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Response of *Desulfovibrio vulgaris* Hildenborough to Acid pH

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ABSTRACT

The anaerobic, sulfate-reducing bacterium *Desulfovibrio vulgaris* Hildenborough has been suggested to be useful for environmental bioremediation applications. Among the constraints likely to be encountered, that effect the growth of a bacterial community in contaminated sites, are low pH conditions. Growth of *D. vulgaris* on acid pH media was studied. It was evident that this bacterium was able to grow at pHs as low as 5 in batch cultures; however, the lag phase was prolonged and the final protein yield was proportionally lower with the decrease in pH. In medium with lactate as the carbon and reductant source and sulfate as the terminal electron acceptor, the final protein yields dropped to 50% or 29% of the control (pH 7) when the initial medium pH was pH 5.5 or pH 5.0, respectively. The average lag phase for initial pH 5.5 medium was 120 hours versus pH 7 which generally had two hours or less.

This bacterium incompletely oxidizes organic acids with the production of acetate. Thus at low pH, growth is limited by the accumulation of acetate in the medium that acts to shuttle protons across the membrane thereby dissipating the proton gradient and acidifying the cytoplasm. The production of sulfide gas through sulfate reduction consumes protons thereby countering the acid conditions. Finally deamination or decarboxylation of certain amino acids, e.g. lysine, arginine, tryptophan, and isoleucine, may gradually alkalize the acid medium. When the medium pH is high enough (~6.5) for lactate oxidation and sulfate reduction, cell growth follows.

Transcriptional profiling was performed for *D. vulgaris* exposed to pH 5.5 and 6.2. Typical acid shock responses for Gram-negative bacteria were not observed. Instead, from the transcripts with the highest differential expression, it was inferred that significant cellular damage had resulted because chaperone genes including heat shock genes and repair genes for both proteins and nucleic acids were greatly induced.