COURSE SYLLABUS
Academic Year: 2020/2021

Identification and characteristics of the course				
Code	502238-1	ECTS Credits		5,25
Course title (English)	**Técnicas Rápidas de Análisis Microbiológico**			
Course title (Spanish)	Rapid Microbiological Analysis Techniques			
Degree programs	DEGREE IN SCIENCE AND FOOD TECHNOLOGY			
Faculty/School	School of Agricultural Engineering			
Semester	Second (8º)	Course type	Optional	
Module	Optional			
Subject matter	Rapid Microbiological Analysis Techniques			

Lecturer/s			
Name	Office	E-mail	Web page
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Subject Area	Nutrition and Bromatology
Department	Animal Production and Food Science
Coordinating Lecturer (If more than one)	**Mª José Benito Bernáldez**

Competencies*

Basic Competencies

CB1 - Students have demonstrated that they possess and understand knowledge in an area of study that is based on general secondary education, and is often found at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.

CB2 - Students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated by making and defending arguments and solving problems within their field of study.

CB3 - Students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant social, scientific or ethical issues.

CB4 - Students are able to convey information, ideas, problems and solutions to both specialised and non-specialised audiences.

CB5 - Students have developed the learning skills necessary to undertake further studies with a high degree of autonomy.

* The sections concerning competencies, course outline, educational activities, teaching methodologies, learning outcomes and assessment systems must conform to that included in the ANECA verified document of the degree program.

General Competencies
CG1 - In the area of process and product quality management and control capacity to establish quality control procedures and manuals; implement and manage quality systems; analyse and report on food, raw materials, ingredients, additives; evaluate and improve the quality of methods of analysis applied to food control. CG2 - In the field of food safety acquire knowledge to assess the hygienic, sanitary and toxicological risk of a process, food, ingredient, packaging; identify the possible causes of food deterioration and establish traceability mechanisms. CG6 - In the field of collective catering, to know how to manage collective catering services; to propose suitable feeding programmes for the different groups; to ensure the quality and food safety of the food managed; to provide adequate training for the personnel involved. CG8 - In the field of legal, scientific and technical advice, to be able to study and interpret administrative reports and files relating to a product, in order to be able to respond reasonably to the question posed; to know the legislation in force; to defend before the administration the need to modify regulations relating to any product.
Transversal Competencies
CT1 - Skills in ICT at a basic level. CT2 - Knowledge of a foreign language (English). CT3 - Provide knowledge and teaching-learning methodologies at different levels; collect and analyse existing information. CT4 - Capacity for effective and efficient problem solving, demonstrating principles of originality and self-direction. CT5 - Capacity for critical reasoning, analysis and synthesis. CT6 - Effective and efficient management capacity with entrepreneurial spirit, initiative, creativity, organization, planning, control, decision making and negotiation. CT7 - Capacity for autonomous learning and concern for knowledge and lifelong learning. CT8 - Knowledge of the principles and methods of scientific and technical research. CT9 - Ability to work in a team. CT10 - Permanent concern for quality and the environment, occupational risk prevention and social and corporate responsibility. CT11 - Working appropriately in a biological laboratory with biological material including safety, handling, disposal of biological and chemical waste and annotated record of activities.
Specific Competencies
CECSA1: Identify and establish the possible causes of food spoilage. CECSA2: To know and evaluate the hygienic-sanitary and toxicological hazards in food and their effects on the health of the consumer. CECSA3 - Capacity to know, understand and promote safety and quality in the food chain, from the production of raw materials to consumption.
Contents

