Food Biotechnology

Code: 100968
ECTS Credits: 6

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Degree	Type	Year
Biotechnology	OP	4

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Teaching groups languages

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

Prerequisites

The syllabus does not determine any specific prerequisite for this subject. However, due to its integrating nature of the different knowledge acquired throughout previous courses, the recommendation is to have passed the maximum number of subjects possible before taking it. In any case, it is essential to have a knowledge on microbiology, biochemistry, process engineering fundamentals, bioreactors, and separation and purification processes.

Objectives and Contextualisation

To provide the student with knowledge of food production processes and the methodologies associated with controlling their quality. This objective must be achieved from the study of biological products and catalysts (microorganisms or enzymes) and the production processes.

Acquire understanding and practice in biotechnological food processes in microbiological, engineering, economic, regulatory compliance, quality, etc.

Introduce to the student the most important tools used in the manufacture of food and the quality control and to be able to use these tools in the design of a particular process.

The execution of a practicum in the laboratory with the aim of deepening the knowledge of the biological mechanisms of the production of a food, in particular of yogurt. In order to study these mechanisms physicochemical and biological analytical methods will be used to determine the concentration of the main products of the fermentation and the rheological characteristics of the food.

Learning Outcomes

1. CM32 (Competence) Plan a process for obtaining biotechnological products.
2. CM33 (Competence) Design the different stages necessary to obtain products by biotechnological means.
3. CM34 (Competence) Design all the stages of obtaining biotechnological products or derivatives taking into account ethical and sustainable development aspects.
4. KM34 (Knowledge) Describe the properties of microorganisms with potential application in different biotechnological processes.
5. KM36 (Knowledge) Describe the bases of the design of a biotechnological production process, as well as its environmental implications.
6. SM32 (Skill) Apply safety standards both in the laboratory and in the design of biotechnological plants.

Content

Syllabus:

1.- Introduction (1)

Food, food and biotechnology. Microbiology, enzymology and transgenic feed.

2.- Applications of microorganisms to the production and modification of foods (1)

Microbiology in the food industry. Historical antecedents. Types of microorganisms of industrial importance. Processes in which they intervene. Industrial activity and traditional elaboration. Importance of environmental determinants.

3.- Microorganisms in foods (1)

Types of microorganisms present in foods. Autochthonous and contaminating microbiota. Types of contaminants. Origin of microorganisms present in foods: environment, raw materials, processing and manipulation.

4.- Microbiological control: preventive measures (1)

Preventive measures. Control of pollution sources. Methods for the evaluation of microbial contamination. Critical levels. Disinfection. Types of disinfectants. Registration of pesticides. Authorized disinfectants in the food industry. Application techniques. Control of the efficiency of the treatment.

5.- Microbiological control: corrective measures (1)

Treatment of raw materials. Corrective measures. Meaning and purpose of sterilization. Resistance to sterilization. Mechanisms of inactivation. Kinetics of sterilization. Thermal treatments. Chemical sterilization. Irradiation

6.- Limitation of microbial growth (1)

Cold storage: cooling and freezing. Modification of water activity. Use of controlled atmospheres. Modification of the pH. Use of preservatives. System of risk analysis and control of critical points.

7.- Production of cell biomass (1)

Composition and characteristics of the unicellular biomass. Fields of application. Production of cell biomass from carbohydrates. Types of substrates used. Cellular biomass obtained from hydrocarbons. Bacteria that use methane. Growth in methanol. Production from wood, from carbohydrates and from wastewater.

8.- Bread, derivatives and baker's yeast (1)

Historical background. Composition of the raw material. Additives. Microorganisms used in fermentation. Stages in the manufacturing process. Characteristics of the breeding yeast and its production: raw materials. Requirements for growth and fermentation conditions. Fermentation process. Recovery of the product.

9.- Microbiology of the production of alcoholic beverages (1)

Types of alcoholic fermentation in yeasts and in bacteria. Industrial use. Type of substrate used. Processes used. By-products of fermentation. Efficiency of production. Wine production. Process kinetics. Types of yeast used. Bacteria that participate. Malic-lactic fermentation. Contribution to organoleptic characteristics. Beer production. Type of yeast. Background and surface fermentation. Microbial alterations of the process. Alcoholic fermentation in the process of production of distilled spirits: Type of substrate used and importance of the fermentation by-products in the development of the final characteristics.

