**Mapping photoautotrophic metabolism of engineered cyanobacteria to identify reactions that limit production of renewable chemicals**

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**Project Goals**: This project aims to study the metabolism of engineered cyanobacteria to identify reactions that limit carbon flux to synthetic pathways. The long term goal is to develop technologies that can be used to enhance the performance of industrially pertinent photosynthetic microorganisms.

Cyanobacteria are emerging as ideal biocatalysts for the synthesis of renewable fuels and chemicals from sunlight and $CO_2$. Despite current advances in cyanobacterial production systems, the efficiencies needed for large scale commercialization have yet to be achieved. In addition to the limited tools available for streamlining strain performance, redirecting carbon flux from central metabolism to product producing pathways remains a challenge. Mapping metabolism of these engineered systems can help identify metabolic reactions that limit carbon flux to desired product(s) and pinpoint 'wasteful' by-product pathways that pull carbon flux away from central metabolism.

Our group focusses on developing novel approaches that use isotopically nonstationary $^{13}$C-MFA to quantitatively assess *in vivo* metabolic phenotypes of photoautotrophs [1-3]. We have previously applied this approach to characterize photoautotrophic metabolism of the model terrestrial plant *Arabidopsis thaliana* [4] and the model cyanobacteria *Synechocystis* PCC6803 [5]. More recently, we used this approach to map carbon fluxes and identify metabolic bottlenecks in an isobutyraldehyde (IBA) producing mutant of the cyanobacteria *Synechococcus elongatus* PCC7942 (strain SA590). By overexpressing the genes associated with the metabolic bottleneck, we successfully generated mutants that showed significant improvement in IBA productivity over SA590 [6].

This presentation summarizes the lessons we learned and demonstrates the potential of using $^{13}$C-MFA in tandem with rational metabolic engineering methodologies to enhance the performance of industrially relevant photosynthetic microorganisms.

## References

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