VNIVERSITAT DE VALÈNCIA

Course Guide
33197 Biotechnological acquisition of industrial and health-related products

COURSE DATA

Data Subject	
Code	33197
Name	Biotechnological acquisition of industrial and health-related products
Cycle	Grade
ECTS Credits	6.0
Academic year	2024 - 2025

Study (s)

Degree	Center	Acad. year	Period
1102 - Degree in Biotechnology	Faculty of Biological Sciences	4	First term

Subject-matter

Degree	Subject-matter	Character
1102 - Degree in Biotechnology	107 - Biotechnological acquisition of industrial and health products	Optional

Coordination

Name	Department
PARDO CUBILLOS, M ISABEL	275 - Microbiology and Ecology

SUMMARY

The contents of this subject is placed into a scenario in which molecular advances occur rapidly allowing to glimpse a vast horizon for organism uses. The chemical industries have been revolutionized by the almost infinite possibilities of organisms, particularly those of microbial nature, to synthesize almost any organic compound and, in many cases, with lower energy and cost than those produced by chemical synthesis. From the biomedical point of view, many of the existing infectious diseases can be prevented with the use of modern vaccines or treated with antibiotics produced by microorganisms. Similarly, plants traditionally used to solve health problems, are still used today to solve problems of our own current lifestyle, as well as cell factories for synthesizing metabolites and proteins.

A major achievement in the treatment of numerous human physiological problems was the possibility of using microorganisms for the production of human proteins in sufficient quantity to be applied to the population in inexpensive, safe and widespread way.

The aim, therefore, is the student knows what organisms are capable of synthesizing products of industrial or sanitary importance, evaluating the benefits of organic synthesis compared to chemical synthesis and understanding that the latter benefits from the discoveries of the former, obtaining the same products at a lower cost and with a lesser environmental impact. It is also intended that the student knows how the biotechnological production of human proteins and pharmacologically active substances has become accessible to most of the developed societies allowing clinical treatments unthinkable just 40 years.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Among the most important previous courses required for understanding OBPIIS are Genetics, Microbiology, Biochemistry, Metabolism and Regulation, Molecular Biology, Molecular Genetics and Cell Biology, and the course contained in the module Instrumental Methods in Biotechnology and in the module Biochemical Engineering, taught in 1st and 2nd and 3rd year).

1102 - Degree in Biotechnology

- Poseer y comprender los conocimientos en Biotecnología.
- The ability to apply this knowledge in the professional world.
- Capacidad de interpretar datos relevantes.
- Be able to convey ideas, problems and solutions in the field of biotechnology.
- Develop skills to undertake further study.
- Have abilities for teamwork and cooperation in multidisciplinary teams.
- Have abilities to disseminate and participate in the social debate on aspects related to biotechnology and its use.
- Have an integrated view of the R&D&I process from the discovery of new basic knowledge to the development of particular applications of that knowledge and the introduction of new biotechnological products into the market.
- Conocer los diferentes tipos de procesos biotecnológicos asociados a la producción industrial.
- Ser capaz de evaluar las aplicaciones biotecnológicas de los microorganismos.

Skills to acquire

The student must:

Correctly apply the vocabulary and specific terminology of the discipline Biotechnology.

To list some of the products that can be obtained from microorgnism and their applications in society, i.e., must be able to define what the social projection of Biotechnology.

Distinguish and identify different organisms useful for the synthesis of molecules of biotechnological interest.

Define current trends in research on products of biotechnological interest worldwide and in the Comunitat Valènciana .

Linking knowledge in Microbiology, Genetics, Molecular Biology, Metabolism and Physiology, Computing, Engineering Process and Basic Operations, that are needed to design a biotechnological process.

Being able to design and evaluate strategies to improve metabolite production and to perk up characteristics of enzymes.

The student will have to show mental and manual skills necessary to solve the problems that arise during practical work.

Prove to be capable of detecting the approach or procedural errors made during the laboratory work, and to discern the extent that mistakes will have on the results.

Demonstrate that it has acquired the knowledge necessary to join the professional work.

Being able to describe clinical applications of metabolites produced by different organisms and strategies for producing recombinant vaccines, insulin, growth hormone, etc..

List and describe the types of strategies that lead to overproduction of metabolites.

Demonstrate that it has purchased an integrated view of the R + D + i, since the discovery of new basic knowledge, the development of specific applications of that knowledge and the commercialization of new biotech products.

Social skills

The student must:

Develop capacities for working as part of a team and for solving problem, collectively.

Develop the critical capacity to evaluate the benefit of the new biotechnological developments for society.

Develop the ability to argue an opinion in public.

