CO_2-Fixation and Engineering for Increased CO_2-Fixation in Photoautotrophic Organisms

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Cyanobacteria, prokaryotes with the capacity of oxygenic photosynthesis, carry out the same type of photosynthesis as higher plants. Solar energy is captured in the light reaction, converted to NADPH and ATP which are used in the Calvin-Bassham-Benson (CBB) cycle to fix CO_2, catalyzed by RuBisCO, into energy rich carbon containing molecules (1, 2). In addition, other carboxylases may also contribute to the fixation of CO_2 (1, 2).

Overexpressing selected photosynthetic carbon flux control enzymes of the CBB cycle in the cyanobacterium *Synechocystis* PCC 6803 resulted in increased *in vivo* oxygen evolution, growth rate and biomass accumulation (3). Targeting the primary carboxylase, RuBisCO, also resulted in increased growth (4), and overexpressing phosphoenolpyruvate carboxylase resulted in enhanced growth at low light intensity (5). Combining the engineered capacity to fix more CO_2 with an introduced capacity to produce a selected product, exemplified with ethanol, resulted in increased ethanol production and higher product to biomass ratio (6). Recent attempts to engineer cyanobacteria for direct photosynthetic butanol production will be presented and discussed.

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