Characterisation and optimisation of mixotrofy in *Phaeodactylum tricornutum*

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Diatoms are a type of photosynthetic microalgae, which play an important ecological role in ocean biogeochemistry. Moreover, they are extremely interesting as potential feedstocks for the production of high value molecules and biofuel. They are endosymbiotic organisms originated from the fusion of an heterotroph ancestor with one or more photosynthetic microalgae. Several diatoms, thanks to their evolutionary history, are able to combine the plant-derived metabolism (*i.e*. photosynthesis) with animal-derived metabolism (*i.e.* respiration). This process is called mixotrophy and represents the ability to grow in the presence of both light and organic carbon source. In some microalgae, the simultaneous use of photosynthesis and respiration can increase the biomass production and therefore reduce the costs of industrial production of algae-derived molecules. During my PhD, the effect of mixotrophic growth on cellular metabolism has been studied in *Phaeodactylum tricornutum*, a model diatom for the production of omega 3 and biofuel. In particular, by combining different "omics" approaches - transcriptomics, metabolomics and lipidomics- we have contributed to elucidate the major metabolic pathways targeted by mixotrophy, which are responsible for the increase of biomass and lipid production. Based on these results, several candidate genes have been selected to improve the mixotrophic metabolism by metabolic engineering. In addition, the results obtained in these experiments have been used for the design of new strategies to improve the growth of *Phaeodactylum*. Indeed, the optimisation of the growth conditions and of the culture medium composition has allowed increasing the respiration and photosynthesis and thus the final biomass. Finally, the optimised conditions were tested in 2L-photobioreactors with an irradiation of about 300 µE m^{-2} s^{-1} and in the presence of 5 g / L of glycerol. In the final conditions, they were obtained up to 12 g / L of biomass, which correspond to an increase of about 80% of the biomass than the control grown in the presence of only light.

Key words: mixotrophy, *Phaeodactylum tricornutum*, "omics" analysis, photobioreactor.