Genetic Variation and Evolution of the Perchlorate Reductase Operon

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ABSTRACT

Perchlorate (ClO_4^-) is a toxic environmental contaminant, commonly found in the United States. Due to its high solubility in water, perchlorate can contaminate streams and agricultural products, which are the main sources of human food consumption. Perchlorate inhibits thyroid hormone synthesis and causes neuropsychological and physical defects; however current filtering systems fail to show promising efficiency. Recently, a microbial metabolic pathway was recognized to reduce perchlorate to benign chloride. The two essential proteins for this metabolism are perchlorate reductase (*Pcr*) and chlorite dismutase (*Cld*). Both are induced under anaerobic conditions and share similar conditions to operate, but they have separate regulatory systems for expression. DNA sequence data for *Cld*, *Pcr* and the *16S rRNA* genes has been collected, to study the evolution and acquisition of the genes, from eleven environmental isolates identified as perchlorate reducers. For PCR amplification, initial primers were designed based on the genomic sequence of *Dechloromonas aromatica* strain RCB and *D. agitata* strain CKB, with subsequent refinement as more sequence data was acquired. I constructed phylogenetic trees for each gene to visualize the similarity of the gene sequences between different organisms and their evolutionary relationship compared to the *16S rRNA*. Nucleotide sequence data for *Pcr* did not mirror the evolutionary relationship established by the *16S rRNA* and *Cld*. These results indicate the two genes are acquired occur separately through horizontal transfer events. Future studies may examine protein sequences for functional analysis, and optimal environmental conditions for gene induction. They may help design efficient perchlorate treatment systems.

KEYWORDS

Perchlorate reductase, chlorite dismutase, phylogenetics study, thyroid hormone synthesis, bioremediation

Note: Only the abstract is available for this thesis. Research is ongoing on this project. Please contact the author of this thesis directly for information.