Discern the truth and fiction of scientific information received through various areas of society, with special attention to the media.

Develop skills to communicate knowledge, using appropriate techniques to achieve the objective efficiently at scientific and popular levels.

Acquire social and professional awareness on issues of general interest that may be affected by biotechnologist work.

DESCRIPTION OF CONTENTS

1. Biodiversity and bio prospecting

Biodiversity as a source of new products. Genomics, Proteomics, and Metabolomics for the screening of compounds. High performance tracking techniques and bioprocess optimization. Organisms of interest and applications. Current status and prospects of biotechnology and healthcare industry

2. Living organisms of interest and applications.

Animals. Vegetables. Microorganisms. Types of mutants useful for industry.

3. Biofuel from plants and microorganisms

Diferent fuel types based on their origin. Bioethanol: substrates, metabolic pathways involved and organisms used. Biodiesel from plants and microorganisms. Other biofuels: hydrogen and methane. Ethical, economical and energetically concerns about biofuels.

4. Production of amino acids

Commercial uses of amino acids. Processes for obtaining amino acids. Organisms used to overproduce amino acids. Obtainment of L-glutamic acid by corynebacteria: overproduction by altering the membrane permeability. Obtainment of L-lysine: chemical, microbiological and mixed methods. Overproduction by overcoming feedback inhibition.

5. Biopolymers from plants, algae and microbes

Uses of the polymers. Polymers from plants, algae and microorganisms. Rheological properties of the polysaccharides. Advantages of microbial compared to plants polysaccharides. Microbial synthesis of homo and hetero polysaccharides. Poly-hydroxyalkanoates: raw material for biodegradable plastics. Poly-hydroxyalkanoate production in bacteria and plants.

6. Production of industrial enzymes and analytical

Global market of enzymes. Development of enzyme-overproducing strains. Recombinant proteins against non-recombinants. Biological systems for the production of heterologous enzymes. Immobilization of enzymes. Most important industrial enzymes and applications. Most important analytical enzymes for diagnostics and molecular biology.

7. Pharmaceuticals: traditional drugs

Pharmaceutical companies, marketed products and applications. Rational drug design. Animal drugs: hormones, steroids, prostaglandins. Drugs from plants: alkaloids, flavonoids, xanthines, aspirine .... Microbial Drug: Antibiotics. The revolution of antibiotics. Research objectives on antibiotics. Basis for improving antibiotic production. Beta-lactamics antibiotics: penicillins, cephalosporins and cephamycins.

8. Antimicrobials against infectious diseases

Antibiotics and enzibiotics. Objectives of antibiotic research. Methods for improving antibiotic production. Antibiotic resistance Antimicrobial peptide and peptide-glucan hydrolases.

9. Synthesis of heterologously produced therapeutic hormones

The biopharmaceutical industry's great achievement: therapeutic hormones produced heterologously. Insulin. Growth hormone. Gonadotropins.

10. Vaccines and monoclonal antibodies

Polyclonal (PCA) and monoclonal antibodies (MCA) Preparation of MCA and phage display tracking. Therapeutic applications of MCA. Traditional and recombinant vaccines. Vaccine production technologies (traditional, recombinant, nucleic acid and toxoid). Cancer vaccines: limitations

11. Laboratory work 1: Attainment of mutants of Penicillium chrysogenum overproducing penicillin

The objective of this experiment is to employ the mutation in order to improve a micro-organism from the original strain. In this case the improvement is focused on obtaining penicillin overproducing mutants from an industrial strain of the fungus Penicillium chrysogenum. This lab work seeks to demonstrate that the mutation is a random technique producing also less efficient producers of penicillin, or other kind of mutants. Other objectives of this la work are to inform students about bioassays and methods for quantifying penicillin obtained in broth cultures.

12. Laboratory work 2: Production of dextran by Leuconostoc mesenteroides

The objective of this experiment is to demonstrate the production of the polysaccharide dextran by the bacterium Leuconostoc mesenteroides CECT 394. The dextran is used for the manufacture of artificial blood plasma, and in food processing. Labl work objectives are: a) demonstrate that dextran production requires the presence of sucrose in the culture medium as a carbon source, b) establish the dextran recovering procedure from liquid medium, c) to quantify the dextran produced by measuring the viscosity and d) calculate the yields.

13. Practical 3: Obtaining citric acid by the fungus Aspergillus carbonarius

The objectives of this practical are: to demonstrate the production of this acid by A. carbonarius, to show that the cultivation conditions influence the yield, to show the methodology to recover this acid and to quantify the production, to show the calculation of yields.

