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on
ENVIRONMENTAL BIOTECHNOLOGY

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ENVIS CENTRE

on

ENVIRONMENTAL BIOTECHBNOLOGY

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C O N T E N T S

BACKGROUND

Environmental Information System (ENVIS) is established in the year 1984 as a network of Information Centres. It is planned by the Ministry of Environment and Forest. Aim of this centre is to provide descriptive and environmental subject related numerical data. Now 78 centres are working under this network on various subject areas in the country. The focal point of this network is situated at the Ministry of Environment and Forest, Government of India, New Delhi.

This ENVIS Centre is established for studies on Environmental Biotechnology at the Department of Environmental Science, University of Kalyani, Nadia-741235, West Bengal.

The objective of this centre is to collect data related to the above mentioned subject, from different major libraries mainly in West Bengal and also from other states in India, through consultation with different journals, Annual Reviews, Internet and to generate a database and create a website uploaded with these information. Besides, we publish biannualy Abstract Volume on our thematic area Environmental Biotechnology under fourteen subheads. The volume contains abstracts of scientific articles from relavent national and international journals. Viewpoint of this abstract volume is to help the interested research workers, scientists, administrators and the general people.

This is the 13th publication of Abstract Volume of this ENVIS Centre. This contains the abstracts of research papers collected from the various areas of Environmental Biotechnology from different journals published in December, 2008. In this issue, various topics like Bioenergy, Bioengineering, Bio-degradation, Bio-remediation, Bio-transformation etc. have been covered. We are grateful to the various libraries and their staff for their cooperation extended to us during the collection of the articles.

Abstract Format

The format of the abstract is as follows:

Abstract : The abstracts are arranged in different subheads.

Author: Name of the authors are given in the order in which they appear in the original document. These names are given in succession.

Address of Authors: Address of the author is given in parenthesis at the end of the authors name. When the address of any other author is found, it is written after wards delimited by stop(.).

Locus: The name of the journal is followed by the volume number, issue number, year of publication and the page no.

GENERAL INFORMATION

Abstract have been taken directly from source documents like research report, journals, internet, seminar proceedings, standards and patents. All the resources are published within last six months.

Abstract are broadly classified and arranged under the following 14 heads:

Bioaccumulation: Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in living things whenever they are taken up and stored at a rate faster than they are broken down (metabolized) or excreted. Understanding the dynamic process of bioaccumulation is very important in protecting human beings and other organisms from the adverse effects of chemical exposure, and it has become a critical consideration in the regulation of chemicals.

Bioremediation: It is a clean-up technology that uses naturally occurring microorganisms to degrade hazardous substances into less toxic or nontoxic compounds. The microorganisms may:

1. Ingest and degrade organic substances as their food and energy source,
2. Degrade organic substances, such as chlorinated solvents or petroleum products, that are hazardous to living organisms, including humans, and degrade the organic contaminants into inert products.

As the microorganisms occur naturally in the environment they are likely to pose little risks of contamination.

Bio-Transformation: This is a process of Biological changes of complex compounds to simpler one or toxic to non-toxic and vice-versa. Several microorganisms are capable of transforming a varity of compounds found in nature but generally in case of synthetic compounds they are unable to show any appropriate action. Biotransfer appears to be one of the major detoxication methods known so far.

Biomarker: It is a biological response to a chemical that gives a measurement of exposure and, sometimes, of toxic effect. It can be defined as any kind of molecule which indicate the existence (past or present) of living organisms. In particular, in the fields of geology and astrobiology biomarkers are also known as biosignatures. However, in environmental science a bio-markers can also be used to indicate exposure to various environmental substances in epidemiology and toxicology.

Biofertilizer: To reduce the impact of excess chemical fertilizers in the field of agriculture the biofertilizer is being considered as a potential tool; biologically fixed nitrogen is such a source which can supply an adequate amount of Nitrogen to plants and other nutrients to some extent. Many free living and symbiotic bacteria, which fix

atmospheric Nitrogen are used as biofertiliser material as a substitute for Nitrogen fertilizer. In general two types of biofertiliser are used

1. Bacterial Biofertilizer
2. Algal Biofertilizer

Biocomposting: It involves combining organic materials under conditions that enables them to decompose more quickly than they would in nature. Think about logs and leaves on the ground in a forest. The leaves will break down and disappear within a year. Logs of course will take much longer to crumble away. Composting is the process of converting all biodegradable wastes into organic manure. In composting process certain input should be made into waste to convert the process in a short time.

Biopesticide: Pest control by biological antagonism appears to be very useful tool in recent years. Bacterial pesticides are being developed. *Heliothis* complex, which lives in close association with plant roots, consists of two major crop pests budworm and ball warm. Biological insecticides against both these insects are being prepared by transfer of a gene from *Bacillus thuringiensis*

.**Biodegradation**: It is nature's way of recycling wastes, breaking down organic matter into nutrients that can be used by other organisms. "Degradation" means decay, and the "bio-" prefix means that the decay is carried out by a huge assortment of bacteria, fungi, maggots, worms, and other organisms that eat dead material and recycle it into new forms.

In the nature, nothing is known as waste, because everything gets recycled. The waste products from one organism become the food for others, providing nutrients and energy while breaking down the waste organic matter. Some organic materials may break down much faster than others, but all will eventually decay.

By harnessing these natural forces of biodegradation, people can reduce wastes and clean up some types of environmental contaminants. Through **composting**, we accelerate natural biodegradation and convert organic wastes to a valuable resource.

Biosensor: Biosensor represents biophysical devices, which can detect the presence and measure the quantities of specific substances in a varity of environments. These specific substances may include sugars, proteins, or humas and varity of toxins in the industrial effluents. In designing a biosensor an enzyme or an antibody or even microbial cells are associated with microchip devices, which are used for quantitative estimate of a substance.

Bioengineering: It is a developing speciality featuring a multidisciplinary approach to the solution of problems in medicine and biology, based on the application of advances in science, engineering and technology. It generally engineers the biological processes through biotechnological or genetic engineering

interventions. It may also be a broad-based engineering discipline that involve product design, sustainability and analysis of biological systems.

Pollen-Biotechnology: This is a new field of science dealing with the pollen chemistry and allerginicity of aerospora. This subject also covers genetic manipulation of pollen development of haploid culture. Such haploid plants have immense values in genetic research.

Biotechnology Policy Issue: Biotechnology appears to be an emerging science in present decades. Genetic manipulation and development of genetically modified organism in human welfare is now showed a potential prospect and risk. Thus, researches and application of Biotechnology in diverse field is a major policy issue in the present decades.

Agricultural Biotechnology: Over the years, tremendous success has been made in diverse field of agriculture by applying Biotechnology. It includes development of genetically modified crops, genetic improvement in sericulture practices, improvement in Biofertilizer development and similar other aspects. Production of pest and disease resistant crop is also being considered to be an emerging area of Agricultural Biotechnology.

Bioenergy: In recent decades, efforts have been made for evolving were non-polluting bioenergy sources or energy generation from organic wastes and biomass. These are all ecofreindly solutions. Biomass energy supply-demand balances have become a component of energy sector analysis and planning and is propelled huge importance in the countries. Biomass, Biogas, Hydrogen are the example of Bioenergy.

ABBREVIATIONS USED IN ADDRESSES AND CITED JOURNALS

Acad	Academy	Chem	Chemistry
Adm	Administration	Cheml	Chemical
Admn	Administrative	Clinl	Clinical
Adv	Advance	Co	Company
Agri	Agriculture	Coll	College
Agricl	Agricultural	Comm	Committee
Amer	American	Commn	Commission
An	Annual	Comp	Comparative
Analyt	Analytical	Conf	Conference
Anat	Anatomy	Conv	Convention
Anim	Animal	Conserv	Conservation
Ann	Annals	Contl	Control
Appl	Applied	Contam	Contamination
Arch	Archives	Corpn	Corporation
Archaeo	Archaeology	Coun	Council
Archaeol	Archaeological	Cult	Culture
Architect	Architecture	Cultl	Cultural
Assoc	Association	Curr	Current
Asst	Assistant	Dept	Department
Atom	Atomic	Dev	Development
Bacterio	Bacteriology	Develop	Developmental
Bacteriol	Bacteriological	Dig	Digest
Bd	Board	Div	Division
Bio	Biology	Divl	Divisional
Biochem	Biochemistry	Dte	Directorate
Biocheml	Biochemical	Dy	Deputy
Bioengg	Bioengineering	Eco	Ecology
Biol	Biological	Ecol	Ecological
Biometeo	Biometeorology	Econ	Economics
Biophys	Biophysics	Ecosys	Ecosystem
Biometeol	Biometeorological	Ecotoxico	Ecotoxicology
Biotech	Biotechnique(s)	Endocrinol	Endocrinological
Biotechno	Biotechnology	Engg	Engineering
Biotechnol	Bitechnological	Engrs	Engineers
Bldg	Building	Env	Environment
Bot	Botany	Environ	Environmental
Botl	Botanical	Epidemic	Epidemiology
Br	Branch	Epidemiol	Epidemiological
Bull	Bulletin	Estd	Establishment
Cent	Centre	Ethnopharmaco	Ethnopharmacology
Centl	Central	Expt	Experiment

Exptl	Experimental	Microbiol	Microbiological
Fac	Faculty	Min	Ministry
Fd	Food	Monit	Monitoring
Fedn	Federation	Myco	Mycology
Fert	Fertiliser	Mycol	Mycological
Fmg	Farming	Nat	Natural
Gaz	Gazette	Natl	National
Genet	Genetics	N-E	North Eastern
Geo	Geology	Nut	Nutrition
Geogr	Geography	No	Number
Geogrl	Geographical	Occ	Occassional
Geol	Geological	Occupl	Occupational
Geosci	Geoscience	Oceanogr	Oceanogoraphy
Govt	Government	Org	Original
Hist	History	Orgc	Organic
Hlth	Health	Orgn	Organisation
Hort	Horticulture	Pharmaco	Pharmacology
Hosp	Hospital	Pharmacol	Pharmacological
Hydro	Hydrology	Phyl	Physical
Hydrol	Hydrological	Patho	Pathology
Immuno	Immunology	Pathol	Pathological
Immunol	Immunlogical	Petrochem	Petrochemical
Ind	Industry	Petro	Petrology
Inf	Information	PG	Post Graduate
Inst	Institute	Phys	Physics
Instn	Institution	Physio	Physiology
Int	International	Phytopath	Phytopathology
Irrig	Irrigation	Phytopathol	Phytopathological
J	Journal	Plang	Planning
Lab	Laboratory	Polln	Pollution
Lett	Letter(s)	Proc	Proceedings
Ltd	Limited	Prot	Protection
Malario	Malariology	Pub	Publication
Malariol	Malariological	Pvt	Private
Manag	Management	Qlty	Quality
Med	Medicine	Qr	Quarter
Medl	Medical	Rad	Radiation
Metab	Metabolism	Radio	Radiology
Metall	Metallurgy	Radiol	Radiological
Metallurg	Metallurgical	Rd	Road
Meteo	Meteorology	Recd	Received
Meteol	Meteorological	Reg	Region
Microbio	Microbiology	Regl	Regional

