OA1. 2 - Excitation energy quenching by a cysteine-mediated mechanism in IsiA in cyanobacteria.

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Iron deficiency is a common nutrient stress in aquatic environments that limits the growth of cyanobacteria. In response of iron-deficiency, cyanobacteria have evolved various strategies to reduce the damage caused by the loss of iron. IsiA protein is a membrane-bound Chl *a*-antenna protein produced by cyanobacteria under iron deficient and other stressful conditions. Under prolonged iron starvation, IsiA aggregates are the dominant Chl *a*-binding proteins in *Synechocystis* sp. PCC 6803. It has been shown that aggregates of IsiA use a non-photochemical quenching (NPQ) mechanism to protect cyanobacterial cells from photodamage. Using ultrafast time-resolved fluorescence spectroscopy, we demonstrated that excitation energy in IsiA is quenched by a cysteine-mediated process (1), similar to the protein-pigment interactions regulating the light-harvesting capabilities of the FMO protein in green sulfur bacteria. In particular, targeted mutagenesis of the critical Cys residue in IsiA abolished this NPQ process. Phylogenetic studies showed that only one third of the ~ 400 sequenced cyanobacterial genomes examined have the *isiA* gene (2). In addition, multiple protein sequence alignment showed that the motif 'AYFCAVN' is highly conserved in cyanobacterial strains containing IsiA, which further emphasizes the critical role that the cysteine plays in this protein. These analyses are allowing us to understand the function and physiological significance of IsiA in cyanobacteria.

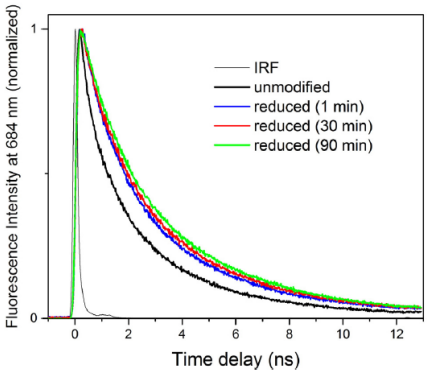

Figure 1. Kinetics of IsiA-bound Chl *a* fluorescence decay upon addition of sodium dithionite to the sample buffer (1). Reduction of cysteine shows that IsiA can no longer quench light energy. Fluorescence was recorded at 684 nm at room temperature. IRF, instrument response function.

References

1. Chen, H-Y. S., Liberton, M. Pakrasi, H. B. and Niedzwiedzki, D. M. (2017) Reevaluating the Mechanism of Excitation Energy Regulation in Iron-Starved Cyanobacteria. Biochim. Biophys. Acta, 1858: 249-258.
2. Chen, H-Y. S., Bandyopadhyay, A. and Pakrasi, H. B. (2018) Function, regulation and distribution of IsiA, a membrane bound chlorophyll a-antenna protein in cyanobacteria. Photosynthetica, 56: 321-333.

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