SC1.2 - A molecular switch for oxygenic photosynthesis and metabolism in a green alga

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Primary productivity of plants and algae is driven by regulation of metabolism and photosynthesis. Algae can contribute to a sustainable bio-economy, because they produce bioproducts for energy, food, and pharmaceuticals while minimizing negative environmental impacts. Here, we show the commercially valuable green alga *Chromochloris zofingiensis* reversibly switches photosynthesis off during metabolic changes associated with trophic transitions, and augments production of biofuel precursors and the high-value antioxidant astaxanthin. Addition of exogenous glucose triggers a reversible decline in photosynthesis and components of the photosynthetic machinery, an increase in respiration and energy stores including triacylglycerols, and broad transcriptomic changes. Furthermore, we use forward genetics to reveal hexokinase1, an important glycolytic enzyme, as a glucose sensor that regulates photosynthesis, astaxanthin synthesis, and metabolism in this alga. Sugars play fundamental regulatory roles in gene expression, physiology, metabolism and growth in plants and animals, and this study introduces a simple system to investigate conserved eukaryotic sugar sensing and signaling at the base of the green lineage. (This work was supported by the U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research, under Award Number DE-SC0018301, the U.S. Department of Energy, Office of Science, Basic Energy Sciences, Chemical Sciences, Geosciences, and Biosciences Division under field work proposals SISGRKN and 449B, Agriculture and Food Research Initiative Competitive Grant No. 2013-67012-21272 from the USDA National Institute of Food and Agriculture, and DOE BER award No. DE-FC02-02ER63421. K.K.N. is an investigator of the Howard Hughes Medical Institute.)