Rep	Report	Surv	Survey
Reptr	Reporter	Syst	System
Res	Research	Tax	Taxonomy
Rev	Review	Techl	Technical
Sch	School(s)	Techno	Technology
Sci	Sciences(s)	Technol	Technological
Scient	Scientific	Toxico	Toxicology
S-E	South East	Toxicol	Toxicological
Sec	Section	Transc	Transcations
Sect	Sector	Transpt	Transportation
Semin	Seminar	Trng	Training
Ser	Services	Trop	Tropical
Soc	Society	Univ	University
Socl	Social	Util	Utilisation
Stat	Statistics	Vet	Veterinary
Statl	Statistical	Zoo	Zoology
Stnd	Standard(s)	Zool	Zoological
Stud	Study/ (eis)		

Bioaccumulation

E. Romera[a], F. González [a], A. Ballester[a], M.L. Blázquez[a] and J.A. Muñoz[a]. ([a]Dpto. Ciencia de los Materiales e Ingeniería Metalúrgica, Facultad de C. Químicas, Universidad Complutense, Ciudad Universitaria, 28040 Madrid, Spain). Biosorption of heavy metals by *Fucus spiralis* . Bioresource Technology, Volume 99(11) (2008): 4684-4693

The sorption uptake of cadmium, nickel, zinc, copper and lead by marine brown alga *Fucus spiralis* was investigated in bimetallic, trimetallic and multimetallic solutions. The experimental data fitted very well to Langmuir model. In bimetallic systems, the affinity of biomass for lead and copper increased and the sorption uptake of these metals was not affected by increasing concentrations of cadmium, nickel or zinc. However, in solutions with both metals there was a significant mutual decrease of their sorption levels at high concentrations of the other metal. The sorption uptake of cadmium, nickel and copper was investigated in trimetallic aqueous systems. Based on the kinetic parameter *b*, the affinity of *F. spiralis* for copper was considerably higher than for cadmium or nickel: $b_{Cd} = 6.39$, $b_{Ni} = 1.82$ and $b_{Cu} = 17.89$. In all tests, the maximum sorption uptake remained practically constant around 1 mmol/g, indicating that the number of active sites on the biomass was limited. Tests with four and five metals showed that copper was preferentially adsorbed. The differences between the experimental sorption data and those given by the chemical speciation program PHREEQCI were negligible. In general, the software used provided satisfactory estimated data for each metal and hence can be a useful tool to predict or simulate the real process.

Keywords: Biosorption; Heavy metals; *Fucus spiralis*; Langmuir;

B.C. Qi[a] and C. Aldrich[a]. ([a]Department of Chemical Engineering, University of Stellenbosch, Stellenbosch, Private Bag X1, Matieland 7602, South Africa). Biosorption of heavy metals from aqueous solutions with tobacco dust. Bioresource Technology, Volume 99(13) (2008): 5595-5601

A typical lignocellulosic agricultural residue, namely tobacco dust, was investigated for its heavy metal binding efficiency. The tobacco dust exhibited a strong capacity for heavy metals, such as Pb(II), Cu(II), Cd(II), Zn(II) and Ni(II), with respective equilibrium loadings of 39.6, 36.0, 29.6, 25.1 and 24.5 mg of metal per g of sorbent. Moreover, the heavy metals loaded onto the biosorbent could be released easily with a dilute HCl solution. Zeta potential and surface acidity measurements showed that the tobacco dust was negatively charged over a wide pH range (pH > 2), with a strong surface acidity and a high OH^- adsorption capacity. Changes in the surface morphology of the tobacco dust as visualized by atomic force microscopy suggested that the sorption of heavy metal ions on the tobacco could be associated with changes in the surface properties of the dust particles. These surface changes appeared to have resulted from a loss of some of the structures on the surface of the particles, owing to leaching in the acid metal ion solution. However, Fourier transform infrared spectroscopy (FTIR) showed no substantial change in the chemical structure of the tobacco dust subjected to biosorption. The heavy metal uptake by the tobacco dust may be interpreted as metal–H ion exchange or metal ion surface complexation adsorption or both.

Keywords: Biosorption; Heavy metals; Lignocellulose; Tobacco

Bao-E. Wang[a, b] and Yong-You Hu[a]. ([a]School of Environmental Science and Engineering, South China University of Technology, Guangzhou 510640, China, [b]Department of Environmental Science and Engineering, Zhongkai University of Agriculture and Technology, Guangzhou 510225, China). Bioaccumulation versus adsorption of reactive dye by immobilized growing *Aspergillus fumigatus* beads. Journal of Hazardous Materials, Volume 157(1) (2008): Pages 1-7

The removal of reactive brilliant blue KN-R using growing *Aspergillus fumigatus* (abbr. *A. fumigatus*) immobilized on carboxymethylcellulose (CMC) beads with respect to initial dye concentration was investigated. Bioaccumulation was the dominant mechanism of the dye removal. According to the UV–vis spectra and the results of three sets of experiments, it could be concluded that the bioaccumulation using immobilized growing *A. fumigatus* beads was achieved by metabolism-dependent accumulation and metabolism-independent adsorption (15–23% proportion of overall dye removal), which included biosorption by mycelia entrapped in them and adsorption on immobilization matrix. The transmission electron microscope (TEM) images showed the intracellular structures of mycelia and the toxicity of dye. It was found that the fungus had a considerable tolerance to reactive brilliant blue KN-R at initial dye concentrations of <114.7 mg/l. Though at high initial dye concentrations the growth of mycelia was inhibited significantly by the dye molecules in the growth medium, the bioaccumulation capacity was not markedly affected and the maximum bioaccumulation capacity was 190.5 ± 2.0 mg/g at an initial dye concentration of 374.4 mg/l. The bioaccumulation rates were not constant over the contact time.

Keywords: *Aspergillus fumigatus*; Bioaccumulation; Biosorption; Immobilization

S.D.W. Comber[a], K.L. Rule[b], A.U. Conrad[c], S. Höss[d], S.F. Webb[e] and S. Marshall[f]. ([a]Atkins Ltd, Chilbrook, Oasis Business Park, Eynsham, Oxford, OX29 4AH, UK, [b]Centre for Environmental Sciences, University of Southampton, Southampton SO17 1BJ, UK, [c]Scottish Environmental Protection Agency, SEPA Corporate Office, Erskine Court Castle Business Park, Stirling FK9 4TR, UK, [d]ECOSSA, Thierschstrasser 43, 80538 München, Germany, [e]Procter & Gamble, Temselaan 100, Strombeek-Bever B1853, Belgium, [f]Unilever Colworth, Sharnbrook, Bedford MK44 1LQ, UK). Bioaccumulation and toxicity of a cationic surfactant (DODMAC) in sediment dwelling freshwater invertebrates. Environmental Pollution, Volume 153(1) (2008): 184-191

Dimethyldioctadecylammonium chloride (DODMAC, CAS No. 107-64-2) is the principal active component of Di(hydrogenated tallow alkyl) dimethylammonium chloride (DHTDMAC, CAS No. 61789-80-8), a cationic surfactant formerly used principally in laundry fabric softeners. After discharge to water, DODMAC partitions strongly to sediment, therefore the assessment of the effects of DODMAC to benthic organisms is essential in any risk assessment. Chronic toxicity studies were conducted with *Lumbriculus variegatus* (Oligochaete), *Tubifex tubifex* (Oligochaete) and *Caenorhabditis elegans* (Nematode). NOECs were greater than 5738, 1515 and 1351 mg/kg dw, respectively, even for sub-lethal effects. Measurement of the route of uptake of DODMAC by *L. variegatus* demonstrated the relative importance of uptake via ingestion (86%) compared with direct contact with the sediment and via pore water (14%). The overall tendency of DODMAC to bioaccumulate, however, was low with measured accumulation factors of 0.22 and 0.78 for *L. variegatus* and *T. tubifex*, respectively.

The cationic surfactant, DODMAC, exhibits low bioavailability and toxicity to sediment dwelling organisms, with uptake dominated by ingestion.

Keywords: Cationic; Surfactant; DODMAC; Freshwater; Benthic; Toxicity

G.J. Pierce[a, b], M.B. Santos[a, b], S. Murphy[c, d], J.A. Learmonth[a], A.F. Zuur[e], E. Rogan[c], P. Bustamante[f], F. Caurant[f], V. Lahaye[a, f], V. Ridoux[f], B.N. Zegers[g], A. Mets[g], M. Addink[h], C. Smeenk[h], T. Jauniaux[i], R.J. Law[j], W. Dabin[k], A. López[l], J.M. Alonso Farré[l], A.F. González[m], A. Guerra[m], M. García-Hartmann[g, n], R.J. Reid[o], C.F. Moffat[p], C. Lockyer[q] and J.P. Boon[g]. ([a]School of Biological Sciences, University of Aberdeen, Tillydrone Avenue, Aberdeen AB24 2TZ, UK, [b]Instituto Español de Oceanografía, Centro Oceanográfico de Vigo, P.O. Box 1552, 36200, Vigo, Spain, [c]AFDC, Department of Zoology, Ecology and Plant Science, University College, National University of Ireland, Enterprise Centre, North Mall, Cork, Ireland, [d]Sea Mammal Research Unit, Gatty Marine Laboratory, University of St. Andrews, St. Andrews, Fife KY16 8LB, UK, [e]Highland Statistics, 6 Laverock Road, Newburgh, Aberdeenshire AB41 6FN, UK, [f]Centre de Recherche sur les Ecosystèmes Littoraux Anthropisés, UMR 6217 CNRS-IFREMER-Université de la Rochelle, 22 avenue Michel Crépeau, 17042 La Rochelle, France, [g]Royal Netherlands Institute for Sea Research (NIOZ), P.O. Box 59, 1790 AB Den Burg, Texel, The Netherlands, [h]National Museum of Natural History, P.O. Box 9517, 2300 RA Leiden, The Netherlands, [i]Department of Pathology, University of Liege, Liege, Belgium, [j]Cefas, Remembrance Avenue, Burnham-on-Crouch, Essex CM0 8HA, UK, [k]Centre de Recherche sur les Mammifères Marins, Port des Minimes, Avenue Lazaret, 17000 La Rochelle, France, [l]CEMMA, Apdo. 15, 36380 Gondomar, Pontevedra, Spain, [m]Instituto de Investigaciones Marinas (C.S.I.C), Eduardo Cabello 6, 36208 Vigo, Spain, [n]Elephant house, Muelheimer Str. 273, 47058 Duisburg, Germany [o]SAC Veterinary Science Division, Drummondhill, Stratherrick Road, Inverness IV2 4JZ, UK, [p]FRS Marine Laboratory, 375 Victoria Road, Aberdeen AB11 9DB, UK, [q]Age Dynamics, c/o Heggåsvegen 7, N-9020 Tromsdalen, Norway). **Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. Environmental Pollution, Volume 153(2) (2008): 401-415**

Concentrations of polychlorinated biphenyls (PCBs) in blubber of female common dolphins and harbour porpoises from the Atlantic coast of Europe were frequently above the threshold at which effects on reproduction could be expected, in 40% and 47% of cases respectively. This rose to 74% for porpoises from the southern North Sea. PCB concentrations were also high in southern North Sea fish. The average pregnancy rate recorded in porpoises (42%) in the study area was lower than in the western Atlantic but that in common dolphins (25%) was similar to that of the western Atlantic population. Porpoises that died from disease or parasitic infection had higher concentrations of persistent organic pollutants (POPs) than animals dying from other causes. Few of the common dolphins sampled had died from disease or parasitic infection. POP profiles in common dolphin blubber were related to individual feeding history while those in porpoises were more strongly related to condition.

