

# Food Biotechnology

Academic year: 2018-2019

(Last update: 07/06/2018)

(Approved by the Department of Microbiology: 09/05/2018)

(Approved by the Department of Biochemistry: 07/06/2018)

MODULE	SUBJECT	YEAR	SEMESTER	CREDITS	TYPE
Food Technology	Food Biotechnology	3rd	1st	6	Obligatory
<b>PROFESSOR(S)</b>			<b>COMPLETE CONTACT ADDRESS FOR MENTORING</b>		
<ul style="list-style-type: none"><li>Ana del Moral García: Part I</li><li>María Dolores Mesa García: Part II</li></ul>			Dpto. Microbiology . Dpto. Biochemistry and Molecular Biology II 4th floor, Faculty of Pharmacy. Email: <a href="mailto:admoral@ugr.es">admoral@ugr.es</a> ; <a href="mailto:mdmesa@ugr.es">mdmesa@ugr.es</a>		
			<b>MENTORING SCHEDULE</b>		
			<ul style="list-style-type: none"><li>María Dolores Mesa García (primer semestre los lunes de 9:00 a 13:30 y de 14:30 a 16:00; segundo semestre miércoles de 9.00 a 12.30 y de 13.30 a 16.00)</li><li>Ana del Moral García (Lunes, Miércoles y Viernes de 9,30 a 11,30)</li></ul>		
<b>DEGREE IN WHICH IT IS PROVIDED</b>					
Degree in Science and Food Technology					
<b>PREREQUISITES AND/OR RECOMENDATIONS (if proceeding)</b>					
Have studied the subjects Biology, Chemistry, Microbiology, Chemistry and Food Biochemistry.					
<b>BRIEF DESCRIPTION OF THE CONTENT (ACCORDING TO THE DEGREE MEMORY-CHECK)</b>					
Complete with the corresponding text in each case.					
<b>GENERAL AND SPECIFIC SKILLS</b>					
<ul style="list-style-type: none"><li>E6: Know, understand and apply the classic methodology and the new technological processes aimed to the improvement in the production and treatment of food.</li><li>E16: Put into practice the principles and methodologies that define the scientist and food technologist professional profile, proving in an integrated manner the acquisition of the skills and competencies that provides the degree.</li></ul>					



## OBJECTIVES (EXPRESSED AS LIKELY OUTCOMES OF THE LESSON)

It is intended that the student acquires a complete view over the use of the microorganisms and the enzymes in Food Biotechnology. To this end, the Genetic Engineering foundations and the processes for the obtention of genetically modified organisms are studied. Also, the microbial species are considered useful in the food processes, the growth and the fermentations, as well as the microbial metabolism and genetic in order to develop search, selection, improvement strategies and design of the strains of interest in Food Biotechnology.

## DETAILED SYLLABUS

### Unit 1. Concept and historical development of Biotechnology. Horizons and importance.

Industrial Microbiology and new Biotechnology History. **Biotechnology**: Definition and concepts. Categories. Biotechnology stages and milestones. Biotechnology applications. Biological processes involved in Food Biotechnology.

### Unit 2. Microorganisms of interest in Food Biotechnology.

Characteristics that microorganisms must gather in order to being used in Biotechnology. Isolation and selection of microorganisms. Strain selection advanced techniques. Accelerated selection methods. Industrial microorganisms maintenance and conservation. Starter cultures.

**Microbial groups of interest**: stringy fungi, yeast and prokariotic of interest. General characteristics and implementation in Food industry.

### Unit 3. Improvement and development of strains for biotechnological use.

Justification of the improvement of strains. Procedures used for the improvement of strains: **Mutation**: Mutants selection. **Recombination**: Sexual recombination in eukariotics. Recombination in prokariotics: transformation, transduction and conjugation. **Protoplast fusion**. **Parasexual cycles**.

**Unit 4. Molecular Biology**. Replication, transcription and traduction. **Regulation of the gene expression**: Promoters and enhancers. Transcription factors. DNA binding sites. Epigenetics. Transcription regulation. Translation regulation. Techniques for the study of the gene expression regulation.

**Unit 5. Nucleic acid manipulation**. Nucleic acid purification and analysis. DNA extraction. Plasmidic DNA isolation. RNA extraction. Polyadenylated RNA purification. Techniques for the marking of nucleic acid. Hybridisation in rigid supports: Southern and Northern blots. Methods for DNA sequencing. Immunological systems of analysis used in Molecular Biology.

**Unit 6.- Recombinant DNA technology**. DNA amplification in vitro: PCR. Reverse transcription and PCR (RT-PCR). Cloning strategies. Enzymes used in recombinant DNA technology. Cloning and expression vectors. Construction and analysis of genebanks.

