Bioavailability of iron to Trichodesmium colonies in the western subtropical Atlantic Ocean

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ABSTRACT: *Trichodesmium* provides new nitrogen (N) to marine surface waters via N_2 fixation, a process that requires a substantial amount of iron (Fe). Organic ligands in seawater that bind Fe could either increase or reduce the bioavailability of Fe. Electrochemical techniques indicate that these naturally occurring ligands have Fe-binding constants similar to those of siderophores and porphyrins, suggesting that these chelators play an important role in determining the bioavailability of Fe to cyanobacteria. We conducted Fe uptake experiments using model ligands labeled with 55Fe to compare the bioavailability of inorganic Fe(III), porphyrin-bound Fe(III), and siderophorebound Fe(III) to field-collected *Trichodesmium* colonies. Inorganic Fe(III) and siderophore-bound Fe(III) were more bioavailable to *Trichodesmium* colonies than was porphyrin-bound Fe(III). Furthermore, the bioavailability of the siderophore-bound Fe(III) can be characterized by the functional groups of the siderophore. The dihydroxamate siderophore and an uncharacterized ligand from a cultured *Synechococcus* sp. increased the bioavailability of Fe compared to the trihydroxamate siderophores. Except for experiments with desferrioxamine B, dark incubations resulted in lower Fe uptake rates for all treatments, relative to parallel lighted incubations. This suggests that light enhances the photochemical dissociation of most of the ligand complexes or that light energy is required for the active transport of Fe complexed to the model ligands. The Fe uptake rate of *Trichodesmium* colonies also differed slightly on the basis of colony morphology, with higher uptake rates with "puffs" than "tufts." These experiments show that *Trichodesmium* colonies are capable of discriminating between Fe bound to different organic complexes.

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