High PCB levels were recorded in porpoises and common dolphins from European coasts.

Keywords: *Phocoena phocoena*; *Delphinus delphis*; Persistent organic pollutants; Reproduction; Diet

C.A. Oliveira Ribeiro[a], Y. Vollaire[b], E. Coulet[c] and H. Roche[b]. ([a]Universidade Federal do Paraná, Departamento de Biologia Celular, Caixa Postal 19031, CEP: 81.531-990 Curitiba, PR, Brazil, [b]UMR8079 CNRS-Université Paris-Sud XI, Ecologie Systématique et Evolution, Bât 362, F91405 Orsay Cedex, France, [c]Réserve Nationale de Camargue, La Capelière, F13200 Arles, France). Bioaccumulation of polychlorinated biphenyls in the eel (*Anguilla anguilla*) at the Camargue Nature Reserve – France. **Environmental Pollution, Volume 153(2) (2008): 424-431**

Fish consumption is a potential source of human exposure to pollutants. Here, we study residue levels of PCBs in the eel, *Anguilla anguilla*, from the Nature Camargue Reserve in southern France. Chromatographic analysis (GC-ECD) found seventy identifiable congeners, among which, 10 are considered as dioxin-like PCBs, such as the non-ortho PCB 81 and the mono-ortho chlorobiphenyls PCB105, 114, 118, 123, 156, 157, 167, 170, 180. Toxic Equivalents (TEQ, WHO 2005 TEF-Toxic Equivalent Factors) varied among sites with a maximum in eels from Mornès (29.6 pg g^{-1} dry weight). Indicator PCBs (28, 52, 101, 118, 138, 153 and 180) were 22% and 29% of the total PCBs in livers and muscles respectively. Greater homogeneous bioaccumulation in muscle than that in liver suggests an increase risk for humans due to fish consumption.

The reserve of Camargue – South of France is impacted by a myriad of pollutant organic persistent like PCBs.

Keywords: PCBs; Bioaccumulation; *Anguilla anguilla*; Camargue Reserve; Risk assessments

Kerstin Hund-Rinke [a] and Markus Simon[a]. ([a]Fraunhofer Institute for Molecular Biology and Applied Ecology, Auf dem Aberg 1, 57392 Schmallenberg, Germany). **Bioavailability assessment of contaminants in soils via respiration and nitrification tests. Environmental Pollution, Volume 153(2) (2008): 468-475**

For the assessment of contaminated soils ecotoxicological tests are used to estimate the bioavailability of contaminants in soil samples. Terrestrial tests reveal the habitat function of soils, and parameters applied in tests involving microorganisms include respiration activity and potential ammonium oxidation. For such tests, the threshold values needed to assess the results have already been established in guidelines ISO 17155 and ISO 15685. In this paper, we discuss about the respiration activity and potential ammonium oxidation results obtained from a wide variety of soils with different physico-chemical properties and levels of contamination. These results show that microbial respiration and potential ammonium oxidation have different sensitivities to various classes of contaminants. We demonstrated that both organic and inorganic contaminants influence potential ammonium oxidation, whereas microbial respiration is predominantly affected by biodegradable organic contaminants. These differences might be useful for more detailed assessments of soil contamination, leading to different recommended actions depending on which parameter is affected.

The paper provides a further criterion for a more detailed assessment of soil contamination, leading to different recommended actions depending on which parameter is affected.

Keywords: Soil assessment; Ecotoxicological tests; Microorganisms; Respiration activity; Nitrification

Thierry Lebeau [a], Armelle Braud[a] and Karine Jézéquel[a]. ([a]Equipe Dépollution Biologique des Sols (EDBS), University of Haute-Alsace, 28, rue de Herrlisheim, BP 50 568, 68 008 Colmar Cedex, France). **Performance of bioaugmentation-assisted phytoextraction applied to metal contaminated soils: A review. Environmental Pollution, Volume 153(3) (2008) : 497-522**

Bioaugmentation-assisted phytoextraction is a promising method for the cleaning-up of soils contaminated by metals. Bacteria mainly Plant Growth Promoting Rhizobacteria (PGPR) and fungi mainly Arbuscular Mycorrhizal Fungi (AMF) associated with hyperaccumulating or non-hyperaccumulating plants were analyzed on the basis of a bioprocess engineering approach (concentration and amount of metals extracted by plants, translocation and bioconcentration factor, and plant biomass). In average bioaugmentation increased metals accumulated by shoots by a factor of about 2 (metal concentration) and 5 (amount) without any obvious differences between bacteria and fungi. To optimize this process, new relevant microorganism–plant associations and field scale experiments are needed along with a common methodology for the comparison of all experiments on the same basis. Recommendations were suggested concerning both the microbial-plant selection and the implementation of bioaugmentation to enhance the microbial survival. The use of microbial consortia associated with plant was discussed notably for multi-contaminated soils.

Bioaugmentation-assisted plant improves the phytoextraction performances for soils contaminated by metals.

Keywords: Bioaugmentation; Bioprocess engineering; Bioremediation; Metals; Phytoremediation; Rhizosphere engineering

Maria I.S. Gonzaga[a], Jorge A.G. Santos[a] and Lena Q. Ma[b]. ([a]Department of Soil Chemistry, Universidade Federal da Bahia, Cruz das Almas, 44380000, Brazil [b]Soil and Water Science Department, University of Florida, 2169 McCarty Hall, Gainesville, FL 32611-0290, USA). Phytoextraction by arsenic hyperaccumulator *Pteris vittata* L. from six arsenic-contaminated soils: Repeated harvests and arsenic redistribution. Environmental Pollution, Volume 154(2) (2008): 212-218

This greenhouse experiment evaluated arsenic removal by *Pteris vittata* and its effects on arsenic redistribution in soils. *P. vittata* grew in six arsenic-contaminated soils and its fronds were harvested and analyzed for arsenic in October, 2003, April, 2004, and October, 2004. The soil arsenic was separated into five fractions via sequential extraction. The ferns grew well and took up arsenic from all soils. Fern biomass ranged from 24.8 to 33.5 g plant^{-1} after 4 months of growth but was reduced in the subsequent harvests. The frond arsenic concentrations ranged from 66 to 6,151 mg kg^{-1}, 110 to 3,056 mg kg^{-1}, and 162 to 2,139 mg kg^{-1} from the first, second and third harvest, respectively. *P. vittata* reduced soil arsenic by 6.4–13% after three harvests. Arsenic in the soils was primarily associated with amorphous hydrous oxides (40–59%), which contributed the most to arsenic taken up by *P. vittata* (45–72%). It is possible to use *P. vittata* to remediate arsenic-contaminated soils by repeatedly harvesting its fronds.

Pteris vittata was effective in continuously removing arsenic from contaminated soils after three repeated harvests.

Keywords: Continuous phytoextraction; Plant arsenic uptake; Arsenic fractionation

Ying Yin [1 *], Xiaorong Wang [1], Yuanyuan Sun [2], Hongyan Guo [1], Daqiang Yin [1]. ([1]State Key Laboratory of Pollution Control and Resources Reuse, School of Environment, Nanjing University, Nanjing 210093, China, [2]Department of Hydrosciences, Nanjing University, Nanjing 210093, China. [*]Correspondence to Ying Yin, State Key Laboratory of Pollution Control and Resources Reuse, School of Environment, Nanjing University, Nanjing 210093, China. email: Ying Yin: ekxr@nju.edu.cn). **Bioaccumulation and oxidative stress in submerged macrophyte *Ceratophyllum demersum* L. upon exposure to pyrene. Environmental Toxicology, Volume 23(3) (2008): 328 - 336**

Laboratory experiments were carried out to investigate pyrene bioaccumulation and its consequent biological responses in submerged macrophyte *Ceratophyllum demersum*. Plants were exposed to different levels (0.01, 0.02, 0.05, 0.07, 0.1 mg/L) of pyrene for 10 days, and the pyrene content, and total free radicals in plant were analyzed. The pyrene concentration in plant was highly correlated to exposure concentration (R^2 = 0.990). Electron paramagnetic resonance (EPR) analysis revealed that pyrene exposure significantly increased total free radicals in the plants. A strong positive correlation (R^2 = 0.956) between $O_2^{\cdot-}$ generation and pyrene contents implied that pyrene exposure induced reactive oxygen species (ROS) and led to oxidative stress in *C. demersum*. The activities of antioxidant enzymes and the contents of glutathione were determined. Change in the contents of malondialdehyde (MDA) was also studied. Results indicated that the bioaccumulation of pyrene resulted in the changes of the antioxidant defense system and the production of ROS with the oxidative stress, ultimately induced damnification in *C. demersum*.

