UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Fermentations and Microbial Bioprocesses

2021-3-E0201Q060

Aims

The course aims to introduce topics and problems related to basic and applied research related to the use of natural microorganisms for both classical fermentation biotechnologies.

Knowledge and understanding.
At the end of the course the student will know the microbiological and process bases for understanding the growth of a microorganism in biorector; he/she will gain how to recognize the advantages of different bioreactor technologies, growth techniques and the basic principles for the immobilization of enzymes and cells. The student will gain the ability to compare the central metabolism of microorganisms and the various classic productions of the biotechnology industry in different fields such as food, pharmacological and health products, in the production of fine chemicals, but also for processes to protect the environment and recover of energy (Circular Bioeconomy) .

Applying knowledge and understanding.
At the end of the course the student will be able to apply the acquired knowledge above described to biosynthetic methodologies for basic research and industrial processes.

Making judgments.
The student must be able to process what learned and be able to recognize the processes and problems of the industrial microbiology.

Communication skills.
Use of an appropriate scientific vocabulary and ability in written and oral reports.

Learning skills.
At the end of the course the student will be able to read the literature on the topics covered and will be able to analyse, use and integrate the knowledge acquired with what will be learned in lessons related to the production of chemical products of interest for the biotechnology industry.

Contents

Fermentations and microbial bioprocesses play an important role both in teaching and in the scientific development of industrial biotechnologies. If a biotechnological process exploits the characteristics of living cells or their components to obtain goods and services, the bioprocesses try to obtain these results from microorganisms, natural or genetically modified. The interest in this discipline is constantly increasing as nodal for different biotechnological applications in different fields such as food, pharmacological and health, in the production of fine-chemicals, but also for processes for the protection of the environment and bioenergy productions (Circular Bioeconomy).
The course focusses on the following topics:

1. The Bioreactor.
2. Monitoring and control of the parameters
3. Immobilized cells and enzymes
4. Biotechnology of classic fermentations.

Detailed program

1. The Bioreactor.
Ideal features for an industrial microorganism. Bioreactor technologies for cultures of microorganisms. Sterility and safety, heat transfer, oxygen transfer, homogeneity. Main fermentative techniques: batch culture, continuous cultivation, fed-batch culture. Composition and development of culture media. Scale-up.
2. Monitoring and control of the parameters.
Measured, determined and calculated parameters. Aggregated and segregated parameters. Fermentation control. Comparative evaluation of aggregated and segregated parameters.
3. Immobilized cells and enzymes.
Immobilization methods. Advantages and disadvantages. Applied examples.
4. Biotechnology of classic fermentations.
Carbon metabolism. Comparative analysis of central metabolism of microorganisms. Mass and energy balances. The node and pyruvate bypass. Production of organic acids (lactic acid, citric acid). Solvent production (Ethanol, ACE). Production of amino acids (glutamic acid). Vitamin production (Vitamin C). Production of antibiotics (Penicillin).

Prerequisites

Background: Basics of biochemistry and Industrial Microbiology.
Specific prerequisites: Industrial Microbiology.
General prerequisites: Students can take the exams of the third year after having passed all the exams of the first year of the course.

Teaching form

Classroom lectures, supported by PowerPoint slides, blackboard or electronic facilities. The methodological approach provides for a historical reconstruction of the progress of knowledge accompanied by an analysis of the logical process that guided the experimentation and led to the understanding of the mechanisms underlying the bioprocesses.
Teaching language: italian.

During the Covid-19 emergency period, lessons will take place in a mixed mode: partial attendance and asynchronous / synchronous videotaped lessons.

Textbook and teaching resource

Learning material is available at the e-learning web page of the course.

Semester

First semester

Assessment method

Written + oral examination.
Two-hour written examination. Studens are asked to answer three questions on the whole course content.
Oral examination. Students are asked to answer on the whole course content.

Office hours

Contact: on demand, upon request by mail or phone to lecturer.