Universitat Autònoma de Barcelona

2020/2021

Immobilised Biocatalysts

Code: 100941
ECTS Credits: 6

Degree	Type	Year	Semester
2500253 Biotechnology	OT	4	0

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

Fluent knowledge (spoken and written) of Catalan and / or Spanish

To achieve the objectives of the course it is recommended to have some solid basic knowledge in:

Biochemistry
Enzymatic kinetics
Microbial kinetics
Cell biology
Enzymology
Relationship structure / function of proteins
Bioreactors
Organic chemistry

Objectives and Contextualisation

Description and objectives:
The immobilization of biocatalysts can be understood as a whole series of techniques that allow to have the biocatalyst located in a limited space, while maintaining its activity. A biocatalyst is an enzyme, a cell or a cellular organelle. In the case of cells, the maintenance of its activity is usually linked to its viability. The process of biocatalyst immobilization opens up a whole range of possibilities in its use, mainly due to the fact that by means of immobilization it is passed from having a microscopic biocatalyst, normally dissolved or dispersed in a liquid medium, to a macroscopic biocatalyst, usually attached to a solid matrix. These possibilities range include: the development of continuous bioprocesses in a much more intensive and productive way, to obtain biosensors or bioxips and the improvement of purification processes.

The first aim of the subject is to present the different techniques with which the process of immobilization of biocatalysts can be addressed, with particular emphasis on how to alter the design of the immobilized biocatalyst for a desired application. In a second block, the aspects associated with the physical processes derived from having the biocatalysts in a solid matrix are analyzed in greater detail. Finally, a series of specific applications are analyzed, which serve to see the impact of immobilization in the whole of a particular application in Biotechnology.

It is basically intended to establish the relationship between the nature of the biocatalyter employed, the different immobilization methods available and the final application that is intended to be developed, analyzing different alternatives and modifications in the design of the particles and the final system to be developed.

Competences

- Describe the principles behind the design and functioning of bioreactors and calculate, interpret and rationalise the main parameters in transport phenomena and the matter and energy balances in bioindustrial processes.
- Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
- Make decisions.
- Read specialised texts both in English and ones own language.
- Reason in a critical manner
- Work individually and in teams

Learning Outcomes

1. Acquire practical experience in biocatalyst immobilisation.
2. Characterise an immobilised biocatalyst.
3. Choose the right biocatalyst for a specific biotechnological process.
4. Describe the catalytic properties of biocatalysts (cells and enzymes).
5. Explain the different techniques for immobilising biocatalysts and their actual or potential applications to industry.
6. Identify the advantages and disadvantages of the immobilisation of biocatalysts.
7. Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English or in one's own language.
8. Make decisions.
9. Read specialised texts both in English and ones own language.
10. Reason in a critical manner
11. Work individually and in teams

Content

Program:

Topic 1. Introduction
Topic 2. Immobilization of biocatalysts: definition and classification
Topic 3. Immobilization of biocatalysts. Advantages
Topic 4. Immobilization of biocatalysts. Disadvantages
Topic 5. Basic steps during the immobilization of Biocatalysts
Topic 6. Mass transfer limitations in immobilized biocatalysts: External and internal
Topic 7. Monitoring of the immobilization process
Topic 8. Immobilization by adsorption
Topic 9. Immobilization by covalent bond
Topic 10. Immobilization by crosslinking. Self-immobilization
Topic 11. Immobilization by entrapment
Topic 12. Immobilization by encapsulation in membranes

Methodology

Directed activities:

• Theoretical classes: Master classes on the concepts of the syllabus

• Laboratory practices: Students performed laboratory practices in which they will gain practical experience in the immobilization of biocatalysts.

• Public presentation of works: Students will present orally (10-20 minutes) and publicly a summary of the most relevant results of the work on immobilization techniques and will deliver the presentation to the professor in digital format through the virtual campus. Both the documentation of the work and oral presentations are part of the content of the subject and therefore are subject of examination

Autonomous activities:

• Student study: Individual study and preparation of diagrams and summaries

• Preparation of practical reports: group work of 2-4 students in which each group will prepare a report with the results obtained in the laboratory practices and will deliver the report to the professor in paper format (printed) and in digital format through the campus virtual

• Writing of papers: group work of 2-4 students in which each group will write two written works. A work on immobilization techniques and another on biocatalysts. Both papers must be submitted to the teacher in paper format (printed) and in digital format through the virtual campus. Both the documentation of the work and oral presentations are part of the content of the subject and therefore are subject of examination

