UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Applied Organic Chemistry To Biotechnologies

2122-1-F0802Q041

Aims

The course is focussed on selected industrial products and their synthetic methodologies through chemical and/or biocatalytic strategies, toward a more sustainable production approach. Advantages and disadvantages of chemical versus (chemo)enzymatic synthesis will be highlighted.

Knowledge and understanding
The student will gain knowledge of the chemical principles at the basis of selective and specific chemical reactions; of advantages/disadvantages of chemical vs enzymatic methods; of selcted enzyme classes relevant for industrial production (i.e. alcohol dehydrogenases, lipases, esterases)

Applying knowledge and understanding
The student will be able to apply the knowledge acquired in the course to synthetic methodologies used in research or in industrial processes.

Making judgements
The student will be able to process the acquired knowledge towards the application of chemical and enzymatic methodologies to real problems

Communication skills
Use of an appropriate scientific/chemical vocabulary and ability in oral reports

Learning skills
Skills in literature reading and understanding, skills in the elaboration of interconnections among the course-related knowledge and other subjects related to industrial biotechnology.

Contents

1. Review on isomerism and stereoisomerism
2. In-depth analysis of selective and specific reaction systems, both through synthetic chemistry or biocatalysed reactions.
3. Biocatalysis in the chemical-biotechnological industry: advantages versus disadvantages.
4. Biocatalysts of interest for industrial production.

Detailed program

1. Review of isomerism and stereoisomerism

Stereoisomerism and topism. Stereoisomers properties and stereotopic groups. Involvement in the synthesis of industrial products. Analysis and purification methods of stereoisomers: industrial relevance. Racemate purification: kinetic and dynamic resolution. Use of chemical methods vs enzymatic methods.

2. (Stereo)selective and (stereo)specific reactions.
Chemical basis of (stereo)selective and (stereo)specific reactions. In-depth analysis of selective and specific reaction systems, both through synthetic chemistry or biocatalysed reactions.

3. Biocatalysis in the chemical-biotechnological industry: advantages versus disadvantages.

4. Biocatalysts of industrial interest

alcohol dehydrogenases: reaction mechanism, cofactors, substrate specificity and stereoselectivity, industrial applications; comparison with classical organic synthesis

lipases and esterases: reaction mechanism, substrate specificity and stereoselectivity, industrial applications; comparison with classical organic synthesis

phospholipases: reaction mechanism, substrate specificity and stereoselectivity, industrial applications; comparison with classical organic synthesis

aldolases: reaction mechanism, substrate specificity and stereoselectivity, industrial applications; comparison with classical organic synthesis

glycosidases and glycosyltransferases: reaction mechanism, substrate specificity and stereoselectivity, industrial applications; comparison with classical organic synthesis

Design of experiments (DoE)

Prerequisites

Background. Basics of organic chemistry (organic compound classes and their reactivity)

Prerequisites. none

Teaching form

Classroom lectures supported by PowerPoint slides.
Flipped classroom. Application of the knowledge given during lectures for group report preparation as examples of case studies.

Teaching language: italian.

Lectures in the classroom will be recorded and made available in the e-learning page of the course.

Textbook and teaching resource

Slides
Available at the e-learning platform of the course
Textbooks
David Van Vranken, Gregory Weiss Introduction to Bioorganic Chemistry and Chemical Biology Ed. Garland Science

Semester

First semester

Assessment method

Oral examination. One general question focussed on one wide topic described during the course.
The student shall demonstrate to be skilled in connections among the topics of the course, in scientific vocabulary, comprehension and communication.

Office hours

On demand by mail to the lecturer