Probing Metabolite Overflow Mechanisms of Cyanobacterium *Synechocystis* sp. PCC 6803 under High Light and High Salt Conditions

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Metabolic overflow in cyanobacteria may play a crucial role in managing excess energy and redirecting carbon flow during stressful conditions (Cano et al 2018). We have previously reported the metabolite overflow of cyanobacteria using HPLC, LCMS, and FTIR (Alamin et al 2024). We identified 56 targeted and 170 untargeted metabolite end-products of overflow metabolism in cyanobacteria. The 226 metabolites include organic acids, amino acids, organic bases, esters, alcohols, ketones, aldehydes, and sugars. HPLC data showed that pyruvate overflow is sensitive to the presence of nitrate and lower pH in the growth medium. FTIR analysis showed the changes in overflow metabolites end-products in cyanobacterium *Synechocystis* 6803 at high light condition. In this work we focus on the overflow metabolism of Synechocystis sp. PCC6803, when exposed to high light and high salt environments, which are significant abiotic stressors that can disrupt cellular balance. The cultures were cultivated in BG-11 medium and subjected to increased photon flux densities along with elevated NaCl concentrations. The research monitored changes in growth and the excretion of various metabolites. A major overflow product with mM scale of glycerol with minor other metabolite was observed at the late growth phase (Figure 1). The findings highlight that heightened light conditions enhance photosynthetic electron flow, leading to an increased accumulation and release of overflow metabolites such as glycerol, acetate, and ethanol. Additionally, high salt stress adds an energetic burden due to the need for ion homeostasis and the biosynthesis of compatible solutes, further amplifying the overflow responses. Overall, these insights enhance our understanding of how Synechocystis sp. PCC 6803 reallocates energy and carbon during environmental stress, contributing valuable information for developing metabolic engineering approaches aimed at improving biofuel and bioproduct synthesis. Future work will access the mechanistic details using genetically engineering mutants associate salt stress in cyanobacteria.

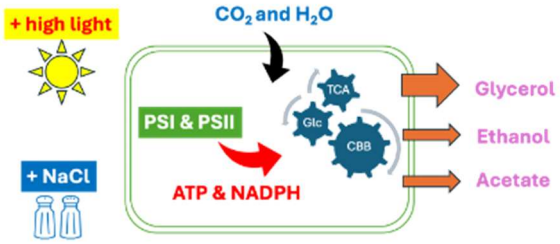

Figure 1: Metabolite overflow profiles of cyanobacteria at high light and high salt conditions

Cano et al (2018) Manipulation of glycogen and sucrose synthesis increases photosynthetic productivity in cyanobacteria, Front Microbiol. 14: 1124274.

Ibrahim Alamin, Jacob Sebesta, Arnav Deshpande, Vida A Dennis, Lieve Lauren, Jianping Yu, and Harvey J.M. Hou, "HPLC, LCMS, and FTIR analysis of cyanobacterial metabolite overflow for energy management," 50th Midwest/southeast Photosynthesis Meeting, Turkey Run Inn, Marshall Indi, October 25-27, 2024