing the practical sessions.
- Maximum weight in the overall grade: up to 3 points in case of attendance at all practical sessions.
- Skills evaluated: E01, E05, E08, T01, T02, T03

Students who are in ANY of the following circumstances will be considered "Not Evaluable":
1.- Has not participated in evaluation activities that represent at least 15% of the final grade.
2.- Do not carry out the Module 1 exam and its retake.
3.- Do not carry out all the practices. Given that, generally, there is only one group of practices, cases of non-attendance due to force majeure will be considered individually by the subject teachers.

Bibliography

Books:

* Richard J. Reece. *Analysis of Genes and Genomes*. 1st Edition. Wiley. 2004.

* Christopher Howe. *Gene Cloning and Manipulation*. 2nd Edition. Cambridge University Press. 2007.

* ANDY PRIMROSE and RICHARD TWYMAN. *Principles of Gene Manipulation and Genomics*. 7th Edition. Wiley-Blackwell. 2006.

* Terry Brown. *Gene Cloning and DNA Analysis: An Introduction*. 6th Edition. Wiley-Blackwell. 2010.

* E. M. T. El-Mansi, C. F. A. Bryce, A. L. Demain & A.R. Allman. *Fermentation Microbiology and Biotechnology.* 3rd Edition. Taylor & Francis Group. 2011.

* Johnson-Green. *Introduction to Food Biotechnology* . 1st Edition. CRC Press. 2002.

* Gutiérrez, G., Barbosa-Cánovas, G.V. *Food science and food biotechnology*. CRC Press LLC, 2003.

* Knut J. Heller. *Genetically Engineered Food*. Methods and Detection. 2nd Edition. Wiley. 2006.

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* Colin Ratledg and Bjorn Kristiansen. *Basic Biotechnology*. 3rd Edition. Cambridge University Press. 2006.

* Smith, E. John. *Biotechnology*. 5th Edition. Cambridge University Press. 2009.

* Thieman W J, Palladino M A. *Introducción a la Biotecnología*. 2ª Edición. W.J. Pearson. 2010.

* Lee, B. H. (Byong H.) Fundamentals of food biotechnology / Byong H. Lee. - Second edition. JohnWiley & Sons, Ltd. 2015.

* David Castle, Nola Ries. *Nutrition and Genomics: Issues of Ethics, Law, Regulation and Communication*. 1st Edition. Academic Press. 2009.

http://www.sciencedirect.com/science/book/9780123741257

* Advances in Food Biotechnology. Ravishankar Rai V. (Ed.) 2015. Wiley Online.

Journals:

* Food Science and Biotechnology.

https://link.springer.com/journal/volumesAndIssues/10068

* The Journal of Microbiology, Biotechnology and Food Sciences.

http://www.jmbfs.org/

* Food Biotechnology

http://journalseek.net/cgi-bin/journalseek/journalsearch.cgi?field=issn&query=0890-5436

* Food Biotechnology

http://www.tandfonline.com/loi/lfbt20

* Food Technology and Biotechnology

http://hrcak.srce.hr/ftb

* Journal of Food Biochemistry

http://eu.wiley.com/WileyCDA/WileyTitle/productCd-JFBC,subjectCd-FO24.html

* Applied Food Biotechnology

http://journals.sbmu.ac.ir/afb/index

Review papers:

* Biology of food. Specual issue of Cell journall. Volume 161, Issue 1, 26 March 2015.

Biophysics of Molecular Gastronomy; Food for the Brain; Modeling Human Nutrition Using Human Embryonic Stem Cells; Putting the Balance Back in Diet; Multisensory Flavor Perception; Cultivating Healthy Growth and Nutrition through the Gut Microbiota; Meeting the Global Food Demand of the Future by Engineering Crop Photosynthesis and Yield Potential; Nutrient-Sensing Mechanisms across Evolution; Time for Food: The Intimate Interplay between Nutrition,Metabolism,andtheCircadian Clock; I'm Eating for Two: Parental Dietary Effects on Offspring Metabolism; Promoting Health and Longevity through Diet: From Model Organisms to Humans; The Hunger Genes: Pathways to Obesity; Neural Control of Energy Balance: Translating Circuits to Therapies; Immune Regulation of Metabolic Homeostasis in Health and Disease; A Century of Cholesterol and Coronaries: From Plaques to Genes to Statins.

Ma X. *et al.*Genome Editing for Global Food Security. Trends in Biotechnology, February 2018, Vol. 36, No. 2. pp. 123-127. (https://www.cell.com/trends/biotechnology/fulltext/S0167-7799(17)30223-8)

Malyska A. *et al.*The Role of Public Opinion in Shaping Trajectories of Agricultural Biotechnology. Trends in Biotechnology, July 2016, Vol. 34, No. 7. pp. 530-534. (https://www.cell.com/trends/biotechnology/fulltext/S0167-7799(16)00067-6)

Fraiture MA, Herman P, De Loose M, Debode F, Roosens NH. How Can We Better Detect Unauthorized GMOs in Food and Feed Chains? Trends Biotechnol. 2017 Jun;35(6):508-517. doi: 10.1016/j.tibtech.2017.03.002. https://www.sciencedirect.com/science/article/pii/S0167779917300380?via%3Dihub

Software

NCBI- Blast

Search WEB interface for similar DNA or protein sequences in diverse databanks

https://blast.ncbi.nlm.nih.gov/Blast.cgi

RCSB-Protein DAta Bamk (PDB)

Databank of protin 3D structures including its own viewer.

https://www.rcsb.org/

Swiss Institute of Bioinformatics- EXPASY

Assorted collection of free and bioinformatic software

https://www.expasy.org/

Uniprot

Protein data bank with many useful links

https://www.uniprot.org/

Language list

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan/Spanish	second semester	morning-mixed
(TE) Theory	1	Catalan/Spanish	second semester	afternoon