

Interactions between microalgae and bacteria during growth in photobioreactor:

Modulation and biotechnological implications

Director of Studies: Christophe Brunet

Department of Integrative Marine Ecology

Project Summary

In recent years, marine microalgal growth received a great attention for the huge potential of these microbes in biotechnology, from energy production to cosmetics and nutraceuticals. In photobioreactors, microalgal growth is boosted by nutrient enrichment and other controlled conditions imposed by the operator (e.g., light). The maintenance of axenic conditions in photobioreactor is traditionally regarded as one of the main challenges to face when growing microalgae, since bacteria are thought to have a detrimental effect on biomass production. However, recent studies have challenged this view, showing that bacteria might also positively affect algal metabolism under specific conditions. The interactions between microalgae and bacteria are complex spanning from mutualism to parasitism and the threshold between one interaction and another is modulated in space and time by multiple physiological and environmental factors. Among these factors, light climate is one of the most forceful, as it regulates the balance between light harvesting and photoprotective capacity in photosynthetic cells. This balance is crucial for the physiology of the algae and the quality of the surrounding environment as it defines both the intracellular allocation of the photosynthesised carbon and the exudation of dissolved material outside the cell. The latter is the primary source of energy for the bacterial community. While bacteria rely on algal exudates to thrive, they also affect microalgae; positively, by providing inorganic nutrients (through remineralization) and vitamins, or negatively, by outcompeting algae when nutrients are scarce. The understanding of the interactions between microalgae, bacteria and the surrounding environment is therefore of primary importance for exploiting the biotechnological potential of marine microalgae.

The PhD project aims to investigate these interactions in a controlled system such as a photobioreactor. To this end, microalga and bacteria parameters (e.g., growth, photosynthesis, enzymatic activities) along with the chemistry of the culture medium will be monitored under changing light conditions. The selected microalga is the diatom *Skeletonema marinoi*, which has physiological properties (high growth rate, physiologically flexible, macromolecular composition) relevant for biotechnology. Since the studied organisms play a fundamental role within the marine ecosystem, project's results are expected to be relevant not only for biotechnological research but also for marine ecology and biogeochemistry. Data and understanding generated within this PhD will be used to develop and implement a mathematical model simulating microalgal growth dynamics in photobioreactors. Such a model will be a powerful tool for both ecological studies and biotechnological applications and a clear legacy of this project.