Course outline*
Know the fundamentals and applications of rapid and automated techniques. Importance of the rapid techniques application for the detection of microorganisms. Microbiological analysis of food using specific fast and accurate techniques. Characterization and identification of microorganisms using nucleic acid techniques. Detection of microorganisms or their products by physical-chemical and immunological methods. Uses of bioassays and related methods. This subject will be taught in English.
Course contents
Denomination of Lesson 1: **GENERAL ASPECTS** Contents of Lesson 1: 1.1. INTRODUCTION. Systems, methods, importance of new detection techniques. General concepts.
Denomination of Lesson 2: **DETECTION TECHNIQUES OF MICROORGANISMS OR THEIR PRODUCTS IN FOODS BY MOLECULAR BIOLOGY METHODS** Contents of Lesson 2: 2.1. NUCLEIC ACIDS. Physical and chemical structure of DNA. Renaturalization. Structure of RNA. 2.2. RECOMBINANT DNA TECHNOLOGY I. DNA isolation: extraction. Visualization of DNA. DNA fragmentation: restriction enzymes. Union of DNA molecules. 2.3. RECOMBINANT DNA TECHNOLOGY II. Nature of vectors: plasmids and phage vectors. Genes synthesized in the laboratory: complementary DNA. Cloning: stages. 2.4. TECHNIQUES USED FOR THE STUDY OF NUCLEIC ACIDS I. Hybridization: Definition of probe. Labelling of the probe. Advantages of the probes. Sensitivity and specificity. Fragment hybridization techniques: Southern Blotting and Northern Blotting. 2.5. TECHNIQUES USED FOR THE STUDY OF NUCLEIC ACIDS II. Sequencing, visualization and types. DNA digestion with restriction enzymes (REN). Amplification of DNA fragments by the polymerase chain reaction: limitations and efficiency; uses and applications. Study of C + G values. Complementarity of DNA. 2.6. TECHNIQUES USED FOR THE STUDY OF NUCLEIC ACIDS III. Studies of genetic polymorphisms I. Karyotyping. Restriction Fragment Analysis (RFLPs), rDNA study. Study of non-ribosomal DNA and RNA (RT-PCR). 2.7. TECHNIQUES USED FOR THE STUDY OF NUCLEIC ACIDS VI. Studies of genetic polymorphisms II. DNA fingerprinting or fingerprinting, Random PCR or RAPD, PCR fingerprinting or PCR fingerprinting, polymorphisms of amplified DNA fragments or AFLP.
Denomination of Lesson 3: **TECHNIQUES FOR DETECTING MICROORGANISMS OR THEIR PRODUCTS IN FOODS BY PHYSICAL, CHEMICAL AND IMMUNE METHODS** Contents of lesson 3: 3.1. PHYSICAL METHODS: Impedance, microcalorimetry and flow cytometry. Turbidimetry. 3.2. CHEMICAL METHODS: determination of adenosine triphosphate (ATP), direct Epifluorescence (DEFT). Radiometry. Fluorogenic and chromogenic substrates. API Galleries. Thermostable nuclease. Limulus lysate for endotoxin screening (LAL). 3.3. CHROMATOGRAPHIC METHODS: classification of chromatographic methods. Analysis and detection. 3.4. IMMUNOLOGICAL METHODS I: Precipitation in A) liquid medium: quantitative and qualitative and in B) solid medium: double immunodiffusion, radial immunodiffusion

and immunoelectrophoresis. Agglutination: agglutination in port, sero-agglutination in tube and direct hemagglutination in microplate. 3.5. IMMUNOLOGICAL METHODS II: Immunofuorescence: direct and indirect. Radioimmunoassay: solid phase; Direct and indirect. ELISA: Fundaments and types. Direct ELISA. Indirect ELISA. Double ELISA antibody sandwich. Indirect ELISA double antibody sandwich. ELISA competition. 3.7. BIOSENSORS. Definition. Components of a biosensor. Characteristics of biosensors. Future of biosensors.
Denomination of lesson 4: **TECHNIQUES FOR DETECTING MICROORGANISMS OR THEIR PRODUCTS IN FOOD THROUGH BIOASSAYS AND RELATED METHODS** Contents of Lesson 4: 4.1. TESTS IN LIVE ANIMALS. Lethality in mouse, lactating mouse, rabbit and mouse diarrhea, kitten test, skin tests in rabbit and guinea pig. 4.2. MODELS REQUIRING SURGICAL TECHNIQUES. Ligament bowel ligation techniques. RITARD method 4.3. SYSTEMS OF CELL CULTURES. Human cells of mucous epithelium. Guinea pig intestinal cells. Vero cells
Competencies acquired: CB1, CB4, CB5, CG1, CG2, CG6, CT3, CT7, CT8, CT10, CECSA1, CECSA2, CECSA3 **Learning outcomes: 1,2,3,5,6,7,8,9,10**
Practical sessions
Denomination of lesson: **Practical session 1**. Contents of Lesson: Identification of microbial toxins by nucleic acid techniques (PCR). Bacterial DNA extraction, real-time PCR **Competencies acquired: CB2, CB3, CG1, CG2, CT8, CT9, CT11, CECSA1, CECSA2, CECSA3** **Learning outcomes:1,2,3,5,6,7,8,9**
Denomination of lesson: **Practical session 2**. Contents of Lesson: Identification of different microorganisms by DNA profiles. **Competencies acquired: CB2, CB3, CG1, CG2, CT8, CT9, CT11, CECSA1, CECSA2, CECSA3** **Learning outcomes: 1,2,3,5,6,7,8,9**
Denomination of lesson: **Practical session 3**. Contents of Lesson: Identification of microorganisms using immunological techniques test agglutination kit, ELISA, TECRA UNIQUE and VIDAS. **Competencies acquired: CB2, CB3, CG1, CG2, CT8, CT9, CT11, CECSA1, CECSA2, CECSA3** **Learning outcomes: 1,2,3,5,6,7,8,9**
Denomination of lesson: **Practical session 4**. Contents of Lesson: Use of other rapid methods for detection of microorganisms index indicators such as Chromogenic agar, SIMPLATE (coliforms and *E. coli*). **Competencies acquired: CB2, CB3, CG1, CG2, CT8, CT9, CT11, CECSA1, CECSA2, CECSA3** **Learning outcomes: 1,2,3,5,6,7,8,9**
Denomination of lesson: **Practical session 5**. Contents of Lesson: Rapid biochemical methods: API GALLERIES. **Competencies acquired: CB2, CB3, CG1, CG2, CT8, CT9, CT11, CECSA1, CECSA2, CECSA3** **Learning outcomes: 1,2,3,5,6,7,8,9**
Denomination of lesson: **Practical session 6**. Contents of Lesson: Physical-chemical methods (Flow cytometry - technique used to detect and measure physical and chemical characteristics of a population of cells). **Competencies acquired: CB2, CB3, CG1, CG2, CT8, CT9, CT11, CECSA1,**

