UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Metodi di Isolamento e Purificazione di Prodotti Biotecnologici

2627-1-F0803Q084

Aims

The aim of the course is to provide the student with in-depth knowledge about the principles, techniques and application strategies used for the isolation and purification of products obtained through biotechnological processes. The course will also provide the student with the technical-scientific skills to independently address various issues related to bioseparations.

Knowledge and understanding
At the end of the course the student will have acquired knowledge about the main bioseparation techniques and methodologies used for the isolation and purification of biotechnological products and will be able to understand their potential and critical issues in the various application contexts.

Ability to apply acquired knowledge
At the end of the course the student will be able to apply the knowledge acquired for the evaluation and implementation of a process of purification and isolation of products of different nature and will be able, on the basis of the chemical-physical properties of the product of interest, to autonomously elaborate an appropriate separation strategy.

Autonomy of judgment
At the end of the course the student will be able to recognize the technical-scientific problems of bioseparation processes, in order to be able to choose and critically apply the most appropriate techniques and methodologies for the purification of different types of biotechnological products of interest. The analysis of several case studies and the related critical discussion guided by the teacher during the lessons will contribute to achieving this objective.

Communication Skills
At the end of the course, the student must be able to consult the technical-scientific literature in order to be able to independently learn and explore future innovations in the field of bioseparations.

Learning ability
At the end of the course, the student must be able to consult the technical-scientific literature in order to be able to

independently learn and explore future innovations in the field of bioseparations.

Contents

During the course, methodologies and strategies relating to industrial bioseparations of biotechnological products of interest will be addressed.

The typical phases and the strategies of a purification and isolation process and the main separation techniques in a downstream process will be covered. Finally, some industrial processes (*case studies*) will be examined regarding the isolation of the main classes of (bio)molecules: products with high added value, products of pharmaceutical and nutraceutical interest, proteins and peptide hormones, monoclonal antibodies and related products of bioconjugation.

Some specific applications will be treated with a "flipped learning" approach through the critical presentation of scientific articles by the students, possibly also with the help of group work.

Detailed program

- Introduction to bioproducts and bioseparations
- General classification of bioproducts and their chemical-physical properties
- General overview of a bioseparation process and separation criteria
- Phases of a bioseparation process: Recovery, Isolation, Purification and Polishing
- Overview of the main unit operations of separation in a downstream process
- Guidelines for developing a downstream process
- Evaluation parameters of the efficiency of the purification process: analytical aspects and requirements and notes on the regulatory aspects.
- Application examples and analysis of *case studies* on different types of products

Prerequisites

Basic knowledge of general chemistry, organic chemistry and fermentation chemistry.

Teaching form

21 lessons of 2 hours each

The teaching will be delivered in:

- **Didactic mode** (DE), focused on the presentation-illustration of contents by the lecturer (about 30 hours)
- **Interactive mode** (DI), including teaching interventions supplementary to delivered didactic activities, short interventions by trainees, demonstrations of practical applications (about 12 hours)

Classes will be delivered in frontal mode and in part in flipped learning and with a problem solving approach, the

latter with presentation and discussion of applications and/or case studies by students.

Classes will be held **in Italian**, all activities will be carried out **in person**.

Textbook and teaching resource

Slides and other materials will be available on the e-learning platform.

All lessons will be video-recorded and made available on the e-learning portal.

References:

- R.G. Harrison, P. Todd, S. Rudge and D. Petrides, Bioseparations Science and Engineering, 2nd Ed. Oxford U. Press, NY, 2015 https://unimib.on.worldcat.org/oclc/899240244
- Doble, M. Principles of Downstream Techniques in Biological and Chemical Processes; Apple Academic Press: Oakville, ON, 2016. https://unimib.on.worldcat.org/oclc/929952139
- Current Developments in Biotechnology and Bioengineering : Production, Isolation and Purification of Industrial Products; Pandey, A., Negi, S., Soccol, C. R., Eds.; Elsevier: Amsterdam, 2017. https://unimib.on.worldcat.org/oclc/958936607

Semester

Second semester

Assessment method

Final oral exam on the topics covered during lectures and an optional project work. No mid-term exams are scheduled

Skills Assessed
Specifically, the following will be assessed:

- Mastery of the bioseparation methods and techniques covered in class.
- Ability to independently develop an appropriate separation strategy based on the chemical-physical properties of the target product.
- Problem-solving skills applied to bioseparation contexts.
- Appropriate use of technical language and confidence in delivery.

Assessment Criteria and Grading Scale
The final grade (expressed out of 30) will take into account scientific accuracy, critical processing skills, and the appropriate use of technical language:

18 - 21/30: Elementary knowledge of the course content; limited capacity for independent processing; very basic technical-scientific language.

22 - 25/30: Satisfactory understanding of bioseparation techniques and their limitations in various application contexts; good delivery and confidence when presenting standard case studies.

26 - 28/30: Solid, complete, and well-structured knowledge; clear independent judgment in selecting and critically applying the most appropriate methodologies; confident and accurate scientific vocabulary.

29 - 30/30 and Cum Laude: Excellent mastery of the strategies and unit operations of a downstream process; strong ability to independently design complex separation strategies; brilliant, fluid delivery characterized by absolute terminological rigor.

Office hours

Appointment on demand

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION