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Improving growth and glycogen productivity of a *Cyanobacterium* through genetic engineering

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Statement of the Problem: Fast growing *cyanobacteria* have potential as platform organisms for photosynthetic production of variety of chemicals. Amongst the various applications of *cyanobacteria* is production of simple sugars through the hydrolysis of stored glycogen. However, a big challenge in the widespread use is the slow growth of these organisms. Many of these cells require bubbling of CO_2 mixed with air to improve growth rates. Marine *cyanobacteria* have greater advantage for countries with limited freshwater supply. *Synechococcus* PCC 7002 cells are marine/euryhaline *cyanobacteria* with fastest reported growth rates. However, these cells have low basal levels of glycogen, limiting their potential as producers of sugars.

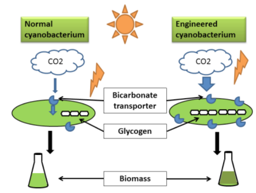

Figure 1. The effect of overexpression of bicarbonate transporters in cyanobacterium Synechococcus PCC 7002. Overexpression of two homologous bicarbonate transporters increases biomass and glycogen content of the cells

Methodology & Result: In this work, we overexpressed two different native carbon transporters in *Synechococcus* PCC 7002 cells. The overexpression of these transporters led to a significant increase in growth and biomass concentration both on air as well as on 1% Carbon dioxide. Additionally, the glycogen content of the cells was greater in the engineered cells both on air and on 1% CO_2. The glycogen productivity in the cells was about 4-fold than those for the control cells. We also document other changes in the cells on overexpression of this transporter such as altered pigment content when grown in presence of air.

Conclusion & Significance: Our work shows the utility of increased carbon transport in improving the growth and product formation in this *cyanobacterium*. The improved productivity on just air has potential for significant cost-savings. As the approach improves carbon intake and assimilation, it has the potential to improve productivity of other molecules using this *cyanobacterium* and could be an important advancement in increasing the utility of these organisms as potential photosynthetic bio-factories.

Recent Publications

1. Pathania R, Ahmad A and Srivastava S (2017) Draft genome sequence of an Indian marine cyanobacterial strain with fast growth and high polyglucan content. *Genome Announcements;* 5: e01334-17.
2. Ahmad A, Hartman H, Krishnakumar S, Fell D A, Poolman M G and Srivastava S (2017) A Genome Scale Model of *Geobacillus thermoglucosidasius* (C56-YS93) reveals its biotechnological potential on rice straw hydrolysate. *J. Biotechnol.*; 251: 30-37.

Biography

Shireesh Srivastava is the Group Leader of Systems Biology for Biofuels group at ICGEB, New Delhi and a Team Leader in the DBT-ICGEB Center for Advanced Bioenergy Research. He had earned his PhD in Chemical Engineering from Michigan State University, winning the Sigma Xi award for excellence in graduate studies. He has conducted his Postdoctoral research work in the National Institutes of Health (NIH), in metabolism and won the Fellows Award for Research Excellence (FARE). He has published 21 research articles in reputed journals in the field of systems biology and metabolism.

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