ABSTRACT

Defining the role of two-component sensory transduction proteins that regulate the composition of photosynthetic pigment-protein complexes in Cyanobacteria

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Light serves as an environmental stimulus, which has been shown to influence various photosynthetic components within the cells of *Synechocystis* 6803. The response mechanism employed in a majority of cases involves a histidine-aspartate phospho-transfer, called two-component signal transduction. The *rpaA* and *rpaB* (*ycf27*) genes, which are highly conserved in cyanobacteria, have been shown to regulate the distribution of energy from phycobilisomes to the reaction centres via this mechanism. The DNA-binding domain of these genes were expressed, purified and used in protein-DNA interaction studies with a 6803 gene library. The results indicate that each of these genes may have numerous targets and that the parameters for efficient protein-DNA complex formation are specific for individual proteins. The *nblS* gene, coding for a putative sensory histidine kinase, is conserved in plastids and cyanobacteria. The *nblS* orthologue in the cyanobacterium *Synechococcus* sp. PCC7942 is involved in controlling the degradation of phycobilisomes during nutrient stress. The results show little phenotypic effect during nitrate starvation. However, when the mutation was combined with deletion of the *pta* gene coding for phosphotransacetylase, there was a strong phenotypic effect which was not seen in either single mutant. The *pta*⁻*nblS*⁻ double mutant degraded phycobilisomes as normal, but unlike the wild-type it did not degrade its chlorophyll-protein complexes. Phosphotransacetylase synthesizes acetyl phosphate, which is known to phosphorylate response regulators in other bacteria. Data from this study suggest that acetyl-phosphate-dependent phosphorylation of response regulator(s) can suppress NblS-dependent signalling in *Synechocystis*. Deletion of *pta* may be a generally-applicable method to expose hidden phenotypes of sensory histidine kinase mutants in bacteria. The sensory domain of NblS was found to be unique and the only of its kind present in all the sequenced cyanobacteria. The findings indicate that alteration/loss of genes involved in environmental signalling lead to drastic changes in photosynthetic pigment-protein complexes.

Keywords: cyanobacteria; two-component system; histidine kinase; response regulator; acetyl phosphate; signal transduction.