expression of *phsABC*, *E. coli* DH5α harboring the *phsABC* constructs showed higher thiosulfate reductase activity and produced significantly more sulfide than the control strain (*E. coli* DH5α) under both aerobic and anaerobic conditions. Among the four constructs, *E. coli* DH5α harboring pSB74 produced the highest level of thiosulfate reductase and removed most of heavy metals from solution under anaerobic conditions. In a mixture of 100 μM each of cadmium, lead, and zinc, the strain could remove 99% of the total metals from solution within 10 hours. Cadmium was removed first, lead second, and zinc last. In contrast, a negative control did not produce any measurable sulfide and removed very little metals from solution. These results have important implications for removal of metals from wastewater contaminated with several metals.

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Carbon Tetrachloride Dechlorination and Metal Chelating Properties of Pyridine-2,6-bis (thiocarboxylic acid) Produced from *Pseudomonas stutzeri* Strain KC

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Pseudomonas stutzeri strain KC was originally characterized as having, under iron-limiting conditions, novel carbon tetrachloride (CCl_4) dehalogenation activity, specifically, a net conversion of CCl_4 to CO_2. The exact pathway and reaction mechanisms are unknown, but chloroform is not an intermediate and thiophosgene and phosgene have been identified as intermediates in trapping experiments. Previous work by others using cell-free preparations has shown that cell-free culture supernatants that have been passed through a low-molecular-weight cutoff membrane can confer rapid CCl_4 transformation ability upon cultures of bacteria which otherwise show little or no reactivity toward CCl_4. We used a cell-free assay system to monitor the complete purification of compounds showing CCl_4 degradation activity elaborated by iron-limited cultures of strain KC. Electerospray tandem mass spectroscopy, NMR spectroscopy, and comparisons with synthetic material have identified pyridine-2,6-bis (thiocarboxylate) (PDTC) as a metabolite of strain KC which has CCl_4 transformation activity in the presence of chemical reductants, e.g., titanium[III] citrate or dithiothreitol, or actively growing bacterial cultures. We have tested the ability of complexes of synthetic PDTC and several transition metal ions, as well as the uncomplexed ligand, to dechlorinate CCl_4 in assays, which include either bacterial cells, chemical reducing agents, or the complex alone with CCl_4. Of the Fe, Ni, Co, and Cu complexes, only the Cu:PDTC complex showed activity under all conditions tested. The reaction between Cu:PDTC and CCl_4 took place both aerobically and anaerobically. Identification of end products and intermediates of the reaction suggested a reaction pathway that includes trichloromethyl radical coupling to one of the sulfur atoms of PDTC, and hydrolysis of the resulting thioester.

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Developmental Pattern Formation Controlled by *patS* in a Cyanobacterium

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Many filamentous cyanobacteria grow as multicellular organisms that show a distinct one-dimensional developmental pattern of single nitrogen-fixing heterocysts separated by approximately ten vegetative cells. Overexpression of a 54-base-pair gene, *patS*, blocked heterocyst differentiation in *Anabaena* sp. strain PCC 7120. A *patS* null mutant showed an increased frequency of heterocysts and an abnormal pattern. Expression of a *patSgfp* reporter was localized in developing proheterocysts. Significantly, exogenously added synthetic peptide corresponding to the last five COOH-terminal residues of PatS inhibited heterocyst development. PatS appears to control heterocyst pattern formation cell nonautonomously by serving as a diffusible inhibitor of differentiation.