



## TRAINING IN MICROALGAE-RELATED INDUSTRIAL PROCESSES

Dates: July 3<sup>rd</sup> - 7<sup>th</sup> 2023

Teaching hours: 20h

Area of knowledge: Chemical Engineering and Biotechnology

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Registration: <https://www.ual.es/index.php?CID=97767>

## INTRODUCTION

This is an intensive course about microalgae-based processes, on which expertise from academia and industry explain the major aspects of these processes. The course will cover all the aspects related with microalgae-based processes, from (i) the modelling of strains and light utilization, to (ii) the design and operation of photobioreactors, (iii) harvesting and processing of the biomass to achieve reliable and high-value products, and (iv) scale-up to commercial size. Fundamental and practical aspects will be covered always including the participation of internationally recognised researchers, young researchers and the exchange of experiences between the assistants. Lecturers have extensive experience in bioeconomy, climate change, and in the development of processes that will make industrial production more sustainable in the future.

The course is oriented towards PhD students or equivalent experience students in microalgae biotechnology and chemical engineering fields from whatever fundamental area as microbiology, biology or biological/ biochemical engineering, chemistry and biochemistry. The course is also intended to give those working in the industry an opportunity to upgrade their knowledge in microalgae biotechnology.

## MAIN GOALS

1. **To provide the basic knowledge, and needed skills to grow microalgae, characterize the biomass and conceptualize microalgae processes.**
2. **To demonstrate the feasibility of microalgae-related processes and identify the markets in which these processes can be suitable**
3. **To provide access to real data and experience of microalgae-related industrial processes**

## CONTENT

Module	Description
<b>MODULE 1: Biology and basic principles of microalgae cultures</b>	The microalgae cell. Photosynthesis and kinetic models. Basic techniques of microalgae culture and maintenance. Stoichiometry and kinetic of microalgae cultures. Microalgal culture optimization outdoors. In this module, the fundamentals of microalgae production are reviewed. Major factors influencing the growth of microalgae in addition to modelling of this behaviour are included. The module is completed with laboratory practices on light irradiance measurements, Chlorophyll fluorescence quenching measurements, photosynthesis rate and photosynthetic efficiency.

<b>MODULE 2:</b> <b>Fundamentals of microalgae photobioreactors</b>	<p>Fundamentals of PBR design. Fluid-dynamics and mass transfer in PBR. Heat and momentum transfer in PBR.. In this module, the fundamentals of the design of photobioreactors for the production of microalgae are reviewed. This includes mass and heat transfer phenomena and how mixing influences the light regime to which the cells are exposed in the culture. The module is completed with experiments in pilot-scale photobioreactors locate at IFAPA research centre as part of SABANA project. Measurement of culture conditions gradients in raceway and thin-layer reactors, and variation of those culture conditions when modifying mass transfer (air/CO<sub>2</sub>) into the reactor.</p>
<b>MODULE 3:</b> <b>Harvesting and processing of microalgae biomass</b>	<p>Microalgae harvesting (coagulation-flocculation, sedimentation, filtration and centrifugal recovery). Cell disruption. Fundamentals of recovery, extraction, isolation and purification of microalgae products. Microalgae biorefinery concept. In this module, the processes required for the harvesting and processing of microalgae biomass are reviewed. The challenge is to minimize the energy and cost of these operations at the same time that maximizing the quality of end-products. The module is completed with laboratory practices on harvesting (coagulation-flocculation-sedimentation), cell disruption and extraction methods. Major aspects to be studied will involve flocculation and centrifugation experiments.</p>
<b>MODULE 4:</b> <b>Economic and sustainability analysis of microalgae processes</b>	<p>Life cycle analysis. Risk analysis. Techno-economic analysis. In this module, the sustainability of microalgae-related processes is reviewed. Both environmental and economic aspects will be studied, in addition, also social sustainability will be introduced. The module is completed with the visit and revision of the SABANA project such as the case study.</p>
<b>MODULE 5:</b> <b>Commercial application of microalgae and techno-economic assessment of microalgae processes</b>	<p>Food ingredients from microalgae (tailored lipids, carotenoids and PUFAs). Phycobiliproteins recovery and purification. Commodities and bulk chemicals (biofuel and biofertilizer). Microalgae and Aquaculture. Wastewater treatment with microalgae cultures. In this module, a general overview of the most relevant applications of microalgae is performed. Susscessful commenrcial process in addition to potential new processes will be included. The module is completed with the revision of the BIORIZON project such as the case study.</p>

### COURSE METHODOLOGY

In-lab sessions <input checked="" type="checkbox"/>	Company visits <input checked="" type="checkbox"/>
Academic visits <input type="checkbox"/>	Talks <input type="checkbox"/>
Lectures <input checked="" type="checkbox"/>	Others <input type="checkbox"/>

Each module will be divided into two hours of lectures and three hours of practice. Course lectures (10 hours), short lab and pilot plant practical (15 hours). The language of the course is English. On the course will participate experts from academia and private companies all of them with extensive experience in the field.

### REQUIREMENTS

Degrees in Microbiology, Biology, or in Biochemical, Chemistry and/or Biochemistry Engineerings

### ACADEMIC VISITS & NETWORKING

- SABANA demo facility at IFAPA research centre: to perform practices and training activities
- BIORIZON BIOTECH: Industrial facility producing biostimulants and biopesticides based on microalgae
- FCC AQUALIA: Industrial facility performing wastewater treatment using microalgae

### ASSESSMENT

- 40% Final written exam on the contents corresponding to the course lecturers
- 40% Assessment of the reports presented by the students on lab practices
- 20% Regular attendance during the course

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