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Desulfovibrio strain PCS, a novel metal reducing pleomorphic sulfate reducing bacterium

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ABSTRACT

A sulfate reducing bacterium was isolated from the Paleta Creek site in San Diego Bay with 60mM lactate as the sole carbon source and electron donor, and 50mM sulfate as the electron acceptor. The novel isolate, strain PCS is an anaerobic, non-sporulating, gram-negative organism that is highly motile. The optimum temperature for growth of strain PCS was determined to be 37 °C. Preliminary 16S rDNA analysis revealed that the closest relative to strain PCS is Desulfovibrio gbyamani (98% similarity). Light microscopy and SEM images of individual cells reveal sigmoid morphology. Cells of strain PCS appear like slender curved rods during the early log phase and spiral in exponential/stationary phase to approach 5.0μm in length and 0.5μm in width. In this regard, strain PCS is less than half the width of its closest known relative D. gbyamani. The images also reveal the presence of lemon shaped/spiral structures approx 1μm in diameter especially in early log and stationary phases of growth. Detailed investigations are underway to determine the nature and function of these structures. When grown on LS4D minimal media, strain PCS incompletely oxidizes lactate, accumulating acetate as an end product. Sulfate is reduced to hydrogen sulfide. Apart from lactate, strain PCS also utilizes alternative electron donors like pyruvate, benzoate and dihydroxyacetone. Propanone, butyrate and formate were not utilized. Alternative electron acceptors utilized include Fe(III) and thiosulfate. Nitrate and chlorate were not reduced. When tested for reduction of toxic metal like Cr(VI), a washed cell suspension of strain PCS could remove almost 150 M of Cr(VI) supplied as potassium chromate with lactate as the electron donor. This high chromium reducing capability of strain PCS is of great significance for the potential utilization of this microbe towards the treatment of Cr(VI) contaminated environments.

CHARACTERIZATION

When growing on LS4D medium, strain PCS reached stationary phase after 48 hours incubation at 30 °C. At this time, 29mM lactate had been oxidized and 18.4 mM sulfate reduced to give a stoichiometry of 96% of the theoretical value. 2 C₃H₅O₃ + SO₄²⁻ → 2 CH₂CO + 2 H₂O + H₂S

METAL REDUCTION

An active washed cell suspension of strain PCS enzymatically reduced 500 M Chromium (VI) supplied as potassium chromate within 5 hours with lactate as the electron donor. No reduction occurred in parallel incubations without electron donor. Further, the absence of cells, no abiotic reduction of Cr(VI) took place (data not shown).

Similar to Cr(VI), active cells of strain PCS also enzymatically reduced Fe(III) supplied as Ferric citrate to Fe(II). Almost 5mM Fe(III) was reduced over 9 hours relative to controls. Lactate served as the electron donor in this experiment.

CONCLUSION

•Strain PCS is a gram negative, highly motile, non spore forming, pleomorphic, sulfate reducing alkaliphilic bacteria isolated from hydrocarbon impacted sediments of San Diego Bay.
•Strain PCS can utilize a wide range of organic acids and sugars as its C-source compared to its closest relative D. gbyamani.
•While optimally maintained and on fresh water medium, strain PCS exhibits wide salt tolerance of upto 5% NaCl and 6% KC.
•Strain PCS can enzymatically reduce high concentration of toxic, soluble chromate to its non-toxic form.
•Cr(VI) reducing capability of strain PCS is not diminished under stress conditions.

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