The biotic degradation of Metaldehyde

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Introduction

The aim of this project is to investigate the molecular mechanisms by which metaldehyde is degraded in soil. Metaldehyde is a cyclic tetramer of acetaldehyde that is used as a molluscicide. It is very stable in water and is often found in ground supplies used for drinking water. Its half-life in soil varies but is often around a week. Using radiolabeled compound it has been shown to be oxidised to carbon-dioxide with acetaldehyde as an intermediate. The best explanation for the short half-life in soil is the involvement of microorganisms in the soil, but the identity of any organisms and genes or enzymes involved has not previously been reported.

Isolating metaldehyde degrading species

To understand how metaldehyde is degraded by microorganisms in soil the first step has been to isolate the organisms responsible. This has been achieved using enrichment cultures containing high (100 mg/L) concentrations of metaldehyde that have been inoculated with various soils. The enrichment cultures contain no other significant carbon source and so only organisms that can metabolise metaldehyde were able to grow. To date two species have been isolated; bacteria of the genera Acinetobacter and Variovorax. Their capacity to degrade the pesticide has been demonstrated in culture (figure 1).

Future work

The next step is to identify the enzymes that catalyse the depolymerisation reaction. This will be achieved by constructing a genomic library of the isolated organisms in \textit{E. coli} and testing the transformed \textit{E. coli} for the acquired ability to metabolise metaldehyde; and also by constructing a knockout library using transposons. Experiments will also be undertaken to understand the chemical nature of the depolymerisation reaction. This can begin with the testing of cell lysate of bacteria grown using metaldehyde and will continue with purified enzyme once the genes encoding them are found. Attention will also be given to investigating how metaldehyde is actually degraded in the environment.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1}
\caption{Optical density at 600nm (solid lines) and metaldehyde concentration (dashed lines) of minimal media inoculated with the isolated bacteria (left and centre) and an uninoculated control (right).}
\end{figure}