Vanadium reduction by bacterial isolates from SA mine soil samples

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Vanadium is a naturally occurring multivalent transition metal. It occurs in nature as a white-to-grey metal and is often found as crystals. It is mostly produced to be used industrially, where the main use is as an alloying ingredient in steel, but also plays an important role as a catalyst in certain chemical reactions.

The toxicity of vanadium depends on its physico-chemical state; particularly on its valence state and solubility. The pentavalent state of vanadium is known to inhibit many enzymes which form covalent, phosphoryl-enzyme intermediates as part of the enzyme reaction mechanism. This inhibition is caused by competition between vanadate and phosphate for enzyme binding. This is believed to be due to vanadate's close structural similarity to phosphate.

Sixteen bacterial isolates from soil samples collectively form Evander and Antimony mines were screened for pentavalent vanadium tolerance using TYG plates containing 5mM pentavalent vanadium. The tolerant cultures were purified and subjected to whole cell reductions under both aerobic and anaerobic conditions. One culture was selected for further investigations. Identification was done by 16S rDNA sequencing. The optimum temperature for whole cell reduction under anaerobic conditions is 45°Cand the best electron donor is sodium lactate. During growth the maximum tested concentration tolerated was 5mM, but it grows optimum at a concentration of 2mM. The proteins responsible for vanadate reduction do not need to be activated but have higher activity when grown in the presence of vanadate.

1. Broderick, G.N. (1977). Vanadium. U.S. Dept. of the Interior, Bureau of Mines, Pittsburgh, Pa.

2. Mannazzu, I., Guerra, E., Ferretti, R., Pediconi, D. and Fatichenti, F. (2000). Biochemica et Biophysica Acta, 1475: 151-156.

3. Henderson, G.E., Evans, I.H. and Bruce, I.J. (1989). Antonie van Leeuwenhoek, 55: 99-107.

4. Henderson, G.E., Evans, I.H. and Bruce, I.J. (1989). Yeast, 5: 73-77.