Keywords: pyrene • bioaccumulation • *Ceratophyllum demersum* • electron paramagnetic resonance • free radical • oxidative stress

Ilemobayo Oguntimehin[a], Nobutake Nakatani[a] and Hiroshi Sakugawa [a] ([a]Department of Environmental Dynamics and Management, Graduate School of Biosphere Science, Hiroshima University, 1-7-1 Kagamiyama, Higashi, Hiroshima 739-8521, Japan). **Phytotoxicities of fluoranthene and phenanthrene deposited on needle surfaces of the evergreen conifer, Japanese red pine (*Pinus densiflora* Sieb. et Zucc.). Environmental Pollution, Volume 154(2) (2008): 264-271**

Polycyclic aromatic hydrocarbons (PAHs) have been widely studied with respect to their carcinogenic and mutagenic effects on animals and human cells. Phenanthrene (PHE) and fluoranthene (FLU) effects on the needle photosynthetic traits of 2-year-old Japanese red pine (*Pinus densiflora* Sieb. et. Zucc.) seedlings were investigated. Three months after fumigation of foliage with solutions containing these PAHs (10 μM each), FLU had negative effects on net photosynthesis at near-saturating irradiance, stomatal conductance, initial chlorophyll fluorescence, and the contents of total chlorophyll, magnesium, and ribulose 1,5-bisphosphate carboxylase (rubisco) of current-year needles. PHE had similar negative effects to FLU but in lesser magnitude. The effects of the PAHs were mitigated by the addition of an OH-radical scavenger (mannitol) into the PAH solutions. PAHs deposited on the surface of pine needles

may induce the generation of reactive oxygen species in the photosynthetic apparatus, a manner closely resembling the action of the herbicide paraquat.

Fluoranthene and phenanthrene caused negative effects on the needles of Japanese red pine.

Keywords: PAH fumigation; Fluoranthene; Phenanthrene; Mannitol; Pine needles

Bioremediation

Xuewei Hu[a], Aimin Li [a], Jun Fan[a], Conglin Deng[a] and Quanxing Zhang[a]. ([a]State Key Laboratory of Pollution Control and Resources Reuse, School of the Environment, Nanjing University, Nanjing 210093, PR China). Biotreatment of *p*-nitrophenol and nitrobenzene in mixed wastewater through selective bioaugmentation. Bioresource Technology, Volume 99, Issue 10, July 2008, Pages 4529-4533

This work combined selective adsorption and bioaugmentation to treat mixed wastewater of nitrobenzene and *p*-nitrophenol. The mixed wastewater of nitrobenzene (217 mg/L) and *p*-nitrophenol (500 mg/L) was adjusted its pH to 8 and then passed through the adsorption column at 100 mL/h. In effluent the nitrobenzene concentration was less than 4 mg/L. Without the toxic inhibition of nitrobenzene, *p*-nitrophenol in effluent could be degraded within 60 h through bioaugmentation. About 23 mg/g of nitrobenzene adsorbed the dry resin HU-05 could be desorbed and degraded through bioaugmentation. During this process the adsorption capacity of the resin HU-05 was recovered partly. The recovered extent was limited by nitrobenzene bioavailability. The performance of the resin HU-05 kept stably in the recycle experiments of 60 days.

Keywords: Selective bioaugmentation; Competitive adsorption; Mixed wastewater; Nitrobenzene; *p*-Nitrophenol

Wen-Xin Gong[a], Shu-Guang Wang [a], Xue-Fei Sun[a], Xian-Wei Liu[a], Qin-Yan Yue[a] and Bao-Yu Gao[a]. ([a]School of Environmental Science and Engineering, Shandong University, Jinan, 250100, China). Bioflocculant production by culture of *Serratia ficaria* and its application in wastewater treatment. Bioresource Technology, Volume 99(11) (2008): 4668-4674

A bioflocculant-producing bacterium was isolated from soil and identified as *Serratia ficaria*. Using optimized culture conditions a flocculating activity of 95.4% was obtained. It was found to be effective for flocculation of a kaolin suspension over weakly acidic pH (5–7); divalent cations (Ca^{2+} and Mg^{2+}) enhanced the flocculating activity, while the co-presence of Al^{3+} and Fe^{3+} resulted the negative effect. Measurements of zeta potential revealed that charge neutralization played an important role in the flocculation. It could flocculate a variety of real wastewaters, including river water, brewery wastewater, meat processing wastewater and soy sauce brewing wastewater. The bioflocculant was also used to treat pulp effluent, and the removal rate of color and chemical oxygen demand (COD) were up to 99.9% and 72.1%, respectively, which were better than traditional chemical flocculants.

Keywords: Bioflocculant; *Serratia ficaria*; Flocculation; Real wastewater

Md. Zahangir Alam[a], Suleyman A. Muyibi[a] and Rosmaziah Wahid[a]. ([a]Bioenvironmental Engineering Research Unit (BERU), Department of Biotechnology Engineering, Faculty of Engineering, International Islamic University Malaysia (IIUM), Gombak, 50728 Kuala Lumpur, Malaysia). Statistical optimization of process conditions for cellulase production by liquid state bioconversion of domestic wastewater sludge. Bioresource Technology, Volume 99(11) (2008): 4709-4716

A two-level fractional factorial design (FFD) was used to determine the effects of six factors, i.e. substrate (domestic wastewater sludge – DWS) and co-substrate concentration (wheat flour – WF), temperature, initial pH, inoculum size and agitation rate on the production of cellulase enzyme by *Trichoderma harzianum* in liquid state bioconversion. On statistical analysis of the results from the experimental studies, optimum process conditions were found to be temperature 32.5 °C, substrate concentration (DWS) 0.75% (w/w), co-substrate (WF) concentration 2% (w/w), initial pH 5, inoculum size 2% (v/w) and agitation 175 rpm. Analysis of variance (ANOVA) showed a high coefficient of determination (R^2) of 0.975. Cellulase activity reached 10.2 FPU/ml at day 3 during the fermentation process which indicated about 1.5-fold increase in production compared to the cellulase activity obtained from the results of design of experiment (6.9 FPU/ml). Biodegradation of DWS was also evaluated to verify the efficiency of the bioconversion process as a waste management method.

Keywords: Cellulase enzyme; Domestic wastewater sludge; Liquid state bioconversion; Optimization; *Trichoderma harzianum*

Asha A. Juwarkar[a] and Hemlata P. Jambhulkar[a]. ([a]Environmental Biotechnology Division, National Environmental Engineering Research Institute (NEERI), Nehru Marg, Nagpur 440 020, India). Phytoremediation of coal mine spoil dump through integrated biotechnological approach. Bioresource Technology, Volume 99(11) (2008): 4732-4741

Field experiment was conducted on mine spoil dump on an area of 10 ha, to restore the fertility and productivity of the coal mine spoil dump using integrated biotechnological approach. The approach involves use of effluent treatment plant sludge (ETP sludge), as an organic amendment, biofertilizers and mycorrihzal fungi along with suitable plant species. The results of the study indicated that amendment with effluent treatment plant sludge (ETP sludge), @ 50 ton/ha improved the physico-chemical properties of coal mine spoil. Due to biofertilizer inoculation different microbial groups such as *Rhizobium*, *Azotobacter* and *VAM* spores, which were practically absent in mine spoil improved greatly. Inoculation of biofertilizer and application of ETP sludge helped in reducing the toxicity of heavy metals such as chromium, zinc, copper, iron, manganese lead, nickel and cadmium, which were significantly reduced to 41%, 43%, 37%, 37%, 34%, 39%, 37% and 40%, respectively, due to the increased organic matter content in the ETP sludge and its alkaline pH (8.10–8.28), at which the metals gets immobilized and translocation of metals is arrested. Thus, amendment and biofertilizer application provided better supportive material for anchorage and growth of the plant on coal mine spoil dump.

Keywords: Effluent treatment plant sludge (ETP); Vesicular arbuscular mycorrhizae (VAM); Biofertilizer; *Rhizobium* and *Azotobacter*; Integrated biotechnological approach

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Maeztu #9, 28040 Madrid, Spain). Bioremediation of lignosulphonates by lignin-degrading basidiomycetous fungi. Bioresource Technology, Volume 99(11) (2008): 4929-4934

The capability of some ligninolytic fungi to degrade lignosulphonates has been studied. Three lignosulphonates concentrations, three culture media and seven different basidiomycetes in solid-cultures have been assayed to select the conditions for further experiments on submerged cultures. The best results of growth and lignosulphonate decolourization in solid-cultures were obtained with *Pycnoporus sanguineus*, *Coriolus pubescens* and *Trametes* sp. I-62 on Kirk's medium and 1% and 2% of lignosulphonate concentrations. In submerged cultures the lignosulphonate decolourization rate was generally higher when it was added on the 6th day, rather than when it was added from the beginning of the incubation and *C. pubescens* and *P. sanguineus* showed again the optimum results of decolourization. Extracellular laccase activity increased with lignosulphonate concentration in all assayed fungi, suggesting that lignosulphonate act as inductors of laccase activity.

Keywords: Pulp industry; Acid bisulphite cooking; Lignosulphonates; White-rot fungi; Laccase

Mehrdad Farhadian[a, b], Cédric Vachelard[a, c], David Duchez[a] and Christian Larroche[a]. ([a]LGCB, Polytech'Clermont-Ferrand, Université Blaise Pascal, Clermont-Ferrand, France, [b]Isfahan High Education and Research Institute, Isfahan, Iran, [c]Biobasic Environnement, Clermont-Ferrand, France). In situ bioremediation of monoaromatic pollutants in groundwater: A review. Bioresource Technology, Volume 99(13) (2008) : 5296-5308

Monoaromatic pollutants such as benzene, toluene, ethylbenzene and mixture of xylenes are now considered as widespread contaminants of groundwater. In situ bioremediation under natural attenuation or enhanced remediation has been successfully used for removal of organic pollutants, including monoaromatic compounds, from groundwater. Results published indicate that in some sites, intrinsic bioremediation can reduce the monoaromatic compounds content of contaminated water to reach standard levels of potable water. However, engineering bioremediation is faster and more efficient. Also, studies have shown that enhanced anaerobic bioremediation can be applied for many BTEX contaminated groundwaters, as it is simple, applicable and economical.

This paper reviews microbiology and metabolism of monoaromatic biodegradation and in situ bioremediation for BTEX removal from groundwater under aerobic and anaerobic conditions. It also discusses the factors affecting and limiting bioremediation processes and interactions between monoaromatic pollutants and other compounds during the remediation processes.

Keywords: Bioremediation; In situ; Groundwater; Monoaromatic; Biodegradation

Suneerat Raungsomboon[a], Amnat Chidthaisong[a], Boosya Bunnag[b], Duangrat Inthorn[c] and Narumon W. Harvey[a]. ([a]Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, [b]School of Bioresources and Technology, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, [c]Department of Environmental Health Sciences, Mahidol University, Bangkok, Thailand). Removal of lead (Pb^{2+}) by the Cyanobacterium *Gloeocapsa* sp. Bioresource Technology, Volume 99(13) (2008): 5650-5658

Pb^{2+} removal ability of the viable-freshwater cyanobacterium *Gloeocapsa* sp. was studied in batch experiments. *Gloeocapsa* sp. was cultured in the Medium 18 with pH adjusted to 3, 4, 5, 6 and 7. Growth was subsequently determined based on the increase of chlorophyll-a content. *Gloeocapsa* sp. was able to grow at all pH levels tested, except at pH 3. Removal of Pb^{2+} was then further studied under pH 4. The results showed that Pb^{2+} concentration in the range of 0–20 mg L^{-1} was not inhibitory to *Gloeocapsa* sp. growth but reduced its Pb^{2+} removal efficiency (by 4.5% when Pb^{2+} concentration increased from 2.5 to 20 mg L^{-1}). Pb^{2+} removal characteristics followed the Langmuir adsorption isotherm with the maximum removal capacity (q_{max}) of 232.56 mg g^{-1}. Adsorption of Pb^{2+} by this cyanobacterium followed the second order rate reaction and intraparticle diffusion was likely the rate-determining step. The initial rate of Pb^{2+}adsorption during intraparticle diffusion was slower under light than under dark conditions, indicating that light probably slowed down the initial rate of intraparticle diffusion through the repulsion effects on cell membrane.