14. Laboratory work 4: Searching for microorganisms with hydrolytic enzymes

The purpose of this lab is to show a procedure to reveal extracellular enzyme activities in microorganisms isolated from natural habitat, such as a soil.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Laboratory practices	20,00	100
Classroom practices	2,00	100
Preparation of practical classes and problem	90,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Lectures

Lectures of the course will be taught by the teacher using the lecture. Attendance at these sessions is optional for the student although regular attendance is recommended. During development of the class, the teacher will invite students to express their opinions or strategies about some of the aspects dealt with in the subject. To answer, the students do not require more than the knowledge gained in previous years or what they heard in the media or in everyday life. Responses will not have specific marks and the aims of the questions posed for the teacher is to involve students through personal contributions on the topic being addressed.

Laboratory works

Lab works will be runned over 5 weeks: one 4 hours session a week in the laboratory. Attendance is considered mandatory, at least 80% of practical hours.

Students will participate in groups of 2 to 4 people depending of the lab practice. Each student will have to collect its results each week in some worksheets that the teacher will provide through Virtual Classroom. Results compiled will be monitored weekly by the teacher. The teacher will monitor and correct the acquisition of skills in each practical session and compile the students and organize a discussion in a final session. The teacher will invite students to draw conclusions from the their own results, taking into account every problems occurred along their activities (handling errors, inconsistency of results, etc...).

It is recommended that students spend 1 to 2 hours a week to process the results obtained in the laboratory and fill out the worksheets.

Visits

Prior the visits acquisition of information about the visit is required in order to prepare questions to address to enterprise staff responsible for conducting the visit. Student questions will be taken into account for marks by the teacher. The assimilation of the information obtained during the visit will be evaluated by means of a questionnaire or memory that must be completed by students in their homes. This activity is not compulsory.

If this activity cannot be carried out for various reasons, it will be replaced by a prospective research work carried out by students on "Prospecting for Biotechnology at the Comunitat Valenciana" based on the Bioval website. Students in groups of 2-3 people will choose a company belonging to this association and will explain: its objectives, field of application, its social importance (identification of target customers), product / service they offer, number of workers, public / private nature of it. They will present their results in 10-minute expositions using 2 slides. Another option for this substitute activity is the exploration of recent patents in biotechnology. This activity is compulsory.

Individual tutorships

It is recommended the student's attendance of, at least, 3 hours of tutorials for resolving doubts or other issues related to the subject.

Group tutorships

For each group (P1 and P2) a 2-hour session will be held in the classroom, on the dates and times marked in the subject calendar. The aim of these sessions is to engage in a debate on topics related to the subject and which are controversial in some social sectors, such as the application or not of vaccines, the use of homeopathic medicines, etc. The discussion will be based on the use of scientific evidence that students should prepare in advance.

This activity is mandatory.

Individual learning

We recommend a commitment of at least 2 hours per week of study, to establish knowledge and prepare for the exam.

EVALUATION

EVALUATION

60 points out of 100, with a minimum of 30 points, obtained through the corresponding final examination. The exam may consist of short questions, multiple-choice questions or a combination of both types of questions. In order to pass the course, the theory exam must be graded with a score equal to or higher than 5. Class attendance: optional.

PRACTICAL SKILLS: 30 points out of 100, with a minimum of 20 points to pass this block.Attendance (10%), recording of skills and attitudes by direct observation (25%) and exam (65%) will be assessed. The exam will include multiple-choice or short-answer questions, and a problem requiring numerical calculations. In order to pass the course, the practical exam must be graded with a score equal to or higher than 5.Compulsory attendance: failure to attend more than 1 session of the total of 5 laboratory sessions will disqualify the student from taking the exam.

VISITS: 5 points out of 100. Attendance (80%) and questions to company staff (20%) will be assessed. Attendance is optional.

If the visit cannot be carried out, it will be replaced by the activity "Prospecting on Biotechnology in the Valencian Community", which will be compulsory. In this case, the score for this activity will be 7 points out of 100.

GROUP TUTORSHIPS: 5 points out of 100 if the visit to the company takes place. If the visit is replaced by the activity "Prospecting on Biotechnology in the Valencian Community", the score will be 3 points out of 100.

Once surpassed Theoretical and Practical work above the minimum threshold, marks obtained will be kept until the second round (July) if any of the other parties were not surpassed in June. There will be, therefore, exams for evaluating separately theorical and práctical knowledges in July.

The second enrollment students (repeaters) having made the minimum number of laboratory sessions in the preceding year have not obligation to attend lab, but they must do an exam for evaluating their acquired practical skills.

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Basic

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Additional

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