**Unit 7 Food genetic ingeneering applications**. Genetically modified organisms (microorganisms, plants and transgenic animals). Genetically modified food: history and present. Genetic Ingeneering applications to the food industry.



### **Unit 8. Microorganisms metabolism of biotechnological interest.**

Microorganisms energy metabolism of biotechnological interest. Breathing: aerobic and anaerobic breathing in chemoheterotrophs, aerobic breathing in chemoautotrophs. Advantages of aerobic growth. Fermentations: fermentation concept from the microbial and industrial point of view. Types of fermentations. Main fermentations of interest in nutrition.

### **Unit 9. Fermenters design and factors that affect the performance of the fermentations.**

Design and description of the basic components of a leaven. Instrumentation and control. Measuring and sterilization systems. Lab and pilot scale leavens.

**Industrial leavens.** Scale-up. Phases, problems and factors associated with the scale-up.

**Factors that affect the performance of the fermentations:** Agitation, aeration and mix. Viscosity effect, temperature and pH. Supply of oxygen.

### **Unit 10. Products of interest in Food Biotechnology classification.** Microbial cells. Microbial cells applications.

**Primary and secondary metabolites.** General characteristics. Trophase and ***idiofase***. Biotechnological methods for the superproduction of primary and secondary metabolites. **Macromolecules** of interest in biotechnology.

**Unit 11. Biotechnological production of primary metabolites. Organic acid and amino acid. Industrial organic acid production.** Citric acid. Biochemistry of the citrate production by *Aspergillus niger*. Gluconic acid. Lactic acid. Tartaric acid. Fumaric acid. Malic acid. **Acetic acid.** Acetic bacteria metabolism. Vinegar fabrication process.

**Amino acid industrial production methods.** Glutamic acid. Lysine. Methionine.

**Unit 12. Other primary metabolites production: alcohol, vitamins, nucleotides and nucleosides. Industrial ethanol production.** Involved microorganisms. Process scheme: continuous and discontinuous fermentation. Process fermentation and optimization conditions. **Microbial vitamins production.** Vitamin B12. Riboflavin. **Nucleotide and nucleoside production.**

### **Unit 13. Macromolecules production: enzymes and biopolymers.**

**Enzymas in food industry.** Microorganisms selection. GRAS Microorganisms. Enzyme industrial production.

**Microbial exopolysaccharides:** exopolysaccharides applications to the food industry. Xanthan industrial production. Other polysaccharides: **gelano, curdlano, escleroglucano, dextrano y alginatos.**

### **Unit 14. Alcohol drinks production.**

**Beer.** General fabrication aspects: raw materials. Types of yeast that intervene in the process. **Wine.** Types of fermentations and involved microorganisms. Second alcoholic fermentation and sparkling wine. Biotechnological improvement of wine and beer yeasts. **Cider. Distilled drinks.**

### **Unit 15. Bread production.**

Bakery yeast. Yeast metabolism in the bread dough. Fabrication techniques. Zero method. Improvement on the making of bread processes. Biotechnological improvement of baker's yeast.



### Unit 16. Dairy Products production.

Lactic bacteria and its transformations. **Yoghurt and fermented milk.** Ferment characteristics. Fabrication process. **Probiotics and prebiotics.** Concept, beneficial effects and action mechanisms. Probiotic microorganisms characteristics. **Cheese.** Types. Fabrication process and ferments involved.

### Unit 17. Fermented vegetables.

Fermentation types and microorganisms involved. Cabbage and olive fermentation. Food derived from soy and other preparations. Exotic culinary preparations.

### Unit 18. Other fermented products.

**Meat products.** Microorganisms role in the developing of meat fermented and ripened products.

**Fishing products fermentation.** Traditional products and new products. Involved microorganisms.

### Practical Syllabus

1. Isolation and characterization of microorganisms of biotechnological interest: isolation of *Bacillus*, exoenzyme producer from ground samples.
2. Collection of food for fermentation: lactic fermentation for yogurt production. Alcoholic fermentation for bakery products.
3. Collection of drinks for fermentation: alcoholic fermentation for beer production

### BIBLIOGRAPHY

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Principles of Gene Manipulation. 2002. 6<sup>a</sup> edición. Old RW y Primrose SB. Blackwell Scientific Publications.  
Lactic Acid Bacteria. Microbiology and Functional Aspects. 2<sup>a</sup> Edición. Salminen S y von Wright A. Marcell Dekker Inc. 1998.  
Biotecnología Alimentaria. 2017. Delgado y Rocha. Ed. Síntesis.

### ENLACES RECOMENDADOS

Cumplimentar con el texto correspondiente en cada caso

### TEACHING METHODS



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- Theoretical classes
  - Presentations and debates (seminars)
  - Specialized tutoring
  - Practical classes

