Exploring natural resources for dealing with waste: The Estuarine Research Group at WIT

The Estuarine Research Group (ERG) has a range of scientific expertise from molecular biology and bioremediation to inorganic chemistry and biological separations. Development of this research team was facilitated through funding under the Technological Sector Research Strand III (Core research strengths enhancement 2000-2006) initiative.

Phase I projects of the research team are focused on novel, fundamental investigations into the chemical and biological mechanisms involved in heavy metal sequestration and binding to a range of seaweeds (Phaeophyceae, Rhodophyceae, and Chlorophyceae) commonly found in the South-East of Ireland. Such research, although fundamental in nature, has positive economic implications for society through the potential development of our natural resources as bioremediation products for metal-laden wastewater streams.

A number of parallel research strands involving genetic, bioremediation, ecological and chemical studies are currently ongoing in the group. The combined output from these research elements is aimed at gaining a better understanding of the dynamics of metal uptake by seaweed species.

Clean seaweed sampling site: Baginbun Bay in County Wexford.

Bioremediation Studies

To date, extensive screening has been carried out to identify key seaweed species (sourced from the South-East coastline of County Wexford, Ireland) for further research. In total, eight live seaweed species. from three divisions

Aerated tanks for seaweed experimentation.

(*Chlorophytes, Rhodophytes* and *Phaeophytes*) were exposed to copper and chromium. These seaweeds have also been exposed to copper, chromium and lead in dried biomass form. The overall objective of this research is to develop a novel dried seaweed biomass- based biofiltration system for use in the bioremediation of heavy metal polluted wastewater streams. This has less environmental impact than conventional metal removal processes. Short-term studies investigating the seasonal variations influencing metal uptake have also been completed.

Chemical Studies

Seaweed biosorption behaviour has been controlled through careful manipulation of experimental parameters such as pH, initial metal concentration and contact time, thus allowing potentially selective biosorption between different metals as well as between different oxidation states of the same metal. Work to date has been focused on surface characterisation of the seaweed species and identification of the various functionalities involved in heavy metal binding using a variety of analytical techniques including potentiometric and conductimetric titrations, infrared spectroscopy, scanning electron microscopy and X-ray photoelectron spectroscopy. The functional groups found to be responsible for metal uptake include carboxyl, sulphate and amino groups. Equilibrium and kinetic studies of metal

SEM image of *Polysiphonia lanosa* (red seaweed) surface morphology (Magnification 1000X)

sorption have been used to elucidate the parameters of metal binding. Ongoing research investigates the effects of chemical modification of the surface functional groups with a view to enhancing metal binding and allowing deduction of metal binding mechanisms.

Genetic Studies

The aim of this research is to identify the genes responsible for metal accumulation in seaweed. To date a variety of screening methods have been applied to identify genes associated with metal accumulation (e.g. genes encoding phytochelatin synthase and metallothioneins). These genes have been identified in a variety of plant and bacteria species. PCR was carried out on all species of interest using gene specific primers from a variety of plants and bacteria. Southern blotting analysis was also carried out using probes designed from known plant metallothionein and phytochelatin synthase genes. Suppression subtraction cDNA hybridization has been used to enrich cDNA from genes expressed in metal exposed seaweed using the red seaweed *Polysiphonia lanosa.* The subtraction products are currently being used for the generation of a cDNA library.

The ERG is housed in a state of the art research laboratory at WIT which facilitates the participation of this team in a wide range of estuarine/environmental based research projects. Facilities include two walk-in growth chambers that are temperature and light controlled to allow for replication of habitat conditions, specific digestion equipment and chromatographic equipment for protein purification.

To develop the operations of the ERG we are always looking for new collaborative opportunities. To avail of this invitation please find contact details below.
ERG members: Dr. Peter McLoughlin, Dr. Helen Hughes, Dr. Eddy Fitzgerald, Dr. Catherine O'Reilly, Dr. Orla O'Donovan, Mr. James Cusack, Ms. Vanessa Murphy, Mr. Richard Walsh and Dr. Brian Murphy.

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