Keywords: Lead (Pb^{2+}); *Gloeocapsa* sp.; Cyanobacteria; Biosorption; Viable cells

Vítor J.P. Vilar[a], Cidália M.S. Botelho[a], José M. Loureiro[a] and Rui A.R. Boaventura [a]. ([a]LSRE-Laboratory of Separation and Reaction Engineering, Departamento de Engenharia Química, Faculdade de Engenharia da Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal). Biosorption of copper by marine algae *Gelidium* and algal composite material in a packed bed column. Bioresource Technology, Volume 99(13) (2008): 5830-5838

Marine algae *Gelidium* and algal composite material were investigated for the continuous removal of Cu(II) from aqueous solution in a packed bed column. The biosorption behaviour was studied during one sorption–desorption cycle of Cu(II) in the flow through column fed with 50 and 25 mg l^{-1} of Cu(II) in aqueous solution, at pH 5.3, leading to a maximum uptake capacity of ≈13 and 3 mg g^{-1}, respectively, for algae *Gelidium* and composite material. The breakthrough time decreases as the inlet copper concentration increases, for the same flow rate. The pH of the effluent decreases over the breakthrough time of copper ions, which indicates that ion exchange is one of the mechanisms involved in the biosorption process. Temperature has little influence on the metal uptake capacity and the increase of the ionic strength reduces the sorption capacity, decreasing the breakthrough time. Desorption using 0.1 M HNO_3 solution was 100% effective. After two consecutive sorption–desorption cycles no changes in the uptake capacity of the composite material were observed. A mass transfer model including film and intraparticle resistances, and the equilibrium relationship, for adsorption and desorption, was successfully applied for the simulation of the biosorption column performance.

Keywords: Biosorption; Copper(II); *Gelidium*; Composite material; Column experiments

Amber Cain[a], Raveender Vannela[a] and L. Keith Woo [a]. ([a]Department of Chemistry, Iowa State University, Ames, IA 50011-3111, USA) Cyanobacteria as a biosorbent for mercuric ion. Bioresource Technology, Volume 99(14) (2008): 6578-6586

The biosorption of Hg^{2+} by two strains of cyanobacteria, *Spirulina platensis* and *Aphanothece flocculosa*, was studied under a batch stirred reaction system. Essential process parameters, including pH, biomass concentration, initial metal concentration, and presence of co-ions were shown to influence the Hg^{2+} uptake. Hg^{2+} uptake was optimal at pH 6.0 for both strains. The maximum loading capacities per gram of dry biomass were found to be 456 mg Hg^{2+} for *A.*

flocculosa and 428 mg Hg^{2+} for *S. platensis*. At an initial concentration of 10 ppm Hg^{2+}, *A. flocculosa* was able to remove more than 98% of the mercury ion from solution. The biosorption kinetics of both strains showed that the metal uptake is bi-phasic, exhibiting a rapid initial uptake followed by a slower absorption process. The presence of dissolved Co^{2+}, Ni^{2+}, and Fe^{3+} were found to play a synergistic role for Hg^{2+} uptake by both strains. Regeneration of the biomass was examined by treating Hg^{2+}-loaded samples with HCl and NH_4Cl over four cycles of sorption and desorption.

Keywords: Mercury ion; Biosorbent; *Spirulina platensis*; *Aphanothece flocculosa*; Sorption equilibrium

Antonella Anastasi[a], Giovanna C. Varese[a], Francesca Bosco[b], Fabiana Chimirri[b] and Valeria Filipello Marchisio[a]. ([a]Dipartimento di Biologia Vegetale, Università degli Studi di Torino, Viale Mattioli 25, 10125 Torino, Italy [b]Dipartimento di Scienza dei Materiali ed Ingegneria Chimica, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy). Bioremediation potential of basidiomycetes isolated from compost. Bioresource Technology, Volume 99(14) (2008): 6626-6630

The potential of a consortium of three basidiomycete mycelia isolated from compost to degrade polycyclic aromatic hydrocarbons (PAH) was first evaluated using a test based on decolorization of Poly R-478 dye. When pre-grown on straw, the consortium decolorized the dye by 83% in 7 days and generated a laccase activity of 663 IU l^{-1}. Its ability to degrade naphthalene was investigated in soil microcosms specially suited for this volatile PAH. The kinetic study was conducted at a maximal naphthalene concentration of 500 mg kg^{-1} of soil. Naphthalene concentration, CO_2 evolution and phytotoxicity (germination index, GI%) on *Lepidium sativum* seeds were monitored. The naphthalene concentration decreased by about 70% in three weeks in the presence of metabolic activity, while the GI% increased indicating reduced phytotoxicity.

Keywords: Fungi; Naphthalene; PAH degradation; Phytotoxicity tests; Poly R-478

Mahmoud A. Khalaf[a]. ([a]Radiation Microbiology Department, National Center for Radiation Research and Technology, P.O. Box 29, Nasr City, Cairo, Egypt). Biosorption of reactive dye from textile wastewater by non-viable biomass of *Aspergillus niger* and *Spirogyra* sp. Bioresource Technology, Volume 99(14) (2008): 6631-6634

The potential of *Aspergillus niger* fungus and *Spirogyra* sp., a fresh water green algae, was investigated as a biosorbents for removal of reactive dye (Synazol) from its multi component textile wastewater. The results showed that pre-treatment of fungal and algal biomasses with autoclaving increased the removal of dye than pre-treatment with gamma-irradiation. The effects of operational parameters (pH, temperature, biomass concentration and time) on dye removal were examined. The results obtained revealed that dried autoclaved biomass of *A. niger* and *Spirogyra* sp. exhibited maximum dye removal (88% and 85%, respectively) at pH3, temperature 30 °C and 8 g l^{-1} (w/v) biomass conc. after 18 h contact time. The stability and efficiency of both organisms in the long-term repetitive operation were also investigated. The results showed that the non-viable biomasses possessed high stability and efficiency of dye removal over 3 repeated batches.

Keywords: Biosorption; Reactive dyes; Textile effluent, *Aspergillus niger*; *Spirogyra* sp.

Peter Schröder[a], Diana Daubner[a], Heiko Maier[a], Juliane Neustifter[a] and Reinhard Debus[b]. ([a]Department Microbe-Plant-Interactions, Helmholtz Zentrum München, German Research Center for Environmental Health, D-85758 Oberschleißheim, Germany [b]Technical University Wiesbaden, Department of Chemistry, D-65428 Rüsselsheim, Germany). Phytoremediation of organic xenobiotics – Glutathione dependent detoxification in *Phragmites* plants from European treatment sites. Bioresource Technology, Volume 99(15) (2008): 7183-7191

Studies on the uptake of several organic xenobiotics and on their subsequent conjugation to biomolecules have been performed to elucidate the use of reed plants in phytoremediation of polluted water. *Phragmites australis* plants were able to accumulate organic xenobiotics in their rhizomes. The uptake was correlated to the log K_{OW} and pK_a of the xenobiotics and highest with compounds exhibiting log K_{OW}s between 1 and 3. Detoxification of xenobiotics was demonstrated when the activity of glutathione S-transferase was determined in plants from various treatment sites. Enzyme activities were strongly dependent on the provenience of the plant and the history of the stand. Detoxification enzymes were also inducible. Naphthylic acetic acid (NAA), 2,4-dichlorophenol and BION were tested as potential inducers. BION was able to induce the GST activity 5-fold, albeit only for a short period of hours. The mechanism of induction and the flexibility of the detoxification system of certain ecotypes of reed toward stress or the pollution level will require further investigation.

Keywords: *Phragmites australis*; Phytoremediation; Organic xenobiotics; Glutathione S-transferase

Yong-Jin Park[a], Jae-Jung Ko[a], Sang-Leen Yun[a], Eun Young Lee[b], So-Jung Kim[a], Sung-Won Kang[a], Byung-Cheol Lee[a] and Seog-Ku Kim[a]. ([a]Department of Environmental Research, Korea Institute of Construction Technology, 2311 Daehwa-dong, Ilsanseo-gu, Goyang-si, Gyeonggi-do 411-712, Republic of Korea, [b]Department of Environmental Engineering, University of Suwon, San 2-2, Wau-ri, Bongdam-eup, Hwaseong-si, Gyeonggi-do 445-743, Republic of Korea). Enhancement of bioremediation by *Ralstonia* sp. HM-1 in sediment polluted by Cd and Zn. Bioresource Technology, Volume 99(16) (2008): 7458-7463

In this study, the potential for the application of the bioaugmentation to Cd and Zn contaminated sediment was investigated. A batch experiment was performed in the lake sediments augmented with *Ralstonia* sp. HM-1. The degradation capacity of 18.7 mg-DOC/l/day in the treatment group was bigger than that of the blank group (4.4 mg-DOC/l/day). It can be regarded as the result of the reduction of the metal concentration in the liquid phase due to adsorption into the sediments, with the increased alkalinity resulting from the reduction of sulfate by sulfate reducing bacteria (SRB). The removal efficiency of cadmium and zinc in the treatment group was both 99.7% after 35 days. Restrain of elution to water phase from sediment in the *Ralstonia* sp. HM-1 added treatment group was also shown. In particular, the observed reduction of the exchangeable fraction and an increase in the bound to organics or sulfide fraction in the treatment group indicate its role in the prevention of metal elution from the sediment. Therefore, for bioremediation and restrain of elution from the sediment polluted by metal, *Ralstonia* sp. augmentation with indigenous microorganism including SRB, sediment stabilization and restrain of elution to surface water is recommended.

