Université de Bretagne Occidentale

MASTER BIOTECHNOLOGIES

PARCOURS MASTER INTERNATIONAL EN BIOTECHNOLOGIES MARINES

semestre 9

Ingredients and active molecules

10 crédits ECTS

Bioactive molecules from marine animal biomasses

Objectifs

The objective is to make the student ready to develop and propose a comprehensive approach for enhancing the value of fisheries and aquaculture products from animal origin (including by-products) for the development of new added-value molecules and ingredients, intended for food, feed, aquaculture, cosmetics, ...
Marine biotechnologies are targeting niche markets by offering products with low volumes and high added-values, and also mass markets like bio-sourced polymers.

2 crédits ECTS

Volume horaire

Travaux Pratiques : 4h
Travaux Dirigés : 12h
Cours Magistral : 20h

Pré-requis nécessaires

Bases of biology, biochemistry, enzyme engineering, microbial engineering.
Possibly, bases of marine biology and ecology.

Compétences visées

Learning outcomes:

- A comprehensive vision of blue biotechnologies on a worldwide scale.
- The capacity to identify the research teams and research activities for establishing collaborations.
- The ability to identify the emerging markets, their size and their potential.
- The ability to transpose data and concepts of the scientific literature into R & D approaches integrating scaling-up.
- The capacity to explain the biological activities and functionality of molecules to non-specialists while having a dialogue with experts.
- The ability to inject new ideas, and to create innovative products.
- The ability to understand what is hindering and driving in marine process, and to choose the most appropriate strategy for achieving the final objective.

Descriptif

Introduction: Global overview of how enhancing the value of fisheries and aquaculture products from animal origin: definitions, resources, markets, notion of value chain, current trends, and examples of innovation in Norway.

Chapter 1: Concentrates and isolates of proteins: conventional methods, Ph-shift, pulps.

Chapter 2: Gelatines et collagens: general properties, specificities of marine collagens, impact of process on techno functional properties. Niche and mass applications of gelatines. Innovative uses in nutraceutics, nutri-cosmetics et biomaterials (tissue engineering, ...)

Chapter 3: Enzymes in industrial processes: 3.1. Fish protein hydrolysates (FPH) with functional properties: pH-stat method, characterisation of peptidic populations, choice of enzymes for FPH. 3.2 Use of enzymes for the controlled destructuration of complex matrices: application to microalgae.

Chapter 4: Peptides exhibiting biological activities: definitions, examples in food, feed, nutraceutical, cosmetics,

Chapter 5: Biopolymers (chitin and chitosan, chondroitin sulphate, hyaluronic acid: general characteristics, extraction process, properties et example of uses.

Chapter 6: Marine lipids: structures and functions: PUFA and phospholipids

Bibliographie

Handbook of Marine Biotechnology 2015 SPRINGER

Marine Biotechnology : Enabling Solutions for Ocean Productivity and Sustainability (2013) OECD

An Introduction to Biomaterials, Second Edition (2011) Jeffrey O. Hollinger, CRC Press

Added Value to Fisheries Waste (2008) J.-P. Bergé Ed., © Transworld Research Network, Kerala, India.

Maximising the Value of Marine By-Products (2007) F. Shahidi Ed In: F. Shahidi (Ed.). Woodhead (GB),

Improving seafood products for the consumer (2008). T. Børresen (Ed.) Woodhead (GB)

Seafood research from fish to dish. Quality, safety and processing of wild and farmed fish (2006) Luten J., Jacobsen C., Bekaert K., Saebo A., Oehlenschlager J. (Eds.). Editions Wageningen Academic Publishers (Netherlands),

Marine Biotechnology I & II (2005), Le Gal & Ulber (Eds.) SPRINGER

Chitine et chitosane: du biopolymère à l'application (2009), Crini, Badot & Guibal, Presses Univ. Franche-Comté,

Biofutur N° 301 : Biotechnologies marines (Juillet-Août 2009), Tec & Doc

Substances naturelles d'origine marine : Chimiodiversité, pharmacodiversité, biotechnologies (2005) Kornprobst JM Tec & Doc

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	120	50%	
UE	CT	Oral - exposé	35	20%	
UE	CT	Ecrit - mémoire		30%	

Bioactive molecules from marine plants biomasses

2 crédits ECTS

Volume horaire

Cours Magistral : 20h
Travaux Dirigés : 6h
Travaux Pratiques : 6h

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - rapport		50%	
	CT	Oral - exposé	30	50%	

