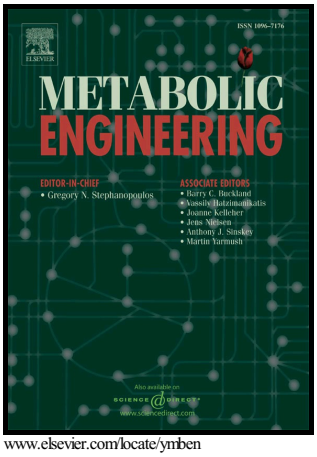

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Effects of overexpressing photosynthetic carbon flux control enzymes in the cyanobacterium Synechocystis PCC 6803

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Abstract

Synechocystis PCC 6803 is a model unicellular cyanobacterium used in e.g. photosynthesis and CO_2 assimilation research. In the present study we examined the effects of overexpressing Ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO), sedoheptulose 1,7-biphosphatase (SBPase), fructose-bisphosphate aldolase (FBA) and transketolase (TK), confirmed carbon flux control enzymes of the Calvin-Bassham-Benson (CBB) cycle in higher plants, in Synechocystis PCC 6803. Overexpressing RuBisCO, SBPase and FBA resulted in increased in vivo oxygen evolution (maximal 115%), growth rate and biomass accumulation (maximal 52%) under 100 μmol photons m^{-2} s^{-1} light condition. Cells overexpressing TK showed a chlorotic phenotype but increased biomass by approximately 42% under 100 μmol photons m^{-2} s^{-1} light condition. Under 15 μmol photons m^{-2} s^{-1} light condition, cells overexpressing TK showed enhanced in vivo oxygen evolution. This study demonstrates increased growth and biomass accumulation when overexpressing selected enzymes of the CBB cycle. RuBisCO, SBPase, FBA and TK are identified as four potential targets to improve growth and subsequently also yield of valuable products from Synechocystis PCC 6803.

Keywords: RuBisCO, CcmM, SBPase, FBA, TK, Synechocystis PCC 6803

1. Introduction

Bio-based products attract increasing attention as replacement of fossil resource and to restrict global warming. Escherichia coli and Saccharomyces cerevisiae are used to ferment bio-based resources into desired products in indirect processes with associated costs (Sanderson, 2011). Photoautotrophic organisms are promising alternatives as they are able to fix CO_2 into organic compounds in direct processes.