IS2.6 - The physiology of photoautotophic microbes in fluctuating light

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Light fluxes in natural conditions vary in time scales of seconds to days. However, most of our understanding about photosynthetic physiology in microbial photoautotrophs comes from studies performed in constant light conditions. I will focus on two areas of research that are being used to generate new hypotheses about how algae and cyanobacteria maintain growth and photosynthetic efficiency. I will first focus on the use of Systems Biology tools to uncover novel aspects of diatom biology that occur during low light photoacclimation. *Phaeodactylum tricornutum,* a model pennate diatom, undergoes extensive remodeling of its photosynthetic apparatus when shifted from excess to low light levels and this is accompanied by considerable changes in the lipidome to facilitate these changes. An unusual mitochondria-based beta oxidation of fatty acids from triacylglycerols likely facilitates this energy intensive process. The second area of focus will be the application of Computational Fluid Dynamics to characterize the light environment of a cyanobacteria growing in conditions similar to those proposed for industrial scale biofuel production. In rapidly mixing conditions, such as in a flat panel bioreactor, the majority of light supplied to an individual cell is supplied well in excess of its P_{max} – despite the optically dense nature of a photobioreactor. Additionally, this energy is typically encountered in pulses of less than a second. Replicating this light environment *ex situ* leads to cells with high levels of light dependent oxygen consumption relative to gross oxygen evolution and very little non photochemical quenching. Taken together, these studies suggest a rich future for the discovery of novel factors that regulate photosynthetic efficiency in photosynthetic microbes.