Session 2 : Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	120	100%	

Green biotechnology and intelligent mariculture

Objectifs

2 crédits ECTS

Volume horaire

Cours Magistral : 20h
Travaux Dirigés : 12h

Teaching objectives

The impact that biotechnology can have on our society and economy will be reviewed in this unit. An overview of industrial biotechnology and its applications in a number of product categories ranging from food ingredients, vitamins, bio-colorants, solvents, plastics and biofuels will be exposed. This module will also focus on the understanding of the environmental and safety risks associated with biotechnolgy together with methods for limiting damage and risk. New biotechnologies will affect the natural environment primarily in two ways: by bringing relatively “wild” areas, such as estuaries, under domestication, and by forcing areas now domesticated, such as farms, out of production, because of surpluses. The problem of the safety of biotechnology—the risk of some inadvertent side-effect—seems almost trivial in relation to the social and economic implications of these intentional uses. Aquaculture productivity is predicted to increase but will need to be re-designed to avoid pollution. The module will focus on the practice of integrating aquaculture and agriculture, also referred to as Integrated Agri-Aquaculture Systems (IAAS), which is based on the need to achieve more economically viable and environmentally sustainable primary industries, and specifically to enhance farm productivity and water use efficiency through multiple water use for integrated production of both terrestrial and aquatic crops. The importance of life cycle analysis (LCA) in biotechnology will be highlighted.

Compétences visées

Course objectives
- In lectures, to provide a framework for understanding contemporary constraints and opportunities for modern use of marine biomass for food and non-food products within a framework of integrated culture
- In paper analysis and small group work, develop skills in critical analysis and provide confidence in working with complex concepts in biology and society;
- In oral presentations, promote skills in succinct oral communication of science;
- In essays, promote scientific writing skills and to encourage the use of library, archival, electronic and other reference sources.

Descriptif

The unit will focus on the expected changes in society and technology, ranging from the shift in the supply of resources, the growing need for efficiency and sustainability of the production systems, changing consumer perception and behaviour and changing mariculture systems and practices. Many of these changes are expected to speed up the transition from a fossil-based to a bio-based economy and society. The module provides an understanding of the use of raw materials such as water, energy and land/coastal waters in industry and transport. It lays the foundation for further in-depth studies of ways in which biotechnology can support recycling, reuse of existing materials and in the generation of new supplies of raw materials.

During lectures and workshops, the following topics will be covered :

Chapter 1: industrial sustainability

Chapter 2: risk (perception and assessment)and safety in biotechnology

Chapter 3: environmental impact of biotechnology

Chapter 4 : integrated agri-aquaculture systems (IAAS).

Bibliographie

G. Acquaah. Understanding Biotechnology: An Integrated and Cyber-Based Approach 1st Edition. Publisher: Pearson Prentice Hall. ISBN-13: 978-0130945006 .

A. Scragg. Environmental biotechnology.2nd edition. Publisher: Oxford University Press. ISBN-13: 9780199268672

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Marine biotechnology applied to cosmetics and healthcare products development

Présentation

2 crédits ECTS

Volume horaire

Travaux Pratiques : 4h
Cours Magistral : 26h

The purpose of this course is to enable students to consolidate knowedge about the corporate world of cosmetics. Cosmetic products represent more than 80 billion of turnover in Europe. This is an area in perpetual change and renewal. In fact, the cosmetic products marketing is regulated by a European directive which was introduced in July 2013. Companies have the obligation to declare the composition of all their products, and, the trend is that Increasingly substances are banned because of their toxic power. Many companies are looking for alternative solution and thus are turning to marine products in order to replace toxic synthetic molecules and because it attracts some customers as well.
This is why companies recruit more scientists with knowledge of the marine biotechnology, and raw materials needed to make these cosmetic products.

Descriptif

Introduction: Definition of cosmetic products, European settlement (4 hours by Sandrine Morvan)

Chapter 1: Biology of skin and appendages (4 hours by Laurence Meslet-Cladiere).

Chapter 2: The physicochemical properties of cosmetic products (2 hours by Sandrine Morvan)

Chapter 3: All raw materials for cosmetics products (4 hours by Laurence Meslet-Cladiere)

Chapter 4: Formulation of cosmetics products (4 hours by Laurence Meslet-Cladiere)

Chapter 5: Toxicology and security of cosmetic products (2 hours by Nolwenn Hymery)

Chapter 6: Research of new conservatives products (2 hours by Julien Claus)

Chapter 7 : Algae in cosmetics products (2 hours by Bernard Kloareg)

Chapter 8 : Voluntary testing on cosmetics (3 hours by Alexandre Batardière)

Bibliographie

Manuel d'anatomie et de physiologie humaine
Bryan Derrickson (Auteur), Gérard G. Tortora (Auteur) - Manuel (broché). Paru en 03/2009

Biologie, cosmétologie BTS esthétique cosmétologie
G. Peyrefitte (Auteur), M.C. Martini (Auteur) - Scolaire / Universitaire (broché). Paru en 05/2013

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Biotechnological potential of marine microorganisms

Objectifs

The main objective of this course is to provide students with general information for better understanding the biotechnological potential of marine heterotrophic microorganisms. The unit will focus on acquiring a broad knowledge on the biodiversity and physiology of marine microorganisms, in order to target specific populations according to the desired industrial applications. Molecular tools applied to data mining will be presented. New strategies for the screening, isolation and culture of marine heterotrophic microorganisms as well as the production of biomass and/or metabolite in bioreactors will be also described. This unit will be illustrated by different research projects using marine microorganisms for biotechnological applications.

