Universidad Zaragoza

Academic Year/course: 2021/22

68758 - Molecular tools in food science

Syllabus Information

Academic Year: 2021/22
Subject: 68758 - Molecular tools in food science
Faculty / School: 105 - Facultad de Veterinaria
Degree: 631 -
ECTS: 3.0
Year: 1
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The main objective of this subject is the use and integration of different molecular tools. Therefore, the theoretical and practical contents have been coordinated. The theoretical classes are aimed to introduce the tools, their bases, advantages and disadvantages. As a complement, in the practical activities the student becomes familiar with these techniques and he/she can apply his/her theoretical knowledge for the design of experiments and analysis of results.

These approach and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the learning goals provides training and competence to contribute to some extent to their achievement:
- Goal 2: Zero hunger
- Goal 3: Good health and well-being
- Goal 4: Quality education
- Goal 8: Decent work and economic growth
- Goal 9: Industry, innovation and infrastructure
- Goal 12: Responsible consumption and production

1.2. Context and importance of this course in the degree

This subject is included in the ?Master of Food Quality, Technology and Safety? which aims to provide with scientific and methodological background to deepen in that field. In this sense, we will use important molecular tools in the Biotechnology field with a promising future in Food Science. Given the multidisciplinary nature of this knowledge, our subject allows to complement other subjects of the Master, such as "Investigation of microorganisms in foods, water and environment: traditional and molecular techniques", "Food Enzymology", "Detection and characterization of antimicrobial compounds in food", ?Investigation of moulds and mycotoxins in food?, "Immunochemistry techniques for food quality control" and "Methodology for the study of bacterial inactivation and survival".

1.3. Recommendations to take this course

It is desirable that the student has prior knowledge of genetics and the use of molecular biology tools. In any case, the necessary materials will be provided prior to the beginning of the course to allow the student to know the minimum fundamentals of these techniques.

2. Learning goals

2.1. Competences

By passing the subject, the student will be more competent ?
1. To critically interpret and analyze scientific articles related to Molecular Biology in Food Science.
2. To study the physiological changes in the microorganisms in different food environments.
3. To identify the present organisms in food with Molecular Biology techniques.
4. To create mutations in genes of interest in Food Science.
5. To identify the bioethical implications of the use of molecular techniques in food science.
6. To communicate scientific results in this field.

2.2. Learning goals

The student, to pass this subject, will have to demonstrate that:

1. He/she knows and is able to differentiate between different methodologies used in molecular biology for the study of the bacterial behaviour in different environments of the food science.

2. He/she is able to design a mutation in a bacterial organism of interest in food science.

3. He/she is able to use different computer tools for experiment design and analysis.

4. He/she is able to identify the bioethical aspects about the use of molecular biology tools and techniques in food science.

5. He/she is able to communicate in an oral presentation and a written work the steps for the study of a practical case related to the subject.

2.3. Importance of learning goals

The acquired knowledge and the tools used in the subject will allow complementing the microbiological, genetic and molecular formation of the Master students. These matters are acquiring a great importance in Food Science, since they offer novel, economic and fast solutions to traditional problems. Thus, the students who attend this subject will extend their qualification to occupy a position in R&D departments or in analytical laboratories of the food industry. In addition, the acquired tools will complement the research formation necessary for the accomplishment of a Ph.D. in Food Science. This knowledge will facilitate the acquisition and understanding of the new Molecular Biology techniques arising in the field and the transference to the Food Science field.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

The student will have to demonstrate that he/she has reached the expected learning results by these evaluation activities?

ACTIVITY 1. Individual written activity. Design an experimental plan for the study of a practical case introduced by the lecturer. The application of the used tools in the classes will be needed to accomplish this objective (60% of the final mark). The accomplishment of this activity will allow proving the achievement of the first four proposed learning results. The completion of this written work is considered compulsory. The grades will rank from 0 to 10 and will represent 60% of the final mark of the student in the subject.

ACTIVITY 2. Oral presentation of the individual activity in which the student will explain the steps followed during the work, the obtained results and the possible explanations that can be made depending on the used methodology (40% of the final mark).
The completion of this activity will allow complementing the evaluation of the first four proposed learning results and to prove the acquisition of the fifth learning result. The completion of this written work is considered compulsory. The grades will rank from 0 to 10 and will represent 40% of the final mark of the student in the subject.

Evaluation criteria and demanded requirements

EVALUATION ACTIVITY 1 (60%).
Approach to the problem and possible solutions (20%).
Appropriate use of the tools taught in the course (30%).
Bibliography: understanding, interpretation, correct data collection (10%).

EVALUATION ACTIVITY 2 (40%):
Exposition ability (organization of the materials, coherence, structure, etc.) (30%)
Discussion of the results (10%)

System of qualifications:

In accordance with the Regulations Evaluation Standards of Learning at the Universidad de Zaragoza (Agreement of Governing Council on 22 December 2010), the obtained results by the student will be graded according to the following numerical scale from 0 to 10, with one decimal, to which corresponding qualitative rating may be added:

0 to 4.9: Failed (SS).
5.0 to 6.9: Appropriate (AP).
7.0 to 8.9: Notable (NT).
9.0 to 10: Outstanding (SB).

