COURSE DATA

DATA SUBJECT

Code: 33199
Name: Protein technology
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1111 - Grado en Biotecnología	Facultat de Ciències Biològiques	4	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1111 - Grado en Biotecnología	Optability	ELECTIVES

COORDINATION

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SUMMARY

Proteins play crucial roles in almost all biological processes, including catalysis, signal transmission, and structural support. This wide variety of functions arises from the existence of thousands of proteins, each with a distinctive three-dimensional structure, which enables them to interact with one or several molecules within a broad range. One of the main objectives of current biotechnology is to determine how amino acid sequences specify the conformations, and thereby the functions, of proteins. Only with a detailed understanding of this structure/function relationship can we rationally develop new biotechnological approaches.

Frequently, the first step in these studies is the purification of the protein of interest, whether for structural studies, functional analysis, or biotechnological application. Proteins can be separated from each other based on their solubility, weight, charge, and binding capacity, among other characteristics. Once a protein has been purified, functional studies or biotechnological improvements can begin. Many protein sequences, often deduced from genomic sequences, are now accessible in large sequence databases, and it is becoming possible to predict and design their structure and even their function thanks to algorithms such as AlphaFold.

The exploration of proteins with a broad range of currently available physical and chemical techniques has enriched our understanding of the molecular foundations of life. These techniques, both rational design and directed molecular evolution, make it possible to address some of the most complex biological questions in molecular terms, which will undoubtedly lead to improvements in a large number of biotechnological processes.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

The subject is a step forward in the knowledge of the biochemistry of proteins, which is why it is clearly related to the subjects Biochemistry and Methods in biochemistry and molecular biology in the second year, as well as Molecular Biology, Methods in Immunology and Methods in molecular biology and genetic engineering in thrid course.

The student must know the structure of the main biological macromolecules, and the forces that stabilize them and allow their specific interactions with other molecules. Likewise, the student will have to know the mechanisms of enzymatic reactions, their kinetics and their regulation.

COMPETENCES / LEARNING OUTCOMES

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Actuar con autonomía en el aprendizaje, tomando decisiones fundamentadas en diferentes contextos, emitiendo juicios en base a la experimentación y el análisis y transfiriendo el conocimiento a nuevas situaciones

Colaborar eficazmente en equipos de trabajo, asumiendo responsabilidades y funciones de liderazgo y contribuyendo a la mejora y desarrollo colectivo

Contribuir en el diseño, desarrollo y ejecución de soluciones que den respuesta a demandas sociales, teniendo en cuenta como referente los Objetivos de Desarrollo Sostenible

Demostrar razonamiento crítico y autocrítico en el ámbito de la titulación, considerando aspectos tales como la ética profesional, los valores morales y las implicaciones sociales de las diferentes actividades realizadas

Determinar los marcadores moleculares apropiados en procesos de mejora con fines biotecnológicos.

Diseñar procesos de manipulación y obtención de productos biotecnológicos.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

Ser capaz de abordar el análisis de la estructura de macromoléculas al objeto de modificarla con fines biotecnológicos.

DESCRIPTION OF CONTENTS

1. Obtaining and structure of proteins

Structural principles of proteins
Description and chemical constitution. Physical interactions that determine the properties of proteins. Amino acid hydrophobicity scales. Structural motifs: alpha-helix, beta-sheets. Domains Structural motifs in membrane proteins.

Protein folding and stability
Concept. Levinthal paradox. In vitro folding. Folding mechanisms. In vivo folding.
chaperones GroEL / Groes operating mechanism. Folding of secretory proteins and membrane proteins. Prediction of structures. AlphaFold.

Alternative strategies to combat antimicrobial resistance
Mechanisms of resistance and different antimicrobial strategies.

Proteins and enzymes of biotechnological interest. Historical perspective. Kinetic properties. Examples of enzymes and proteins mainly used in the biotechnology industry.

Protein extraction, purification, and stability. Properties of proteins used in their purification. Extraction and separation methods. Fusion proteins: large-scale purification. Denaturation mechanisms.

Obtaining recombinant proteins
Reasons for obtaining recombinant proteins. Cloning strategies. Cloning vectors and expression systems in prokaryotes and eukaryotes. Renaturation of proteins from inclusion bodies. Strategies to improve the expression of recombinant proteins in E. coli.