10.- Lactic fermentation in plant substrates (1)

Cabbage, cucumber and olives. Microorganisms that intervene. Stages in the maturation of the products. Succession of populations. Microbial alterations of the normal processing process.

11.- Fermentation in meat products (1)

Factors that affect microbial activity in meat products. Cured meats. Physicochemical changes produced by the development of microorganisms. Use of starters.

12.- Lactic acid bacteria in milk-based products (2)

Characteristics of lactic acid bacteria. Starters: properties. Bacteriocines: characteristics and production. Probiotic bacteria: effects, products and applications. Composition of milk. Modification of the raw material. Production of butter. Cutting and serum formation. Fermented milks: type and composition. Microorganisms. Biochemical changes in the fermentation process. Preparation of fermented milks. Cheese: Definition, composition and varieties of cheeses. Microorganisms used. Process for the elaboration of different types of cheeses. Organoleptic characteristics: biochemistry of the production of aromatic compounds.

13.- Production of organic acids and vinegar (2)

Applications of organic acids in food. Production of lactic acid. Production of citric acid. Other acids of interest in food. Historical antecedents of the production of vinegar. Definition, composition and type of vinegar. Acetic acid bacteria. Industrial elaboration of vinegar.

14.- Production of amino acids (2)

Importance of amino acids in food. Enzymatic production processes. Production by fermentation: microorganisms used. Production processes. Recovery of products.

15.- Applications of enzymes for the production and modification of food (2)

Types of enzymes: nomenclature. Activity, kinetics and stability. Control of the action of enzymes. Legislation. Toxicology and safety. Application range. Modification of the activity.

16.- Enzymes in the production of starch derivatives and sugars, bread, pasta, beer and wine (2)

Bread and paste: amylases, xylanases, pentosanases, hemicellulases, lipases, oxidases. Production of starch derivatives. Starch hydrolysis. Maltose and glucose syrups. Fructose syrups. Applications of syrups. Cyclodextrins. Beer: enzymes in malting, cooking, filtration, fermentation and maturation. Wine: Enzymes in the pressing, maceration, clarification, filtration and maturation. Enzymes in the generation of aromas and coloration: manufacture of varieties of white, pink or black wines. Ureases and Lisozim.

17.- Enzymes inthe production of milk-derived foods, food protein modifications, as well as in the production of fruit/plant-based juices and processing of vegetables (2)

Enzymes for coagulation. Proteases and peptidases. Lactoperoxidases. Galactosidases. Transglutaminases. Lipases. Lactases. Origin of the proteases. Applications in the meet and fish industry. Production of protein hydrolysates. Modification of allergens. Modification of the gluten. Pectinases. Cellulases and hemicellulases. Starch and proteins. Applications to the production of juices and plant-derived products: apple, grape, tropical fruits, berries and fruits with kernels. Applications to the processing of citrics, strawberries and tomatoes. Lipases and their industrial applications: hidrolysis and modification of fats/oils.

18.- Functional ingredients and foods. Aromas and additives (2)

Foods with modifications to increase their nutritional properties and health effects (nutraceuticals). New sustainable sources of proteins: development of sustainable food systems. Food addities. Obtaining flavour enhancers with enzymes and microorganisms. .

Practical sessions and objective of the practicum*

The fermentation of milk is one of the traditional procedures used to modify the characteristics of the raw material, in order to increase its capacity for preservation and improve nutritional and digestive properties.

In our country, the most consumed fermented milk is yogurt. This is obtained by the combined action of two microorganisms in the group of lactic acid bacteria: *Lactobacillus bulgaricus (L. delbrueckii ssp bulgaricus)* and *Streptococcus termophilus.*

The growth of the two microorganisms in a situation of proto-cooperation leads to the formation of a series of compounds, of which the most important are lactic and acetic acids, acetaldehyde, diacetyl, acetoin, Acetone. These substances produce a modification of the organoleptic characteristics, while acids cause a decrease in pH to values close to 4. The decrease in pH produces the casein curdling and the formation of an ice with very little loss of Liquid

Thus, the final product is a gel with some rheological and organoleptic characteristics that are dependent on the properties of the raw material and the conditions in which fermentation has taken place (temperature and time of incubation, acid formation velocity, etc.) and subsequent cooling.

The objective of the practice is to deepen in the knowledge of the biological mechanisms of the production of yogurt. In order to study these mechanisms, analytical methods will be used to determine the concentration of the main products of fermentation.