CECSA2, CECSA3
Learning outcomes: 1,2,3,5,6,7,8,9

SEMINAR ACTIVITIES

Denomination of the lesson: Rapid technique for the microbiological analysis of food

Activity content: Each student will perform different searches of rapid techniques used for the detection and identification of microorganisms. The works will be presented in power point with the following sections: Basis of the method, food and microorganisms detected, method development, total time for detection, sensitivity and specificity.

Type and place: Seminar (A-25, A32)

Competencies acquired: CB1, CB2, CB3, CB4, CB5, CG2, CT1, CT2, CT3, CT4, CT5, CT6, CT7, CT9, CECSA1, CECSA2, CECSA3

Learning outcomes: 1,2,3,5,6,7,8,9, 10

Materials and tools to be used: Computers, databases of scientific literature

Educational activities *

Student workload (hours per lesson)		Lectures	Practical sessions				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
Lesson 1	18,5	2,5					1	15
Lesson 2	28	8						20
Lesson 3	26,5	5					1,5	20
Lesson 4	11	3						8
CAMPO O LABORATORIO								
1	11			6				5
2	11			5			1	5
3	11			6				5
4	11			5			1	5
5	10			5				5
6	10			5				5
Assessment **	2	2						
TOTAL	**150**	**20,5**		**32**			**4,5**	**93**

L: Lectures (100 students)
HI: Hospital internships (7 students)
LAB: Lab sessions or field practice (15 students)
COM: Computer room or language laboratory practice (30 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*

1. Lectures and discussion of theoretical contents
2. Development of problems
3. Laboratory practices, pilot plants and field
6. Development and presentation of seminars
7. Use of the virtual classroom
9. Study of the subject
10. Search and management of scientific literature
11. Exams

Learning outcomes *

** Indicate the total number of evaluation hours of this subject.

1. Know the Fundamentals and Applications of Rapid and Automated Techniques.
2. Know the fundamentals of microorganism counts in food.
3. Know the relevance of the rapid techniques to detect personal hygiene, products and processes.
4. Manage food safety through rapid detection of pathogens and their toxins.
5. Evaluate, control and manage food quality through the application of automated techniques.
6. Improve quality systems.
7. Controlling and assessing food risks. Analysing and assessing food risks.
8. Analyse food using specific techniques.
9. Controlling and optimizing processes.
10. Advise the food industry scientifically and technically.

Assessment methods *

CONTINUOUS ASSESSMENT

They will be evaluated:
- Practical knowledge

The learning of the practical part of the subject will be continuously evaluated, through control of attendance and participation in the practical sessions. The use of the practical part of the course will also be evaluated by means of a practical test, by answering short questions related to the practices carried out (fundamentals, procedure, etc.). This part will be compulsory in order to pass the course. In order to pass this part, it is necessary to obtain a grade of 5 or more points. These activities will be 20% of the final grade of the course.

- Seminars

The seminars will be evaluated by means of monographic works that will be presented throughout the course in a large group. They will be evaluated by monitoring attendance and participation in the sessions. This part will be compulsory in order to pass the course. To pass this part it is necessary to obtain a grade equal to or higher than 5 points in each of the parts. These activities will be 20% of the final grade of the course.

- Theoretical knowledge

It will be evaluated on an ongoing basis through the resolution of questionnaires and short questions in class. In addition, theoretical knowledge will be evaluated by means of a final exam that may consist of test and short questions, or oral questions. In order to pass the theoretical part, it is necessary to obtain a score of 5 or more points in this exam. Theoretical knowledge will make up 60% of the final qualification of the course.