2 crédits ECTS

Volume horaire

Travaux Pratiques : 6h
Cours Magistral : 26h

Pré-requis nécessaires

Basic knowledge on microbial structure, growth and physiology (practical and theoretical)

Compétences visées

At the end of this course, students will:

-be aware of the huge diversity of marine heterotrophic micro-organisms

-understand the link between biodiversity, microbial physiology and potential biotechnological applications

-have a basic knowledge on the use of molecular tools for biotechnological applications

-have a thorough knowledge of innovative approaches used for the isolation and culture of marine heterotrophic microorganisms

-be aware of the classically used screening methods

-know the basic principles of biomass and metabolites production in bioreactors

-have examples of research applications for the industries with the use of marines microorganisms or metabolites

Descriptif

Chapter 1: Presentation of the huge diversity of heterotrophic marine microorganisms focusing on the link between biodiversity (adaptation to different habitats, metabolism, communication/interaction..) and their potential biotechnological applications (4h G Le Blay)

Chapter 2 : Presentation of innovative approaches used for marine heterotrophic microorganism isolation (dilution to extinction, micro-encapsulation, optical tweezers, diffusion chambers etc..) and culture (high throughput cultural techniques and design of culture media) (4h G Le Blay)

Chapter 3 : Screening methodologies (cultural and molecular techniques) used for industrial targets (antimicrobial, antifouling, polyhydroxyalkanoate...) (4h C Hellio)

Chapter 4 : Presentation of the basic principles of marine microbial biomass and metabolite production (bioreactor design and operation modes, yields and stoichiometry) (4h G Le Blay)

Chapter 5 : Presentation of examples of research applications for the industries with the use of marines microorganisms or metabolites (biofouling, -Presentation of examples of research applications for the industries with the use of marines microorganisms or metabolites (biofouling, exopolysaccharides, polyhydroxyalkanoates..) (8h C Hellio, C Simon-Colin)

Chapter 6 : Presentation of molecular tools (data mining..) for biotechnological applications (8h M Jebbar, G Burgaud, L Meslet)

Bibliographie

New approaches for bringing the uncultured into culture. S L'Haridon, GH Markx, CJ Ingham, L Paterson, F Duthoit & G Le Blay. In The marine microbiome – an untold resource of biodiversity and biotechnological potential Editors: L.J. Stal & M.S. Cretoiu Publisher: Springer 2016

Screening microorganisms for bioactive compounds. S Giubergia, C Schleissner, F de la Calle, Pretsch, D Pretsch, L Gram & MS Thøgersen. In The marine microbiome – an untold resource of biodiversity and biotechnological potential Editors: L.J. Stal & M.S. Cretoiu Publisher: Springer 2016

Exploring the microbiology of the deep sea. M Jebbar, P Vannier, G Michoud & VT

Marteinsson. In The marine microbiome – an untold resource of biodiversity and biotechnological potential Editors: L.J. Stal & M.S. Cretoiu Publisher: Springer 2016

Marine fungi. V Rédou, M Vallet, L Meslet-Cladière, A Kumar, KL Pang, YF Pouchus, G Barbier, O Grovel, S Bertrand, S Prado, C Roullier & G Burgaud. In The marine microbiome – an untold resource of biodiversity and biotechnological potential Editors: L.J. Stal & M.S. Cretoiu Publisher: Springer 2016

Entrapment of anaerobic thermophilic and hyperthermophilic marine microorganisms in a gellan/xanthan matrix. Landreau M, Duthoit F, Claeys-Bruno M, Vandenabeele-Trambouze O, Aubry T, Godfroy A, Le Blay G. J Appl Microbiol. 2016 Mar 1.

Discovery of a mcl-PHA with unexpected biotechnical properties: the marine environment of French Polynesia as a source for PHA-producing bacteria. Wecker P, Moppert X, Simon-Colin C, Costa B, Berteaux-Lecellier V. AMB Express. 2015 Dec;5(1):74.

Meslet-Cladiere, L., Delage, L., Leroux, C.J., Goulitquer, S., Leblanc, C., Creis, E., Gall, E.A., Stiger-Pouvreau, V., Czjzek, M., and Potin, P. (2013). Structure/Function analysis of a type III polyketide synthase in the brown alga Ectocarpus siliculosus reveals a biochemical pathway in phlorotannin monomer biosynthesis. Plant Cell 25, 3089-3103.

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