2. Biotechnological applications

Immobilization of Proteins
Introduction. Methods of immobilization. Immobilization of cofactors. Characteristics of immobilized

enzymes. Applications in industry, medicine and research.

Biosensors
Concept of biosensor and its historical evolution. Types of biosensors. The bioactive component: enzymes and antibodies. Types of transducers: electrochemical, optical and piezoelectric. Micro and nano levers.
Examples of industrial application biosensors.

Catalytic antibodies
Introduction: design and generation of catalytic antibodies. Abzymes versus enzymes. Examples of reactions available. Structural information applied to the understanding of catalysis mechanisms. examples
Future of catalytic antibodies. Nanobodies versus Abzyms.

Enzymology in non-aqueous media
Introduction: cosolvents, biphasic mixtures, reverse micelles, organic solvents. Advantages of using enzymes in non-aqueous media. Basic rules for the use of enzymes in non-aqueous media.
Solvent effect on kinetic parameters. Strategies for increasing enzyme activity in these media.

Peptide and protein modification strategies.
Classical chemical modification. Affinity and photoaffinity tags. Enzymatic modification through the use of transglutaminases and glycosyltransferases. GFP: properties and applications in the study of protein-protein interactions (FRET and BiFC).

Encapsulation and controlled release of polypeptide drugs
Design and development of strategies for the formulation and administration of peptides and proteins. Administration using polymeric microspheres and liposomes. PEGylation. Conjugated polymers. Development of systems and / or vectors for targeted administration.

3. Protein design

Directed molecular evolution
Methods for the generation of random diversity. Genetic selection and visual tracking. Evolution of thermostable enzymes. Evolution of enzymes for use in artificial environments. Evolution of specificity and enantioselectivity.
examples.

Combinatorial peptide libraries: chemical and biological
Concept. Peptide libraries for expression in biological systems ("phage display"): type, construction, characteristics, applications and perspectives. Directed evolution of antibodies. combinatorial chemistry. Solid- phase peptide synthesis. Methods for the preparation of synthetic peptide libraries: iterative and positional tracking. examples

4. Practical sessions

Molecular imprinting of lipolytic enzymes based on interfacial activation protocols.
It consists in the trapping of active conformations of lipases for subsequent use in non-aqueous media, with the aim of increasing their catalytic efficiency in this type of environment of particular interest for biotechnological applications.

Study of helix-helix interactions.
Heterologous overexpression, Ni2 +-agarose column purification and electrophoretic analysis of proteins with dimerization capacity will be performed. The model system used will allow us to study the interactions between transmembrane helices as an experimental approach to the structural study of membrane protein folding.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	33,00
Laboratory	12,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	0,00
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**0,00**

TEACHING METHODOLOGY

Theoretical classes: presentation in a conventional classroom of the topics of the program for 26 hours. Eventually, some specific aspect of the syllabus can be presented by an invited specialist. In the same way, they will try to attend research seminars related to the world of proteins that can be taught during the academic period in Research Centers near the University.

Practical classes: attendance is compulsory. They will consist of carrying out the practical sessions described above for 12 hours in a teaching laboratory. The students will carry out the suggested experiments working in pairs. At the end of

the internship, the students will have to hand in a internship report in which they present the experimental results obtained while discussing their results in the context of the structure and function of proteins from a biotechnological point of view.

Seminars: students will present in public, a research article directly related to the contents of the course or any biotechnological innovation in the use of proteins. All students will have to prepare a short summary of all the articles covered by the seminars.

Throughout the course, student participation in different scientific activities in the area of interest in protein technology that take place in Valencia will be promoted.

EVALUATION

The quarter monthly nature of the subject rules out the possibility of partial exams.

The evaluation of theoretical knowledge (8 points) will be carried out by means of a written exam in which a question related to the practical sessions (2 points) will be included.

The quality of the oral presentation, the participation in both the teacher's classes and the students' seminars, as well as the reviews of the lectures and activities outside the classroom, and the written summaries of the articles used in the student seminars and the reports presented from the practices to modulate the final grade.

REFERENCES

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