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MOLECULAR ANALYSIS OF LONG-TERM EXPOSURE TO HIGH LIGHT IN THE MICROALGA *NANNOCHLOROPSIS GADITANA*

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The seawater oleaginous microalga *Nannochloropsis gaditana* has the ability to accumulate large amounts of lipids and it is thus raising as a model organism for the production of next generation biofuels. Several stimuli induce lipid accumulation in Nannochloropsis such as nutrient deficiency but also exposure to excess light. The study of metabolism regulation and understanding the molecular bases of lipid accumulation are essential steps toward the optimization of algae productivity.

In order to decipher light-driven changes, we performed a combined analysis of transcriptome, lipidome and metabolome of *Nannochloropsis gaditana* cultures exposed for five days to three different light intensities: low (LL), medium (ML) or high light (HL) respectively 10, 100 and 1000 mmol photons m^{-2} s^{-1}. The growth of LL cells was limited by light availability while HL algae were impaired because of the toxic effect of the excess light. Clustering analysis of RNA-seq data revealed that light induced significantly the up-regulation of reductive tricarboxylic acid cycle, water-soluble vitamin metabolic process and monosaccharide biosynthetic process and the down-regulation of genes involved in DNA integration, chlorophyll and carotenoid biosynthetic process, unsaturated fatty acid biosynthetic process and photosynthesis/light harvesting.

Coherently with transcriptomic data, we measured a generalized reduction of *Nannochloropsis gaditana* photosynthetic apparatus in HL. Moreover, strong illumination stimulated the biosynthesis of carbohydrates and lipids but also compounds associated to oxidative stress response. Not all lipids had the same response to light, while diacylglyceryl-N,N,N-trimethylhomoserine (DGTS) increased with the light intensity, phosphatidylcholine (PC) and mono-lactosyldiacylglycerol (MGDG) responded negatively, highlighting the reduction of lipid biosynthesis inside the chloroplast. We also compared gene expression regulation under HL and nitrogen deprivation, a condition well known to stimulate lipid accumulation. While chloroplast and photosynthesis have been negatively regulated by both abiotic stress conditions, specific signatures could be associated either to one or the other treatment. We placed the first building blocks for future investigations of the mechanisms underlying lipid production in Nannochloropsis species.