Each part will represent a percentage of the final grade:
- Theoretical knowledge 60%.
- Seminars: preparation and presentation 20%.
- Laboratory work: assistance and knowledge 20%.

The announcements, grades and periods for claiming the exams will be displayed on the corresponding boards and through the virtual classroom of the subject in time and form as established by the regulations approved by the Governing Board and published by Resolution 9/03/2012, DOE No. 59 of March 26, amended by Resolution 27/11/2012, DOE No. 242 of December 17 and Resolution 17/03/2014, DOE 62 of March 31 and Resolution of November 25, 2016, DOE No. 236 of December 12, 2016.

SINGLE ASSESSMENT

1. In the first three weeks of the term, the student who avails himself of this type of evaluation must notify the course coordinator in writing of his intention to avail himself of this type of evaluation.
2. There will be an examination corresponding to the practical contents and the seminar part, both tests may be oral or written, in which case they will follow the same criteria for passing

each part as for continuous assessment.
3. Passing the test on practical knowledge shall be required to pass the course. This will be done by means of a practical test, which may also consist of an oral or written test on the practical contents. A minimum of five points must be achieved in the test of practical knowledge.
Each part will represent a percentage of the final grade:
- Theoretical knowledge 60%.
- Seminars: preparation and presentation 20%.
- Laboratory work: assistance and knowledge 20%.

Bibliography (basic and complementary)

BASIC
-CASARETT, L.J., AMDUR, M.O., KLAASSEN, C.D. (1995). Casarett and Doull's Toxicology: The basic science of poison. McGraw-Hill,
-DOYLE, M.P. (2000). Microbiología de los alimentos:fundamentos y fronteras. Acribia. Zaragoza
-LINDNER, E. (1995). Toxicología de los Alimentos. 2a ed. Acribia. Zaragoza.
-FREIFELDER, D. (1988). Fundamentos de biología molecular. Acribia S. A. Zaragoza.
-FRAZIER, W.C. y WESTHOFF, D.C. (1996). Microbiología.de los Alimentos. 4aEd. Acribia. Zaragoza.
-GRUENWEDEL, D.W. y WHITAKER, J. R. (1984). Food Analysis. Principles and Techniques. Volumen 3. Marcel Dekker, Inc. New York and Basel.
-HAYES, P .R. (1993) Microbiología e Higiene de los Alimentos. Acribia. Zaragoza.
-ICMSF. Microorganismos de los Alimentos. Ecología microbiana de los productos alimentarios (2001): Acribia. Zaragoza.
-JAY, J. (2002) Microbiología Moderna de los Alimentos. 4a ed. Acribia. Zaragoza.
-MORTIMER, S.E. y WALLACE, C. (1996) HACCP: Enfoque práctico. Acribia. Zaragoza.
-NELSON, W.H. (1985). Instrumental methods for rapid microbiological analysis. VCH Publishers.
-PASCUAL ANDERSON M.R. (2000) Microbiología Alimentaria: Metodología Analítica para Alimentos y Bebidas. Díaz de Santos. Madrid.
-STANNARD, C.J., PETIT, S.B. Y SKINNER, F.A. (1989). Rapid microbiological methods for foods, beverages y pharmaceuticals. Blackwell scientific publications.
-WALKER, J.M. Y GINGOLD, E.B. (1997). Biología molecular y Biotecnología. 2ª edición. Acribia S. A. Zaragoza.

COMPLEMENTARY:
- http://www.dce.ksu.edu/dce/cl/rapidmethods/
- http://www.rapidmethod.com
- Aguas: http://www.ua.es/es/servicios/juridico/aguas.htm
- HACCP: http://www.calidadalimentaria.com
- HACCP: http://www.juridicas.es
- Seguridad Alimentaria: http://www.aesa.msc.es/aesa/web/AesaPageServer?idcontent=92&idpage=58
- FDA, métodos rápidos de análisis: http://www.cfsan.fda.gov/~ebam/bam-a1.html
- Journal of Rapid Methods & Automation in Microbiology: http://www.blackwellpublishing.com/journal.asp?ref=1060-3999
- AOAC: http://www.aoac.org/testkits/microbiologykits.htm y http://www.aoac.org/pubs/microcompendium.htm

Other resources and complementary educational materials

Previously to the lecture, they will be given a summary of the subject including the main contents to be taught. These contents can be in Power point format, Word or any of them transformed into pdf. For its disposition it will be deposited inside each thematic block in the virtual campus of the subject.
Extension material may be used, both bibliographical and other types of documentation (e.g. web pages) that allow for the development of other transversal or specific skills of the degree. All this in the moodle virtual campus platform.
Virtual classroom of the subject in the virtual campus of the Uex.
(http://campusvirtual.unex.es/portal/)