Interrelation between Cyanophycin Synthesis, L-Arginine Catabolism and Photosynthesis in the Cyanobacterium *Synechocystis* Sp. Strain PCC 6803

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Dedicated to Professor Dr. Wilhelm Menke on the occasion of his 90th birthday

L-Arginine Catabolism, Cyanophycin, Ultrastructural Analysis

Ultrastructural and immunocytochemical investigations gave evidence that cyanophycin (multi-L-arginyl-poly-L-aspartate) granules accumulate in the cyanobacterium *Synechocystis* sp. strain PCC 6803 under nutrient deficient growth conditions, especially under phosphate limitation. Besides nutrient deficiency, growth of *Synechocystis* PCC 6803 on L-arginine or L-asparagine as sole N-source also led to high increase of cyanophycin synthesis, while growth on the combination of L-arginine or L-asparagine with nitrate only caused minor cyanophycin accumulation. Growth of *Synechocystis* PCC 6803 on L-arginine as sole N-source caused substantial morphological and physiological changes, such as severe thylakoid membrane degradation with partial loss of pigments and photosynthetic activity leading to a phenotype almost like that seen under nutrient deficiency. In contrast to the wild type, the PsbO-free *Synechocystis* PCC 6803 mutant could grow on L-arginine as sole N-source with only minor morphological and physiological changes. Due to its fairly balanced growth, the mutant accumulated only few cyanophycin granules. L-arginine degrading activity (measured as ornithine and ammonium formation) was high in the PsbO-free mutant but not in the wild type when cells were grown on L-arginine as sole N-source. In both cells types the L-arginine degrading activity was high (although in the PsbO-free mutant about twice as high as in wild type), when cells were grown on L-arginine in combination with nitrate, and as expected very low when cells were grown on nitrate as sole N-source. Thus, net cyanophycin accumulation in *Synechocystis* PCC 6803 is regulated by the relative concentration of L-arginine to the total nitrogen pool, and the intracellular L-arginine concentration is greatly influenced by the activity of the L-arginine degrading enzyme system which in part is regulated by the activity status of photosystem II. These results suggest a complex interrelation between cyanophycin synthesis, L-arginine catabolism, and in addition photosynthesis in *Synechocystis* PCC 6803.