The laboratory practicum will be carried out in the first semester, in 3 sessions of 4 hours each one.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practicals	12	0.48	
Theory classes	40	1.6	
Type: Supervised			
Work in group - Wikipedia teaching project	14	0.56	
Type: Autonomous			
Autonomous study	60	2.4	

Laboratory practium report elaboration	20	0.8

This course is mostly based on theory lectures. Some lectures may be given by professionals from the food biotechnology industry. The course will be accessible at the Moodle learning platform, where all teaching material from lectures and laboratory practicals, as well as some additional scientific publications of interest will be uploaded.
Students will carry our practical lab sessions (compulsory) in groups of 3 or 4 persons, and will have to present a report about the practicum, which will be evaluated by the lab practicals professors.
Finally, part of the competences of the course will be achieved through the elaboration of a divulgative article at the Wikipedia, in the context of a Educational Wikipedia Project.

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
Partial Exam (1st)	35%	1	0.04	CM32, CM33, CM34, KM34, KM36
Partial Exam (2nd)	35%	1	0.04	CM32, CM33, CM34, KM34, KM36
Report laboratory practicals	10%	0	0	CM32, SM32
Work in group - Wikipedia teaching project	20%	2	0.08	KM34

Evaluation Process and Activities

The subject has the following evaluation activities:

- Two partial exams. Writen exams, 35% weight of the overall subject grade each exam. Tentatively, the first partial exam will be scheduled by mid November and the second partial exam will take place in January. The exact dates of the exams will appear in the calendar of the subject. In the case that a minimum grade of 4 is not achieved in any of the partial exams, the student will be able to take a second-change written global examination scheduled in January.

- Wikiproject. 20% of the overall grade. Work in group about one of the topics of the subject, which will be structured as a Wikipedia Teaching Project. The program of the subject will include a 2-h session given by a Wikipedia expert to start up the project. Start: end of September. Final handling: End of November. Non-recoverable teaching activity.

- Laboratory practicals report. Writen report (one per group) on the laboratory practicals that will be done in December. 10% of the overall grade. Handling date in January. Non-recoverable teaching activity.

- The definitive calendar of evaluation activities will be given on the first day of the subject, and will be published at the Campus Virtual.

Students who have handled a set of activities representing a minimum of two thirds of the overall grade of the subject can take the second-chance examination.

Single-call evaluation

The single-call evaluation consists of a single synthesis exam that covers the whole theory program of the subject (that is, it replaces the two partial exams). The synthesis exam will have the same type of questions as the partial exams. This exam will have a weight of 70 % of the overall subject.

Students that choose the single-call evaluation modality must attend the lab practicals (PLAB) in a presential manner; it is compulsary to pass thelab practicals. Participation in the Wikiproject is also compulsary (PWIKI). The evaluation and weight on the overal grade of these actvities is the same as for the continuous evaluation modality (PLAB 10%, PWIKI 20%).

The syntesis exam will be scheduled on the same day that the last partial exam of the continuous evaluation, and the same second-chance examination procedure will apply.

To pass the subject, a minimum grade of 4 (over 10) must be achieved in the synthesis exam.

Grade review procedure

Date, hour and place for review of each evaluation activity will be indicated through the Campus Virtual. To this end, students will be allowed to ask for a review of the grade of a given activity, which will be evaluated by the Professor responsible of the subject. If the student does not attend this review session, there will be no second chance for reviewing the evaluation activity.

Grades

Honors qualification. To award an honors qualification is a decision from the Professor of the subject. UAB rules only allow to award a Honors qualification to those students that have obtained an overall final grade equal or higher than 9.00. Honors qualification can be awarded to up 5% of the total registered students.

A student will be considered as non-assessable (NA) when she/he has not performed a set of evaluation activities its weight equalsnt d'activitats el pes de les quals equivalgui a un mínim de dues terceres parts de la qualificació total de l'assignatura.

Bibliography

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Modern Industrial Microbiology and biotechnology. (2007). Nduka Okafor. Science Publishers. USA. ISBN 978-1-57808-434-0 (HC).

Food Biotechnology (2008) Ulf Stahl, Ute E.B. Donalies, Elke Nevoigt (Eds), with contributions of David B. Archer et al. Springer [Recurs Electrònic biblioteca UAB]

Software

The student will have to use a standard software ofimatics package for data processing and writing up of reports.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	441	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	442	Catalan	first semester	afternoon
(TE) Theory	44	Catalan	first semester	morning-mixed