SUMMARY OF FINDINGS

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Development of specific bacterial detoxification enzymes as bioindicators and biosensors of environmental pollution

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Brief Abstract

Bacterial detoxification enzymes such as GSTs could have potential for bioremediation, and for development as bioindicators and biosensors of environmental pollutants, e.g. toxic chlorinated organic PCBs and pesticides. A specific bacterial GST, $BphK^{LB400}$, was developed for use as a bioremediation agent and a modified GC-MS assay was developed for rapid detection of soil pollutants.

Key Words

Thematic Framework for Soil Protection, bioremediation, biosensors, monitoring, Persistent Organic Pollutants (POPs)

Background

Persistent organic pollutants (POPs) are ubiquitous in our modern environment and pose significant human health risks. These compounds include polychlorinated biphenyls (PCBs) and many toxic chlorinated organic pesticides of concern as soil pollutants. Glutathione transferases (GSTs) are a family of enzymes that play an important role in detoxification of a wide range of compounds. The aim of this research project was to investigate bacterial GSTs (known and novel) with a view to their development as Bioindicators, Biosensors and potential Bioremediation agents of POPs in soil.

Key points

- DNA sequences of a number of bacterial GSTs capable of degrading organic compounds were analyzed so as to identify highly conserved amino acids with a view to design primers for amplification of GSTs from the environment.
- A number of environmental soil/ sediment samples of interest as potential sources of bacteria capable of degrading chlorinated organic compounds were sourced, both nationally and internationally, and used for genomic DNA isolation.
- A number of bacterial GST sequences of interest (with increased activity towards pollutants) linked to a fluorescent tag were inserted into plant-associated bacteria. These modified bacteria were shown to be capable of

colonising plants and have potential for the development of biosensors and for bioremediation of chlorinated organic compounds in the environment.

- A relatively simple and inexpensive method (using GC-MS) was developed for the analysis of soil/sediment samples contaminated with chlorinated organic compounds.

Findings/Recommendations

- Environmental technologies play a key role in the Irish Government's paper 'Building Irelands' Smart Economy (2008), the development of plant-associated bacteria to degrade toxic synthetic organic compounds in environmental soil may provide an efficient, economic, and sustainable green remediation technology for our twenty first century environment.
- In 2006, the European Commission published the final Thematic Strategy for Soil protection and a proposal for a directive which would establish a framework for the protection of soil involving identification of the location and extent of soil contamination and the requirements for remediation. As an output of this project, it is recommended that the GC-MS assay could be further developed so that when the Soil Framework Directive is introduced, and legally implemented in all member states of the EU, a large number of Irish environmental soil/ sediment samples can be analysed relatively quickly and inexpensively in Irish laboratories with standard GC-MS facilities.

For Further Information

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