The mention of "Matricula de Honor" will be awarded among students who have obtained a rating higher than 9.0. Their number may not exceed five percent of the students enrolled in the course during the corresponding academic year.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The course is organized into 5 lectures and 5 practical exercises that will be carried out in the computer room and the laboratory. In addition, students will prepare and present a research project, for which they will devot 40 hours of autonomous work.
The lectures will introduce the state-of-the-art techniques of Molecular Biology, focusing on their use in Food Science. In these lectures software tools for data analysis will be introduced.
In the practice sessions, a real-data problem will be presented, and the software taught in the lectures will be needed in order to find its solution. In some cases, the student will have to collect the data by designing and making an experiment.
The basic tools for the accomplishment of these activities will be available in the virtual platform (Anillo Digital Docente: ADD).

4.2. Learning tasks

The course includes the following learning tasks:
Lectures (15 hours). 5 participative lectures. Attendance is required.
Practice sessions (15 hours). 5 practical exercises that will be carried out in the computer room and in the laboratory. Attendance is required.
Research project (40 hours). A practical case will be introduced by the lecturer. To solve the case, the student will have to design synthetic organisms with the tools used in the course. After designing the constructions, the student will select a specific fluorescent probe to study the case. The student will speculate on the expected results and the limitations of the techniques. It will be handed in in the form of a written report.
Oral presentation (2 hours). After handing in the written report, the student will defend the research project with an oral presentation in the classroom. The evaluation criteria will be the clarity in the presentation, and the organization of the work. Furthermore, the defense of the project will be evaluated by questions from the rest of the students and the lecturer. Attendance is required.
Tutorials (3 hours). Attendance is required.

4.3. Syllabus

The course will address the following topics:

Lectures
Topic 1. Introduction (0.45 ECTS: estimated 3 hours)
-Context of the course, historical importance of the new Molecular Biology techniques, advances, new methodological objectives.
-Basic aspects of Molecular Biology. Genetics: nucleotides, synthesis and structure. Proteomics: translation, post-translational modifications.

Topic 2. DNA Polymerase Chain Reaction (PCR) (0.45 ECTS: estimated 3 hours)
-DNA structure and synthesis: template, primer, enzyme and other components.
-DNA template: function, types, requirements.
-DNA primer: function, types, requirements.
-Enzyme: function, types, requirements.
-Other components: function, types, requirements.
-New PCR techniques: qPCR-RT.
-PCR applications in Food Science: identification of microorganisms by 16S sequencing (bacteria) or ITS (yeasts and moulds) identification of adulterations, frauds, etc.

Topic 3. Bioinformatics (0.45 ECTS: estimated 3 hours)
-Databases of public access: Pubmed, Swiss-Prot.
-Tools for analysis of nucleic acid and protein sequences.
-Construction of phylogenetic trees.
-Design of primers for the PCR reaction.

Topic 4. Cloning strategies and generation of mutant organisms (0.45 ECTS: estimated 3 hours)
Concept of gene. Genetic systems. Gene deletion and addition. Tools and reagents. Characteristic as a function of the organism.
Creation of gene reporters. Green Fluorescent Protein (GFP). lac system. Variations. Detection.
Opportunities in the use of mutant organisms in Food Science.

Topic 5. Bioethics. (0.30 ECTS: estimated 2 hours).
-Bioethics concept.
-Stages of ethical analysis
-Economic, social, moral and ecological consequences of genetic improvement
-The future of genomic research

Practice sessions
Practice session 1. Bioinformatics I (0.45 ECTS: estimated 3 hours)
Search and analysis of genomic sequences of different organisms.
Design of DNA primers.
Room: Computers room

Practice session 2. Bioinformatics II (0.45 ECTS: estimated 3 hours)
Practical Case: analysis of microarray experiments. Study of results obtained in a real case of Food Microbiology.
Comparisons with alternative techniques.
Room: Computers room

Practice session 3. Design of PCR experiments (0.45 ECTS: estimated 3 hours)

Practical Case: PCR identification of microorganisms. Design of DNA primers for 16S ribosomal gene. Amplification of the 16S ribosomal gene. Sample preparation for sequencing.
Room: Computers room and laboratory

Practice session 4. Design of mutant organisms (0.45 ECTS: estimated 3 hours)
Practical case: creation of a specific mutant by an in silico program.
Room: Computers room

Practice session 5. Bioethics (0.30 ECTS: estimated 2 hours)
Projection audiovisual. Discussion of the most important ethical aspects reflected in the audiovisual and others raised by the teacher, following the stages of ethical analysis.

4.4. Course planning and calendar

The calendar of the lectures and practice sessions is published in the month of September on the website of the Faculty of Veterinary http://veterinaria.unizar.es/
Submission of the research project: 3 weeks after the end of the lectures and practice sessions. It will be defended in the Postgraduate Seminar room of the Faculty of Veterinary (Zootechnics Building).
The hours of tutorials will be previously agreed with the lecturer. In addition, not in-person office hours will be available via virtual platform ADD and e-mail.

4.5. Bibliography and recommended resources

Check at https://biblioteca.unizar.es/