Keywords: Cd; Zn; *Ralstonia* sp.; Sediment; Sulfate reducing bacteria

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The evaluation of two waste-derived materials used to treat compost leachate by biofiltration is described in this paper. Nine biofilters were constructed using 240 l, high density polyethylene containers. Three containers were filled without compaction with 200 l of each of three types of filter media. Waste-derived filter media (compost and oversize) were compared to a mineral control (granite chips). The filters were fed with compost leachate from a typical green waste composting facility at hydraulic loading rates ranging from 0.05 m^3/m^3/day to 0.5 m^3/m^3/day over a period of twelve months. The oversize medium emerged as the most effective demonstrating characteristics of consistency of effluent quality and resilience to stress. The oversize medium produced an effluent of <10 mg/l ammoniacal nitrogen on >95% of sampling occasions. The organic component of compost leachate was dominated by compounds that proved to be recalcitrant to biodegradation. The solids content of the treated effluent remained too high to be acceptable for direct discharge to a watercourse without further treatment and if discharge to a watercourse is to be considered, a polishing stage (e.g., reed bed) able to remove solids and dampen occasional peaks of ammoniacal nitrogen should be employed.

Keywords: Biofiltration; Compost; Leachate; Treatment; Wastewater

Hong-Juan Bai[a, b], Zhao-Ming Zhang[b], Guan-E Yang[b] and Bao-Zhen Li[b]. ([a]School of Chemical Engineering and Environment, North University of China, Taiyuan 030051, PR China, [b]College of Life Science and Technology, Shanxi University, Wucheng Road, Taiyuan, Shanxi 030006, PR China). Bioremediation of cadmium by growing *Rhodobacter sphaeroides*: Kinetic characteristic and mechanism studies. Bioresource Technology, Volume 99(1) (2008): 7716-7722

The removal kinetic characteristic and mechanism of cadmium by growing *Rhodobacter sphaeroides* were investigated. The removal data were fitted to the second-order equation, with a correlation coefficient, $R^2 = 0.9790–0.9916$. Furthermore, it was found that the removal mechanism of cadmium was predominantly governed by bioprecipitation as cadmium sulfide with biosorption contributing to a minor extent. Also, the results revealed that the activities of cysteine desulfhydrase in strains grown in the presence of 10 and 20 mg/l of cadmium were higher than in the control, while the activities in the presence of 30 and 40 mg/l of cadmium were lower than in the control. Content analysis of subcellular fractionation showed that cadmium was mostly removed and transformed by precipitation on the cell wall.

Keywords: *Rhodobacter sphaeroides*; Cadmium; Kinetic characteristic; Bioremediation mechanism

Hua Fang[a], Yue Qin Xiang[a], Yi Jie Hao[a], Xiao Qiang Chu[a], Xue Dong Pan[a], Jing Quan Yu[b] and Yun Long Yu[a]. ([a]Department of Plant Protection, College of Agriculture & Biotechnology, Zhejiang University, Hangzhou 310029, Zhejiang, People's Republic of China, [b]Department of Horticulture, College of Agriculture & Biotechnology, Zhejiang University, Hangzhou 310029, Zhejiang, People's Republic of China). Fungal degradation of chlorpyrifos by *Verticillium* sp. DSP in pure cultures and its use in bioremediation of

contaminated soil and pakchoi. International Biodeterioration & Biodegradation, Volume 61(4) (2008): 294-303

Pesticides residues in soils and on vegetables are a public safety concern. Pretreatment with microorganisms degrading pesticides has the potential to alleviate the conditions. For this purpose, the degradation characteristics of chlorpyrifos by an isolated fungal strain *Verticillium* sp. DSP in pure cultures, soil, and on pakchoi (*Brassica chinensis* L.) were investigated. Degradation rate of chlorpyrifos in the mineral salts medium was proportional to the concentrations of chlorpyrifos ranging from 1 to 100 mg l^{-1}. The rate of degradation for chlorpyrifos (1 mg l^{-1}) in the mineral salts medium was 1.12 and 1.04 times faster at pH 7.0 than those at pHs 5.0 and 9.0, and the degradation at 35 °C was 1.15 and 1.12 times faster, respectively, than those at 15 and 20 °C. The addition of the fungal strain DSP into the contaminated soils was found to significantly increase the degradation of chlorpyrifos. Degradation rates of chlorpyrifos in inoculated soils were 3.61, 1.50 and 1.10 times faster in comparison with the sterilized soil, previously chlorpyrifos-untreated soil, and previously chlorpyrifos-treated soil under laboratory conditions. In contrast to the controls, the half-lives of chlorpyrifos were significantly shortened by 10.9% and 17.6% on treated pakchoi, 12.0% and 37.1% in inoculated soils, respectively, in the greenhouse and open field. The results indicate that the fungal strain DSP can be used successfully for the removal or detoxification of chlorpyrifos residues in/on contaminated soil and vegetable.

Keywords: Chlorpyrifos; Biodegradation; Bioremediation; Vegetable; Soil

Geoffrey Perchet[a], Matthieu Sangely[a], Marisol Goñi[b], Georges Merlina[a], Jean-Claude Revel[a] and Eric Pinelli[a]. ([a]EcoLab UMR CNRS-UPS-INPT 5245, Ecole Nationale Supérieure Agronomique, Avenue de l'Agrobiopole, BP 32607 Auzeville, Tolosane, F 31326 Castanet, Tolosan Cedex, France, [b]Laboratoire d'Ecologie Moléculaire, Université de Pau et des Pays de l'Adour, PAU, France). Microbial population changes during bioremediation of nitroaromatic- and nitramine-contaminated lagoon☆. International Biodeterioration & Biodegradation, Volume 61(4) (2008): 304-312

Nitration reactions of aromatic compounds are commonly involved in military industrial processes. Military industries treated their process effluents using lagoon systems for many years. In this study, the sediment of a lagoon was investigated from a bioremediation objective. The physico-chemical characterization of the sediments showed the organic nature of the sediment (25.4% carbon with a C:N=3) highly concentrated in RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) as well as two herbicides Dinoterb (2-*tert*-butyl-4,6-dinitrophenol) and Dinoseb (2-*sec*-butyl-4,6-dinitrophenol). Analysis of the 16S rRNA gene clone library revealed the presence of three dominant families, *Geobacteriacea*, *Clostridiaceae* and *Pseudomonaceae*. A bioremediation assay was carried out in anaerobic conditions in order to degrade organic compounds. In these conditions, 100% of Dinoterb and Dinoseb were degraded after 75 days of culture, while RDX and HMX were not consumed. The 16S rRNA gene clone library analysis of this incubation showed a drastic reduction of the final biodiversity composed by clones related to *Enterobacteriaceae* (especially *Leclercia adecarboxylata*) and *Pseudomonaceae* family. It was then suggested that *Enterobacteriaceae* and *Pseudomonaceae* were potentially involved in biodegradation of these two herbicides. To confirm this hypothesis, cultures were carried out with isolated species of *Pseudomonas putida*, *Pseudomonas citronellolis* and *L. adecarboxylata* in the presence of

Dinoterb. The data confirmed that in the presence of glucose, these microorganisms are able to consume Dinoterb.

Keywords: Nitrated compounds; Dinoterb; Biodegradation; Phylogenetic analysis; Pseudomonas

Rosa F. Dominguez[1], Marcio L. B. da Silva[1], Travis M. McGuire[2], David Adamson[2], Charles J. Newell[2] and Pedro J. J. Alvarez[1]. ([1]Department of Civil and Environmental Engineering, Rice University, Houston, TX, USA, [2]Groundwater Services, Inc., Houston, TX, USA). Aerobic bioremediation of chlorobenzene source-zone soil in flow-through columns: performance assessment using quantitative PCR. Biodegradation, Volume 19(4) (2008): 545-553

Flow-through aquifer columns were operated for 12 weeks to evaluate the benefits of aerobic biostimulation for the bioremediation of source-zone soil contaminated with chlorobenzenes (CBs). Quantitative Polymerase Chain Reaction (qPCR) was used to measure the concentration of total bacteria (16S rRNA gene) and oxygenase genes involved in the biodegradation of aromatic compounds (i.e., toluene dioxygenase, ring hydroxylating monooxygenase, naphthalene dioxygenase, phenol hydroxylase, and biphenyl dioxygenase). Monochlorobenzene, which is much more soluble than dichlorobenzenes, was primarily removed by flushing, and biostimulation showed little benefit. In contrast, dichlorobenzene removal was primarily due to biodegradation, and the removal efficiency was much higher in oxygen-amended columns compared to a control column. To our knowledge, this is the first report that oxygen addition can enhance CB source-zone soil bioremediation. Analysis by qPCR showed that whereas the biphenyl and toluene dioxygenase biomarkers were most abundant, increases in the concentration of the phenol hydroxylase gene reflected best the higher dichlorobenzene removal due to aerobic biostimulation. This suggests that quantitative molecular microbial ecology techniques could be useful to assess CB source-zone bioremediation performance.

Keywords: Chlorobenzene - Aerobic - Biodegradation - Biomarkers - Oxygenases - qPCR

Zhen Chen[a], Wei Ma[a] and Mei Han[a]. ([a]Department of Chemistry, Dalian University of Technology, Dalian 116024, PR China). Biosorption of nickel and copper onto treated alga (*Undaria pinnatifida*): Application of isotherm and kinetic models. Journal of Hazardous Materials, Volume 155(1-2) (2008): 327-333

Biosorption of nickel and copper ions from aqueous solution onto treated alga biomass *Undaria pinnatifida* has been studied and the Langmuir, Freundlich and Temkine equilibrium isotherms, pseudo-first-order, pseudo-second-order and intra-particle diffusion kinetic model were determined respectively. Within the test range (initial concentration 5–50 mg/L, biosorption doze 0.1–0.5 g, pH 3–7), biosorption performance for metal ions showed an increase in specific metal uptake capacity with an increasing in initial ions concentration and decreasing in biosorbent doze. The optimized condition of pH value for nickel and copper is 4.7 and 4.0, respectively, while contact time is about 100 min. At equilibrium, the maximum total uptake by *U. pinnatifida* was 24.71 mg/g for nickel and 38.82 mg/g for copper. The results for nickel and copper fit well to the Langmuir and the Temkin isotherm, respectively. Pseudo-second-order model described well the sorption kinetic of nickel and copper ions in comparison to pseudo-first-order and intra-particle diffusion kinetic model.

Keywords: Biosorption; Heavy metal; Treated alga; Kinetic; Isotherm

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The biosorption of Cu(II) from aqueous solutions by mimosa tannin resin (MTR) was investigated as a function of particle size, initial pH, contact time and initial metal ion concentration. The aim of this study was to understand the mechanisms that govern copper removal and find a suitable equilibrium isotherm and kinetic model for the copper removal in a batch reactor. The experimental isotherm data were analysed using the Langmuir, Freundlich and Temkin equations. The equilibrium data fit well in the Langmiur isotherm. The experimental data were analysed using four sorption kinetic models – the pseudo-first- and second-order equations, and the Elovich and the intraparticle diffusion equation – to determine the best fit equation for the biosorption of copper ions onto mimosa tannin resin. Results show that the pseudo-second-order equation provides the best correlation for the biosorption process, whereas the Elovich equation also fits the experimental data well. Thermodynamic parameters such as the entropy change, enthalpy change and Gibb's free energy change were found out to be 153.0 J mol^{-1} K^{-1}, 42.09 kJ mol^{-1} and −2.47 kJ mol^{-1}, respectively.

