

## SHORT TEACHING GUIDES for Subjects of MUIA Master Degree

### **2229202004 Techniques in cellular and molecular biology (4 ECTS)**

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#### *Teaching unit 1 - Analysis of metabolites by HPLC*

- 1.1 Preparation of samples for HPLC analysis
- 1.2. Components and methods in HPLC operations
- 1.3. Application of HPLC technique
- 1.4. Guide for problems that can occur during HPLC operation

#### *Teaching unit 2 - Analysis of metabolites by gas chromatography*

- 2.1. Introduction to chromatography Definition. Basic principles. Components of a gas chromatograph, hazards and critical control points. Identification of compounds, quantification. Recent innovations
- 2.2. Application in the agro-alimentary field (composition, no exogenous, foreign elements). Simple gases and headspace with and without micro extraction in solid phase and/or derivatisation. Other applications: Purge and trap, electronic nose, non-destructive systems, stir bar sorptive extraction, headspace aroma fingerprinting, static and dynamic (continuous) systems. Examples in the agro-alimentary field and extraction and analysis of volatile aromas from plant tissues.

#### *Teaching unit 3 - Analysis of proteins by mono $\zeta$ and bi-dimensional electrophoresis*

- 3.1. Introduction. Basic principles of electrophoresis
- 3.2. Electrophoretic techniques. Polyacrylamide gel electrophoresis: native, SDS and isoelectric focusing. Bi-dimensional electrophoresis. Preparation of samples. First dimension. Second dimension. Protein detection. Proteomic analysis.

#### *Teaching unit 4 - Flow cytometry*

- 4.1 Fundamentals of the technique
- 4.2 Optic and electronic of a flow cytometer
- 4.3 Cell sorting
- 4.4 Applications and practical examples.

#### *Teaching unit 5 - The scanning electron microscope*

- 5.1 Main concepts of the technique
- 5.2 Structure and functioning
- 5.2 Sample preparation
- 5.3 Applications, advantages and disadvantages

#### *Teaching unit 6 - DNA sequence analysis*

- 6.1 Introduction to DNA sequence analysis
- 6.2 Basic molecular techniques with relevance for sequencing and melting peak

analysis.

6.3 Sequencing methods ¿ Sanger; pyrosequencing; next generation sequencing.

6.4 DNA sequence analysis by melting peak analysis and high resolution melting analysis.

6.5 Applications

**229202005 Genomic Technologies for Sustainable Agriculture (4 ECTS)**

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1. Genome structure 2. DNA and chromosome structure 3. DNA structure 4. Second and third generation sequencing technology 5. Plant and animal genomes 6. Transcription and functional genomics 7. Epigenetics 8. Transcriptomic analysis 9. Genome engineering technologies

**229202006 Advanced in-vitro cultivation Techniques: Micropropagation and Production of Compounds of Industrial Interest (4 ECTS)**

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*Unit 1: Introduction and requirements*

- C1. Introduction
- C2. Facilities and equipment in a micropropagation laboratory
- C3. Aseptic work conditions

*Unit 2: Micropropagation: methods, limitations and applications*

- C4. Micropropagation steps
- C5. Multiplication methods
- C6. Automation and large-scale cultures
- C7. Plant micropropagation limitations
- C8. Common problems associated with micropropagation
- C9. Applications

*Unit 3: Biosynthetic potential of plants*

- C10. Introduction to the study of the plant's biosynthetic potential
- C11. In vitro culture of plant cells, tissues and organs
- C12. Special productions techniques: addition of precursors, elicitation, biotransformation, mixed cultures
- C13. Industrial scale cultures
- C14. Applications

**229202007 Plant Defense: Biotechnological Tools to obtain disease resistant Plants (4 ECTS)**

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*Unit 1. INTRODUCTION*

- 1.1. INTRODUCTION. Plant anatomy. Plant physiology.
- 1.2. DEFINITIONS AND CONCEPTS. Pathogen, host, elicitor, resistance, susceptibility, immunity, virulence and avirulence. Plant-pathogen

*Unit 2. PATHOGENS*

- 2.1. Types of pathogens: viruses, bacteria, fungi, nematodes, insects, parasitic plants. Mechanism of invasion.

*Unit 3. PLANT DEFENCE SYSTEMS*

- 3.1. Passive defence.
- 3.2. Active defence.

*Unit 4. GENETICS AND MOLECULAR BASES OF PLANT-PATHOGEN INTERACTION*

- 4.1. Monogenic-oligogenic/polygenic resistance.
- 4.2 General resistance and specific resistance.
- 4.3. Vertical and horizontal resistance. Resistance genes.

*Unit 5. SYSTEMIC RESISTANCE. SIGNALLING OF THE DEFENCE*

- 5.1. Systemic acquired resistance. Signalling.
- 5.2. Induced systemic resistance. Signalling.

*Unit 6. INDUCTION OF RESISTANCE IN PLANTS*

- 6.1. Biotechnological tools to induce resistance in plants. Molecular strategies. Candidate genes for induction of resistance.
- 6.2. Microbial induction. Topical application of inducers.
- 6.3. Integration of induced resistance in crop production

**229202016 Degradation and Restoration of Mediterranean agroecosystems and surrounding areas (4 ECTS)**

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*Unit 1: Ecosystem and agroecosystems services (Lesson 1)*

Lesson 1. Concepts of ecosystems and agroecosystems. Biodiversity and ecosystem services. Ecosystem services of the soil-vegetation binomial. Soil quality indicators. Resistance and resilience.

