IDENTIFICATION OF CELL SURFACE SUGARS IN N_2-FIXING CYANOBACTERIUM *CYANOTHECE* ATCC 51142 USING FLUORESCEIN LABELED LECTINS

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ABSTRACT

Some cyanobacteria carry out both O_2-producing photosynthesis and O_2-sensitive nitrogen fixation, making them unique contributors to global carbon and nitrogen cycles and potential contributors to industrial and agricultural applications. Much research has focused on how cyanobacteria protect the O_2-sensitive N_2-fixing enzyme, nitrogenase. Cyanobacteria separate these two incompatible biochemical processes either spatially, in filamentous N_2-fixing cyanobacteria, or temporally, in unicellular cyanobacteria. Approximately 10% of the vegetative cells in filamentous N_2-fixing cyanobacteria such as *Anabaena* spp. become heterocysts that are present singly at semiregular intervals along the filaments. Heterocysts are morphologically and biochemically specialized for N_2-fixation. By sequestering nitrogenase within heterocysts, *Anabaena* spp. can carry out, simultaneously, oxygenic photosynthesis and the O_2-labile assimilation of N_2. Heterocysts have three mechanisms to protect nitrogenase: (1) form an additional two-layer of cell wall with a layer of glycolipids and an outer, protective layer of specific polysaccharides to block the environmental O_2; (2) stop O_2 production by shutting down PSII; and (3) increase respiration to consume O_2. Unlike filamentous cyanobacteria, *Cyanothece* ATCC 51142 (hereafter cyanothece), a unicellular cyanobacterium, rhythmically separates photosynthesis and nitrogen fixation. However, cyanothece still has to deal with environmental oxygen. Little is known about how cyanothece protects nitrogenase from inactivation by environmental O_2. In this study, cyanothece cells were grown in nitrogen fixing and non-nitrogen fixing conditions and screened with fluorescein-conjugated lectins, allowing a comparative fluorescent microscopy study of polysaccharide distribution on the cell surface. We found a more diverse collection of cell wall polysaccharides in nitrogen replete conditions, while nitrogen deplete conditions resulted in a stronger average signal for polysaccharides containing N-acetylgalactosamine and N-acetylglucosamine, but a relative lack of polysaccharide diversity. These findings suggest that the two cell types (N_2-fixing and non-N_2-fixing) have different cell wall polysaccharides, which warrants further investigation regarding the cell wall's role in nitrogen fixation.