Keywords: Mimosa tannin gel; Copper(II); Biosorption

Ahmet Sarı[a] and Mustafa Tuzen[a]. ([a]Department of Chemistry, Gaziosmanpasa University, 60250 Tokat, Turkey). Biosorption of cadmium(II) from aqueous solution by red algae (*Ceramium virgatum*): Equilibrium, kinetic and thermodynamic studies. Journal of Hazardous Materials, Volume 157(2-3) (2008): 448-454

The biosorption characteristics of Cd(II) ions using the red alga (*Ceramium virgatum*) were investigated. Experimental parameters affecting the biosorption process such as pH, contact time, biomass dosage and temperature were studied. Langmuir, Freundlich and Dubinin–Radushkevich (D–R) models were applied to describe the biosorption isotherms. The biosorption capacity of *C. virgatum* biomass for Cd(II) ions was found to be 39.7 mg/g. From the D–R isotherm model, the mean free energy was calculated as 12.7 kJ/mol, indicating that the biosorption of Cd(II) the metal ions was taken place by chemisorption. The calculated thermodynamic parameters ($\Delta G°$, $\Delta H°$ and $\Delta S°$) showed that the biosorption of Cd(II) ions onto *C. virgatum* was feasible, spontaneous and exothermic at 293–323 K. Evaluation of experimental data in terms of biosorption kinetics showed that the biosorption of Cd(II) *C. virgatum* followed well pseudo-second-order kinetics.

Keywords: *Ceramium virgatum*; Cadmium(II); Biosorption; Thermodynamics; Kinetics

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Biosorption is a technique that can be used for the removal of pollutants from waters, especially those that are not easily biodegradable such as metals and dyes. A variety of biomaterials are known to bind these pollutants, including bacteria, fungi, algae, and industrial and agricultural wastes. In this review, the biosorption abilities of bacterial biomass towards dyes and metal ions are emphasized. The properties of the cell wall constituents, such as peptidoglycan, and the role of functional groups, such as carboxyl, amine and phosphonate, are discussed on the basis of their biosorption potentials. The binding mechanisms, as well as the parameters influencing the passive uptake of pollutants, are analyzed. A detailed description of isotherm and kinetic models and the importance of mechanistic modeling are presented. A systematic comparison of literature, based on the metal/dye binding capacity of bacterial biomass under different conditions, is also provided. To enhance biosorption capacity, biomass modifications through chemical methods and genetic engineering are discussed. The problems associated with microbial biosorption are analyzed, and suitable remedies discussed. For the continuous treatment of effluents, an up-flow packed column configuration is suggested and the factors influencing its performance are discussed. The present review also highlights the necessity for the examination of biosorbents within real situations, as competition between solutes and water quality may affect the biosorption performance. Thus, this article reviews the achievements and current status of biosorption technology, and hopes to provide insights into this research frontier.

Keywords: Biosorption; Bacteria; Metals; Dyes; Wastewater treatment; Packed column; Isotherm model; Kinetic model; Biomass reuse; Multicomponent biosorption

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Sustainable development requires the promotion of environmental management and a constant search for new technologies to treat a wide range of aquatic and terrestrial habitats contaminated by increasing anthropogenic activities. Bioremediation, i.e. the elimination of natural or xenobiotic pollutants by living organisms, is an environmentally friendly and cost-effective alternative to physico-chemical cleanup options. However, the strategy and outcome of bioremediation in open systems or confined environments depend on a variety of physico-chemical and biological factors that need to be assessed and monitored. In particular, microorganisms are key players in bioremediation applications, yet their catabolic potential and their dynamics *in situ* remain poorly characterized. To perform a comprehensive assessment of the biodegradative potential of a contaminated site and efficiently monitor changes in the structure and activities of microbial communities involved in bioremediation processes, sensitive, fast and large-scale methods are needed. Over the last few years, the scientific literature has revealed the progressive emergence of genomic high-throughput technologies in environmental microbiology and biotechnology. In this review, we discuss various high-throughput techniques and their possible—or already demonstrated—application to assess biotreatment of contaminated environments.

Keywords: Microbial communities; Catabolic genes; Microarrays; Metagenomics; Metatranscriptomics; Metaproteomics; Metabolomics; Biosensors

Nazmul Haque[a], Jose R. Peralta-Videa[b], Gary L. Jones[c], Thomas E. Gill[d] and Jorge L. Gardea-Torresdey[a, b]. ([a]Environmental Science and Engineering PhD Program, The University of Texas at El Paso, El Paso, TX 79968, USA, [b]Department of Chemistry, The University of Texas at El Paso, El Paso, TX 79968, USA, [c]Phelps Dodge Miami Inc, P.O. Box 4444, Claypool, AZ 85532, USA, [d]Department of Geological Science, The University of Texas at El Paso, El Paso, TX 79968, USA). Screening the phytoremediation potential of desert broom (Baccharis sarothroides Gray) growing on mine tailings in Arizona, USA. Environmental Pollution, Volume 153(2) (2008): 362-368

The metal concentrations in a copper mine tailings and desert broom (*Baccharis sarothroides* Gray) plants were investigated. The metal concentrations in plants, soil cover, and tailings were determined using ICP-OES. The concentration of copper, lead, molybdenum, chromium, zinc, arsenic, nickel, and cobalt in tailings was 526.4, 207.4, 89.1, 84.5, 51.7, 49.6, 39.7, and 35.6 mg kg^{-1}, respectively. The concentration of all elements in soil cover was 10–15% higher than that of the tailings, except for molybdenum. The concentration of copper, lead, molybdenum, chromium, zinc, arsenic, nickel, and cobalt in roots was 818.3, 151.9, 73.9, 57.1, 40.1, 44.6, 96.8, and 26.7 mg kg^{-1} and 1214.1, 107.3, 105.8, 105.5, 55.2, 36.9, 30.9, and 10.9 mg kg^{-1} for shoots, respectively. Considering the translocation factor, enrichment coefficient, and the accumulation factor, desert broom could be a potential hyperaccumulator of Cu, Pb, Cr, Zn, As, and Ni.

Desert broom, a potential hyperaccumulating plant to clean up Cu, Pb, Cr, Zn, As, Ni and Co from the mine tailings in AZ, USA.

Keywords: Phytoremediation; Hyperaccumulator; Heavy metals; Mine tailings; Desert broom

Nilanjana Das*, R Vimala and P Karthika. (School of Biotechnology, Chemical and Biomedical Engineering, VIT University, Vellore 632 014, India). Biosorption of heavy metals–An overview Indian Journal of Biotechnology, Vol 7 (2008): 159-169

During the last two decades, extensive attention has been paid on the management of environmental pollution causal by hazardous materials such as heavy metals. Decontamination of heavy metals in the soil and water around industrial plants has been a challenge for a long time. A number of methods have been developed for the removal of heavy metals from liquid wastes such as precipitation, evaporation, electroplating, ion exchange, membrane processes, etc. However, these methods have several disadvantages such as unpredictable metal ion removal, high reagent requirement, generation of toxic sludge, etc. Biosorption is a process, which represents a biotechnological innovation as well as a cost effective excellent tool for removing heavy metals from aqueous solutions. This article provides a selective overview of past achievements and present scenario of biosorption studies carried out on some promising natural biosorbents (algae, fungi, bacteria, yeast) and some waste materials which could serve as an economical means of treating effluents charged with toxic metallic ions.

Keywords: algae, fungi, bacteria, yeast, biosorption, heavy metal, biosorbent, wastewater, biomass

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Constructed mangrove wetland as secondary treatment system for municipal wastewater. Ecological Engineering, Volume 34(2) (2008): 137-146

Intermittent subsurface flow mangrove microcosms were constructed to investigate their capabilities in treating primary settled municipal wastewater collected from a local sewage treatment work in Hong Kong SAR and the effect of hydraulic retention time (HRT). The study was carried out in a greenhouse and without any tidal flushing or tidal cycle, with half of the tanks planted with *Kandelia candel* and half without any plants. The removal percentages of dissolved organic carbon (DOC), ammonia-N, inorganic-N and total Kjeldahl nitrogen in the planted systems were 70.43–76.38%, 76.16–91.83%, 47.89–63.37% and 75.15–79.06%, respectively, significantly higher than in the unplanted system during the 6-month treatment period. More than 97% *ortho*-phosphate and 86.65–91.83% total phosphorus were removed by the planted microcosms. The HRT of 10 days had better removal than that of 5 days, and the best performance was obtained in the planted microcosms with 10 days of retention time. During the 6-month experimental period, the concentrations of all forms of nitrogen in the treated effluent were within the standards for effluents discharged into Group B inland waters and coastal zone with open waters. In terms of phosphorus, the effluents met the standards for effluents discharged into Group A inland waters. These results suggest that it is feasible to use the constructed mangrove wetland without tidal flushing as a secondary treatment process for municipal wastewater.

Keywords: Mangrove microcosm; Municipal wastewater; Hydraulic retention time; Nutrients; Dissolved organic carbon (DOC)

Radojka Razmovski[a] and Marina Šćiban [a]. ([a]Faculty of Technology, University of Novi Sad, 21000 Novi Sad, Serbia). Biosorption of Cr(VI) and Cu(II) by waste tea fungal biomass. Ecological Engineering, Volume 34(2) (2008): 179-186

The biosorption of Cr(VI) and Cu(II) ions from aqueous solution by waste tea fungus was studied in a batch biosorption system as a function of pH, contact time and absorbent dosage. The biosorption capacities and adsorption rates of Cr(VI) and Cu(II) ions onto live and dried tea fungal biomass were evaluated. In the experiments, the optimum pH values for Cr(VI) and Cu(II) were 2.0 and 4.0, respectively. The Langmuir, Freundlich, BET and Temkin adsorption models were applied to describe adsorption. Based on the coefficient of determination R^2, Freundlich, BET and Temkin equations produced the very good models for Cr(VI) and Cu(II) biosorption onto waste tea fungal biomass. The kinetics of adsorption of Cr(VI) and Cu(II) have been discussed using two kinetic models, i.e. the Lagergren pseudo-first-order model and Elovich equation. It was shown that both kinetic models could describe the adsorption kinetics very successfully.