*Unit 2. Impacts of anthropic activities on the soil-water-plant system of agroecosystems and surrounding areas. Diagnosis and restoration alternatives.*

Case studies (Lessons 2-6).

Lesson 2. Deforestation. Biological and physical soil degradation. Soil erosion and methods for its prevention/control/restoration.

Lesson 3. Salinization of soils and water: diagnosis and corrective measures.

Lesson 4. Eutrophication. Causes, diagnosis, study methods and normative aspects. Consequences and corrective measures. Role of wetlands to combat eutrophication.

Lesson 5. Contamination. Diagnosis and biogeochemical background. Study methods, normative aspects and prevention and corrective measures.

Lesson 6 Ecotoxicology. General and applied aspects of the employment of ecotoxicological tools in studies of ecosystems degradation.

**229202012 Minimal processing techniques to preserve quality and safety of fruit and vegetables (4 ECTS)**

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*1.- INTRODUCTION AND PROCESSING*

- T1 Introduction. Definitions. Raw material quality. Physiology and Biochemistry
- T2 Minimal Processing Technologies: Unit Operations and Equipments
- T3 Influence of pre-harvest factors on post-harvest quality
- T4 Fresh-cut processing technologies of vegetables. Innovative developments
- T5 Fresh-cut processing technologies of fruits. Innovative developments and shelf life
- T6 Minimal Processing Technology in "Fifth and Sixth Range"

*2.- OPTIMIZATION OF THE PRODUCTIVE PROCESS*

- T7 Process water sanitation. Sodium hypochlorite and alternatives
- T8 Technological innovations and other sanitizers
- T9 Edible coatings. Nanotechnology
- T10 Design of industrial facilities for the minimum processing of fruits and vegetables. Cleaning and sanitation

*3.- EMERGENT TECHNOLOGIES FOR MINIMAL PROCESSING*

- T11 Emerging technologies for the minimal processing of new products: smoothies, purees, hummus, etc.
- T12 UV radiation as abiotic stress to increase the synthesis of bioactive compounds
- T13 LED lighting technology. Energy savings, effect on quality and commercial life
- T14 By-products valorization in the minimal processing industry

## **229202011 Risk analysis and predictive microbiology (4 ECTS)**

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### 1. Present situation of food safety in Europe: The Risk Analysis system

- 1.1. Situation and structure of food safety in Spain and Europe.
- 1.2. Components of Risk Analysis. Application of quantitative risk assessment
- 1.3. Risk ranking and its role to guarantee food safety. Examples

### 2. Predictive models of microbial growth and databases

- 2.1. The microbial growth curve
- 2.2. Methodology to estimate microbial growth
- 2.3. Modelling the microbial growth curve: primary and secondary models
- 2.4. Databases for predictive microbiology

### 3. *MICROBIAL INACTIVATION KINETICS*

- 3.1. Basic concepts in thermobacteriology
- 3.2. Methods to study microbial heat resistance
- 3.3. Deviations of logarithm kinetics of microbial inactivation
- 3.4. Predictive models for microbial inactivation
- 3.5. Non isothermal inactivation treatments and their interpretation
- 3.6. Microbial inactivation exposed to other lethal agents

### 4. *CONTROL OF PATHOGENIC MICROORGANISMS PRESENT IN FOOD*

- 4.1. Intrinsic factors of the food
- 4.2. Extrinsic factors of the food

### 5. *FOOD PRESERVATION BY NON-THERMAL TECHNOLOGIES*

- 5.1. High hydrostatic pressure
- 5.2. High intensity pulsed electric fields
- 5.3. Ionizing radiation
- 5.4. Other alternatives

### 6. *INCREASED RESISTANCE MECHANISMS IN MICROORGANISMS*

- 6.1. Main resistance mechanisms in bacteria
- 6.2. Technological implications of resistance mechanisms

### 7. *APPLICATIONS OF PREDICTIVE MICROBIOLOGY TO FOOD INDUSTRY*

- 7.1. Hurdle technology for food preservation
- 7.2. New emerging pathogens and their implications in food safety
- 7.3. New tools to guarantee food safety



**229202016 Innovations in Horticulture (4 ECTS)**

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*Unit 1.- INTRODUCTION*

1.- The importance of plant genetic resources conservation. Main innovations in horticulture. Urban horticulture importance.

*Unit 2.- BIODIVERSITY AND DOMESTICATION OF PLANTS*

2.- Horticultural biodiversity.

3.- Domestication of plants.

*Unit 3: INTRODUCTION OF NEW CROPS*

4.- Neglected crops

5.- New vegetable crops

*Unit 4: CLIMATE MODIFICATION IN PROTECTED CULTIVATION*

6.- New covering materials

7.- New protected structures

8.- Climate modification

*Unit 5: SOILLESS CULTURE*

9.- Hydroponics systems

10.- Substrate-grown systems

11.- Acuaponics

*Unit 6. VALORISATION OF BYPRODUCTS FOR SOIL IMPROVEMENT*

12.- Management of manure and slurry

13.- Valorisation of agricultural by-products

*Unit 7: ECOSYSTEM SERVICES AND URBAN HORTICULTURE*

14.- Ecosystem services and urban greening

15.- Urban horticulture. Typology. Advantages and disadvantages