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practices	15	0.6	1, 10, 11
Public presentation of works	4	0.16	7, 11
Theoretical classes	36	1.44	2, 4, 3, 5, 6, 9
Type: Autonomous			
Drafting of works	34	1.36	9, 8, 10, 11
Elaboration report of practices	9	0.36	9, 8, 10, 11
Study of the student	49	1.96	9, 10, 11

Assessment

Scheduled evaluation process and activities

Throughout the course different evaluation activities will be carried out that will give rise to the final grade of the subject obtained by continuous evaluation. Specifically, the evaluation activities will be:

- Written work on biocatalysts which is 15% of the final grade. The minimum grade to not have to recover this work is a 4
- Laboratory practices that is 25% of the final grade. The subject can not be passed if the laboratory practices are not approved (minimum grade of 5)
- Written work on biocatalyst immobilization techniques, which is 15% of the final grade. The minimum grade to not have to recover this work is a 4
- Oral presentation that is 5% of the final grade

- Synthesis exam that is 40% of the final grade. The subject matter of the synthesis examination is the syllabus of the subject. The minimum grade to not have to recover this exam is a 4.

The laboratory practices and the oral presentation of the work of immobilization techniques are non-recoverable.

The subject is considered to be passed if the average of the 5 evaluation activities is 5 or higher as long as no activity has a grade lower than 4.

If any of the following circumstances occurs, it implies a grade of Not assessable to the subject:

- Do not perform the synthesis test
- Not perform laboratory practices
- Not presenting both jobs

No note is saved for the next course.

Programming evaluation activities

At the beginning of the subject groups will be formed to do the lab work and practices. The delivery of written papers and oral presentations will be communicated through the virtual campus.

Recovery process

The written work is eliminatory, therefore, a student who has passed (grade equal to or greater than 4) the work can notbe submitted to the recovery of these works. There will be compulsory recovery of those works where the student has obtained a grade lower than 4 regardless of the average obtained according to the calculation of the section "Process and programmed evaluation activities"

The student can apply for recovery whenever he has submitted to a set of activities that represent at least two thirds of the total grade of the subject. Of these, students who have, on average of all the activities of the subject, a grade higher than 3.5 may be presented in the recovery.

The exam of synthesis is eliminatory, therefore, a student who has passed (grade equal or superior to 4) the exam can not be presented to the recovery of the exam. You will have to compulsorily recover this exam if the student has obtained a grade lower than 4 regardless of the average obtained according to the calculation of the section "Process and programmed evaluation activities"

The calculation of the grade will be done in the same way as in the continuous evaluation.

Procedure for review of qualifications

For each evaluation activity, a place, date and time of revision in which the student can review the activity with the teacher will be indicated. In this context, claims may be made on the activity grade, which will be evaluated by the faculty responsible for the subject. If the student does not appear in this review, this activity will not be reviewed later.

Ratings

Granting a grade of honor registration is the decision of the faculty responsible for the subject. The regulations of the UAB indicate that MH can only be granted to students who have obtained a final grade equal to or greater than 9.00. You can grant up to 5% of MH of the total number of students enrolled.

It will be considered as Not Evaluated that student who, not having passed the subject by continuous evaluation, does not show up for the recovery.

Irregularities by the student, copy and plagiarism

Without prejudice to other disciplinary measures deemed appropriate, the irregularities committed by the student that may lead to a variation of the grade of an evaluation act will be scored with a zero. Therefore, copying, plagiarism, cheating, letting copy, etc. in any of the evaluation activities will involve suspending with a

zero. The evaluation activities qualified in this way and by this procedure will not be recoverable. If it is necessary to pass any of these evaluation activities to pass the subject, this subject will be suspended directly, without the opportunity to recover it in the same course. In this situation the final grade that will be reflected in the minutes will be a 2.

