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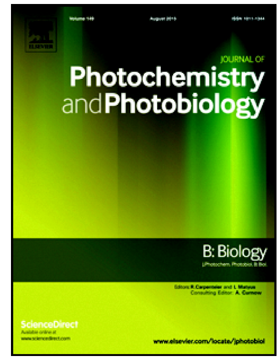

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Effect of carbon limitation on photosynthetic electron transport in *Nannochloropsis oculata*

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Abstract

This study describes the impacts of inorganic carbon limitation on the photosynthetic efficiency and operation of photosynthetic electron transport pathways in the biofuel-candidate microalga *Nannochloropsis oculata*. Using a combination of highly-controlled cultivation setup (photobioreactor), variable chlorophyll *a* fluorescence and transient spectroscopy methods (electrochromic shift (ECS) and P_{700} redox kinetics), we showed that net photosynthesis and effective quantum yield of Photosystem II (PSII) decreased in *N. oculata* under carbon limitation. This was accompanied by a transient increase in total proton motive force and energy-dependent non-photochemical quenching as well as slightly elevated respiration. On the other hand, under carbon limitation the rapid increase in proton motive force (PMF, estimated from the total ECS signal) was also accompanied by reduced conductivity of ATP synthase to protons (estimated from the rate of ECS decay in dark after actinic illumination). This indicates that the slow operation of ATP synthase results in the transient build-up of PMF, which leads to the activation of fast energy dissipation mechanisms such as energy-dependent non-photochemical quenching. *N. oculata* also increased content of lipids under carbon limitation, which compensated for reduced NAPDH consumption during decreased CO_2 fixation. The integrated knowledge of the underlying energetic regulation of photosynthetic processes attained with a combination of biophysical methods may be used to identify photo-physiological signatures of the onset of carbon limitation in microalgal cultivation systems, as well as to potentially identify microalgal strains that can better acclimate to carbon limitation.