論文の要旨
（Thesis Summary）

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論文題目

Microbiological Synthesis of Metalloid Tellurium Towards Biotechnology of Heavy Metal Bioremediation and Rare Metal Recycling

重金属のバイオレメディエーションおよびレアメタルリサイクリングに向けた金属テルルの微生物による合成

Tellurite is a highly toxic residual from copper mining. Microbial cell-mediated reduction of this toxicant can pave the way for sustainable recovery of the semiconductor metalloid, tellurium (Te). Isolation of tellurite-reducing bacterial strains was performed in a marine sediment enrichment culture showing tellurite reduction activity. Metagenome library construction and functional screening were also employed to discover a novel tellurite-reducing gene from the marine sediment enrichment culture. Three tellurite-reducing marine mesophiles were isolated and purified into pure cultures. *Shewanella algae* Strain Hiro-1, *Pseudomonas pseudoalcaligenes* Strain Hiro-2, and *P. stutzeri* Strain Hiro-3, were identified by phylogenetic analysis using the complete 16S rDNA sequence. The three new strains showed intracellular tellurium crystals with a minimum unit size of 60 nm. The Minimum Inhibitory Concentration (MIC) of *S. algae* Hiro-1 was found to be at 15 mM sodium tellurite (Na_2TeO_3) while the two *Pseudomonas* has MIC of 6 mM Na_2TeO_3. A recombinant *Escherichia coli* Strain A1 harboring a putative tellurite-reducing gene was also identified and characterized from the metagenome library. The metagenome fragment is composed of 215 amino acid residues and had shown low sequence homology to known proteins. The probable origin of the metagenome fragment is *P. stutzeri* Hiro-3. Cloning of the Open Reading Frame (*Ps*-ORF1) into expression clones validated the role of the metagenome fragment in conferring tellurite resistance and tellurite reduction activity to *E. coli* host cells. The *E. coli* Strain A1 had shown tellurite resistance at 1 mM Na_2TeO_3. Optimal tellurite reduction activity was recorded at 37°C and pH 7.0. A chloramphenicol-susceptible A1 mutant strain with elevated MIC at 3 mM Na_2TeO_3 and with intact *Ps*-ORF1 was isolated from the metagenome library after sub-culturing in media without the antibiotics. This thesis had shown a feasible application of microbial cell-based bioremediation of toxic heavy metal consequently allowing for the recycling of rare metals like tellurium for use in technological and biomedical applications.