Comparative Biochemistry and Physiology of Iron-Respiring Bacteria from Acidic and Neutral pH Environments

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In contrast to their neutrophilic counterparts, acidophilic dissimilatory iron-reducing bacteria (DIRB) have not been extensively studied. This project is focused on the physiology and biochemistry of a representative acidophilic iron reducer, *Acidiphilium cryptum* JF-5. Preliminary data gathered thus far show *A. cryptum* to be an excellent system for these types of studies. Culturing methods have been developed that result in higher cell yields, and the organism is now routinely cultured in a continuous culture bioreactor, under both aerobic and anaerobic conditions. Preliminary biochemical analysis shows the presence of c-type cytochromes in cell extracts, and molecular "gene-discovery" tools have detected genes encoding cytochromes c. We have also examined the ability of *A. cryptum* JF-5 to reduce Fe(III) and other metals, including U(VI) and Cr(VI), in cell suspensions at pH 2.5. Cells (10^9) reduced Fe(III) at a rate of 1.5 μmol hr^{-1} when glucose was present as an electron donor. In the absence of exogenous glucose, Fe(III) was still reduced, albeit at a slower rate of 0.75 μmol hr^{-1}, indicating the presence of reserve reducing equivalents, possibly as storage carbohydrate. We also examined the reduction of $KCrO_4$ by JF-5. Chromium(VI) was toxic to the cells at conc. ≥ 100 μM. Below this concentration, Cr(VI) was removed from solution within hours, presumably as a Cr(III) species. U(VI) and the humic acid analog AQDS were not reduced during two weeks of incubation. The results indicate that *A. cryptum* may influence the fate of not only Fe, but also Cr in low-pH environments. It thus appears that acidophilic DIRB share certain features and abilities with their neutrophilic counterparts, but additionally have other traits that allow for this type of metabolism in extreme environments. Continuing investigation will include purification of proteins involved in electron transport to metals, characterization of attachment mechanisms to solid phase electron acceptors, and comparison of overall findings to known neutrophilic iron-reducing organisms.