Evaluation of repeating students

There is no provision for a different evaluation system for repeating students.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory practices	25%	0	0	1, 9, 11
Oral presentations of the work of immobilization techniques	5%	0	0	2, 3, 7, 8, 10
Synthesis test	40%	3	0.12	2, 4, 3, 5, 6, 10
Written work on biocatalysts	15%	0	0	4, 9, 8, 10, 11
Written work on immobilization techniques for biocatalysts	15%	0	0	9, 8, 10, 11

Bibliography

Books:

Autor	Fersht, Alan, 1943-
Títol	Enzyme structure and mechanism / Alan Fersht
Edició	2nd. ed.
Publicació/producció	New York : W.H. Freeman, cop. 1985
Descripció	xxi, 475 p.; 24 cm
Matèria	Enzims
ISBN	0716716143
	0716716151 (pbk.)

http://cataleg.uab.cat/record=b1323065~S1*cat

Autor	Dixon, Malcolm
Títol	Enzymes / by Malcolm Dixon and Edwin C. Webb
Edició	3rd ed.
Publicació/producció	London : Longman, 1979
Descripció	XXIII + 1116 p.; 24 cm
Matèria	Enzims

http://cataleg.uab.cat/record=b1016445~S1*cat

Autor	Linqiu, Cao
Títol	Carrier-bound immobilized enzymes : principles, applications and design / Linqiu Cao
Publicació/producció	Weinheim : Wiley-VCH, cop. 2005
Descripció	XV, 563 p. : il.; 24 cm
Matèria	Enzims immobilitzats
ISBN	3527312323
	9783527312320

http://cataleg.uab.cat/record=b1736123~S1*cat

Títol	Enzyme biocatalysis : principles and applications / Andrés Illanes, editor
Publicació/producció	[Dordrecht] : Springer, 2008
Descripció	X, 391 p. : ill. ; 25 cm.

Matèria	Enzims -- Biotecnologia
	Enzims -- Síntesi
ISBN	9781402083600

http://cataleg.uab.cat/record=b1744514~S1*cat

Títol	Ingeniería bioquímica / Francesc Gòdia Casablancas y Josep López Santín (editores) ; Carles Casas Alvero ... [et al.]
Publicació/producció	Madrid : Síntesis, DL 1998
Descripció	350 p. : il.; 24 cm
Col·lecció	Ciencias químicas (Síntesis). Tecnología bioquímica y de los alimentos
Matèria	Enginyeria bioquímica
ISBN	8477386110

http://cataleg.uab.cat/record=b1425826~S1*cat

Autor	Bommarius, A. S.
Títol	Biocatalysis : [fundamentals and applications] / A.S.Bommarius, B.R.Riebel
Publicació/producció	Weinheim : Wiley-VCH, 2004
Descripció	XXIII, 611 p.; 24 cm
Matèria	Enzims
ISBN	3527303448

http://cataleg.uab.cat/record=b1604211~S1*cat

Títol	Immobilized enzymes and cells / edited by Klaus Mosbach
Publicació/producció	Orlando (Fla.) : Academic Press, 1987
Descripció	vol. : il., gràf.; 24 cm
Col·lecció	Methods in enzymology ; 135, 136, 137
Matèria	Enzims
	Cèl·lules
ISBN	0121820351 (vol. B)
	012182036X (vol. C)
	0121820378 (vol. D)

http://cataleg.uab.cat/record=b1825278~S1*cat

Títol	Immobilization of enzymes and cells / edited by Gordon F. Bickerstaff
Publicació/producció	Totowa : Humana Press, 1997
Descripció	XIV, 367 p.; 23 cm
Col·lecció	Methods in biotechnology ; 1
Matèria	Enzims immobilitzats
	Enzims -- Biotecnologia

	Cèl·lules immobilitzades
ISBN	0896033864

http://cataleg.uab.cat/record=b1465205~S1*cat

Títol	Protein stability and folding : theory and practice / edited by Bret A. Shirley
Publicació/producció	Totowa (N.J.) : Humana Press, cop. 1997
Descripció	X, 377 p. : gràf. , 23 cm
Col·lecció	Methods in molecular biology ; 40
	Methods in molecular biology (Humana Press) ; 40
Matèria	Proteïnes
	Proteïnes -- Plegaments
ISBN	0896033015

https://cataleg.uab.cat/record=b1736588~S1*cat

Search engines of scientific bibliography:

Scholar Google: http://scholar.google.es/advanced_scholar_search?hl=en&lr=
Scopus: http://www.scopus.com/scopus/search/form.url?display=authorLookup
Scifinder: Software disponible a la UAB
Sience Direct: http://www.sciencedirect.com/science/journals
ISI Web of Knowledge: http://www.accesowok.fecyt.es/login/

Interesting web sites:

Base de dades d'enzims BRENDA: http://www.brenda-enzymes.info/
National Center for Biotechnology Information: http://www.ncbi.nlm.nih.gov/
ExPASy (Expert Protein Analysis System) Proteomic Server: http://www.expasy.ch/