UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Ingegneria Metabolica e Bioprocessi di Nuova Generazione

2021-1-F0802Q058

Aims

The Course aims to introduce topics and issues related to industrial applications deriving from the use of recombinant microorganisms for advanced biotechnological applications in the sectors of circular bioeconomy sectors and environmental sustainability.

Knowledge and understanding.
At the end of the course the student will gain the ability to evaluate the basic principles for the development of industrial processes based on recombinant microorganisms. The course therefore aims to provide the tools to study the molecular and metabolic aspects that limit current yields, productions and productivity. The student will gain the concept of new generation bioprocesses that lead to a decarbonisation of the current productions. It includes the improvement of microbial strains of industrial interest.
The student will gain the ability to compare the 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 applied to 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

The following production topics will be addressed:
1. Metabolism and metabolic engineering of central metabolism.
2. Development of recombinant microorganisms for the production of organic acids.
3. Production of biofuels and bioplastics.
4. Bio-economy and circular economy: concept and examples of different biorefineries.

Detailed program

Since many years, the possibility of modifying the microbial metabolism via recombinant DNA has allowed the development of new bioprocesses for the production of fine-chemicals (i.e., vitamins, amino acids, food additives, nutraceuticals, etc.), bulk chemicals (organic acids, ...), biofuels (bioethanol, biobutanol, biogas, ...), new nanomaterials (polylactic acid, PHA, etc.), industrial enzymes and pharmaceutical agents. The course aims to provide the tools to study the molecular and metabolic aspects that limit current yields and productions looking forward the development the new generation bioprocesses. It therefore includes the improvement of microbial strains of industrial interest.

In partuclar the following topics will be addressed:
1. Metabolism and metabolic engineering of central metabolism.

Analysis of the central metabolism of a cell factory.
2. Development of recombinant microorganisms for the production of organic acids.

Metabolic engineering of central metabolism and concept of energy source. Advantages and disadvantages offered by different microorganisms for the production of organic acids. Guided evolution and inverse metabolic engineering. Cell factory and process robustness.
3. Production of biofuels and bioplastics.

Evaluation of existing examples at industrial level.
4 Bio-economy and circular economy: concept and application examples of the different biorefineries.

Different generation biorefinery concepts. Comprehensive evaluation of refinery and biorefinery. LCA concept. Examples of applications from the world's leading research centers.

Prerequisites

Background. Concepts of Biochemistry, Industrial Microbiology and Bioreactor technologies.
Prerequisites. None

Teaching form

Classroom lectures, supported by PowerPoint slides and balckboard exercises. 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.

Textbook and teaching resource

All teaching material is available at the e-learning platform of the course.

Semester

Second semester

Assessment method

Oral examination (about 30 min).
During the exam, students will be asked on at least two questions on the whole couse content.

Office hours

Contact. On demand by email or phone to the lecturer.