Keywords: Biosorption; Copper; Chromium; Waste tea fungal biomass; Kinetic models

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Biosafety: a Review of the Principles and Effectiveness of Microbiological Containment Measures. Clinical Microbiology Reviews, Vol. 21(3) (2008): 403-425

We examined the available evidence on the effectiveness of measures aimed at protecting humans and the environment against the risks of working with genetically modified microorganisms (GMOs) and with non-GMO pathogenic microorganisms. A few principles and methods underlie the current biosafety practice: risk assessment, biological containment, concentration and enclosure, exposure minimization, physical containment, and hazard minimization. Many of the current practices are based on experience and expert judgment. The effectiveness of biosafety measures may be evaluated at the level of single containment equipment items and procedures, at the level of the laboratory as a whole, or at the clinical-epidemiological level. Data on the containment effectiveness of equipment and laboratories are scarce and fragmented. Laboratory-acquired infections (LAIs) are therefore important for evaluating the effectiveness of biosafety. For the majority of LAIs there appears to be no direct cause, suggesting that failures of biosafety were not noticed or that containment may have been insufficient. The number of reported laboratory accidents associated with GMOs is substantially lower than that of those associated with non-GMOs. It is unknown to what extent specific measures contribute to the overall level of biosafety. We therefore recommend that the evidence base of biosafety practice be strengthened.

Hassan K. Sreenath[a, 1,] and Richard G. Koegel[a, b]. ([a]Department of Biological Systems Engineering, University of Wisconsin-Madison, 460 Henry Mall, Madison, WI 53706, USA, [b]USDA ARS Dairy Forage Research Center, Madison, WI 53706, USA). Bioconvertion of spent cellulose sausage casings. Enzyme and Microbial Technology, Volume 43(2) (2008): 226-232

Cellulose sausage cellulose casings are used extensively in the manufacture of sausages in meat packaging. After stripping the meat, spent casings mainly contain cellulose and residual meat juice with salt, nitrate and nitrite. Disposal of spent sausage casings has serious economic and environmental concerns for the sausage industry. This work describes bioconversion of spent cellulose casings (SCC) into enzymes, lactic acid and ethanol by using cellulolytic fungi, lactobacillus and yeasts. The solid substrate cultivation (SSC) of *Trichoderma reesei* RUT C-30 on SCC and blends gave a maximum of 152 filter paper cellulase (FPase) activity and about 100 carboxymethylcellulase activity (CMCase)/g dry weight substrate. The SSC produced enzyme-rich casing with 50 FPase when directly mixed as such with 10% fresh SCC produced over 70 g/l lactic acid using *Lactobacillus plantarum* sp. 14431, and also produced 30 g/l ethanol with *Kluveromyces marxianus* IMB-3 under simultaneous saccharification and fermentation (SSF) conditions.

Keywords: Bioconversion; Cellulose; Enzyme-rich casing; Ethanol; Filter paper cellulase (FPase); Lactic acid; Simultaneous saccharification and fermentation (SSF); Solid substrate cultivation (SSC); Spent cellulose casings (SCC)

J. Lin*, M. Reddy, V. Moorthi and B. E. Qoma. (School of Biochemistry, Genetics, Microbiology and Plant Pathology, University of KwaZulu-Natal (Westville), Private Bag X 54001, Durban, Republic of South Africa. *Corresponding author. E-mail: linj@ukzn.ac.za. Tel: +27-31-2607401. Fax: +27-31-2607809). Bacterial removal of toxic phenols from an industrial effluent. African Journal of Biotechnology Vol. 7 (13) (2008): 2232–2238

Chlorinated phenols, widely used in industries, are of growing concern owing to their high toxicity, carcinogenicity and wide distribution in industrial wastes. In the present study, one *Pseudomonas* isolate, identified as *Pseudomonas fluorescens*, was obtained using the enrichment process with 2,4,6-trichlorophenol (2,4,6-TCP) as a sole carbon source. This isolate was found to be able to degrade various highly chlorinated phenolic compounds such as pentachlorophenol, 2,4,5-TCP, 2,4,6-TCP as well as phenol, 2,4-dibromophenol and 2,4-dichlorophenol (2,4-DCP). The ability of *P. fluorescens* isolate to remove phenol from a resin producing industrial effluent was tested by scanning the spectrum with a UV-VIS spectrophotometer. The results indicated that this isolate metabolized phenol in the *meta*-pathway. The optimal phenol degradation conditions of *P. fluorescens* isolate were at pH 7 and 30^{o}C. At the 480 mg/l of phenol concentration, the highest specific degradation rate of was observed. Further increases in phenol concentration slowed down the degradation ability of the isolate. However, *P. fluorescens* isolate still has the ability of degrading phenol at the concentration of 3.2 g/L. The supplementation of 1% glucose stimulated the growth of *P. fluorescens* isolate and enhanced the ability to utilize phenol from the effluent sample. GC-MS results show that 85.4% of phenol in the effluent sample was metabolized after 40 days. In conclusion, *P. fluorescens* isolated in this study has the ability of utilizing various chlorophenolic compounds and demonstrates its potentials of degrading high concentration of phenol in industrial effluents.

Keywords: Bioremediation, *Pseudomonas fluorescens*, industrial effluent, chlorophenols.

R. Razmovski* and M. Šćiban. (Faculty of Technology, University of Novi Sad, Novi Sad, Serbia. *Corresponding author. E-mail: razmovski@tehnol.ns.ac.yu, Tel: ++381 21 4853736. Fax: ++381 21 450413). **Iron(III) biosorption by *Polyporus squamosus*. African Journal of Biotechnology Vol. 7 (11) (2008): 1693–1699**

Polyporus squamosus was tested for its ability to absorb Fe(III) ions from solutions. Kinetic and isotherm sorption experiments were conducted to evaluate the effects of contact time, pH, metal concentration, dose of the adsorbent, ionic strength and glucose. The increases in initial concentration of metal and pH of the solutions resulted in an increase in iron uptake. The equilibrium data could be fitted by Langmuir and Freundlich isotherm equation. Both Langmuir and Freundlich sorption models adequately describe the biosorption of Fe(III) by *P. squamosus.* Maximum metal uptake capacities of *P. sqamosus* biomass (q_m) were found as 31.2, 18.1 and 12.2 mg/g for 1.5, 3.3 and 6.6 g biomass/l, respectively. With increasing ionic strength, there is a decrease in the metal uptake (q_m) as well as coefficient b in Langmuir equation. It was noticed that lower concentrations of glucose resulted in higher rates and amounts of Fe(III) adsorption, while its concentration above 0.1% (w/v) reduced substantially the ability of the cells to absorb this metal.

Keywords: Biosorption, *Polyporus squamosus*, heavy metals, iron, removal

Harrison Ifeanyichukwu Atagana. (Institute for Science and Technology Education, University of South Africa, Pretoria, South Africa. E-mail: atagahi@unisa.ac.za). **Compost bioremediation of hydrocarbon-contaminated soil inoculated with organic manure. African Journal of Biotechnology Vol. 7 (10) (2008): 1516–1525**

Contaminated soil (FAO: Lithosol) containing >380 000 mg kg^{-1} total petroleum hydrocarbons (TPH) was bioremediated by composting. The soil was inoculated with sewage sludge and incubated for 19 months. The soil was mixed in a ratio of 1:1 (v/v) with wood chips. The soil-

wood chips mixture was then mixed in a ratio of 4:1 with sewage sludge. Compost heaps were set up in triplicates on wood pallets covered with double layers of nylon straw sheets. Control experiments which contained the contaminated soil and wood chips but without sewage sludge were set up in triplicate. Moisture, temperature, pH, ash content, C:N ratio of the compost mixture and TPH of the soil was monitored monthly. The concentrations of selected hydrocarbons in the contaminated soil were measured monthly during the incubation period. Temperature rose to about 58°C in the sewage sludge compost within two months of incubation, while temperature in the control fluctuated between 15 and 35°C throughout the incubation period. Total petroleum hydrocarbons (TPH) was reduced by 17% in the control experiments and 99% in the sewage sludge compost at the end of the incubation period. The concentrations of most of the selected hydrocarbon components were reduced by up to 100% within the same period. Microbial activities were shown to correlate with the reduction in hydrocarbon contents of the soil.

Keywords: Bioremediation, composting, PAHs, sewage sludge, soil.

Ashwini C. Poopal1 and R. Seeta Laxman1. (1Division of Biochemical Sciences, National Chemical Laboratory, Pune, 411008, India). Hexavalent chromate reduction by immobilized Streptomyces griseus. Biotechnology Letters, Volume 30(6) (2008): 1005-1010

Hexavalent chromium, which is a mutagen and carcinogen, was efficiently reduced by *Streptomyces griseus*. This activity was associated with the cell. Cr^{6+} reduction by free as well as immobilized cells was studied: cells in PVA-alginate had the highest (100%) Cr^{6+} removal efficiency in 24 h with reduction rates similar to free cells. Immobilized cells completely reduced 25 mg Cr^{6+} l^{-1} in 24 h. PVA-alginate immobilized cells could be reused four times to completely reduce 25 mg Cr^{6+} l^{-1} in 24 h each time. Chromate in a simulated effluent containing Cu^{2+}, Mg^{2+}, Mn^{2+} and Zn^{2+} was completely reduced by PVA-alginate immobilized cells within 9 h.

Keywords: Chromate reduction - Immobilized cells - Polyvinyl alcohol - *Streptomyces griseus*

Jorge A.G. Santos[a], Maria I.S. Gonzaga[a], Lena Q. Ma[b] and M. Srivastava[b]. ([a]Department of Soil Chemistry, Universidade Federal da Bahia, Cruz das Almas, 44380000, Brazil, [b]Soil and Water Science Department, University of Florida, Gainesville, FL 32611-0290, USA). Timing of phosphate application affects arsenic phytoextraction by *Pteris vittata* L. of different ages. Environmental Pollution, Volume 154(2) (2008): 306-311

The effects of timing in phosphate application on plant growth and arsenic removal by arsenic hyperaccumulator *Pteris vittata* L. of different ages were evaluated. The hydroponic experiment consisted of three plant ages (A_{45d}, A_{90d} and A_{180d}) and three P feeding regimens (P_{200+0}, P_{134+66} and P_{66+134}) growing for 45 d in 0.2-strength Hoagland–Arnon solution containing 145 μg L^{-1} As. While all plants received 200 μM P, P was added in two phases: during acclimation and after arsenic exposure. High initial P-supply (P_{200+0}) favored frond biomass production and plant P uptake, while split-P application (P_{134+66} and P_{66+134}) favored plant root production. Single P addition favored arsenic accumulation in the roots while split-P addition increased frond arsenic accumulation. Young ferns (A_{45d}) in treatment P134+66 were the most efficient in arsenic removal, reducing arsenic concentration to below 10 μg L^{-1} in 35 d. The results indicated that the use of young ferns, coupled with feeding of low initial P or split-P application, increased the efficiency of arsenic removal by *P. vittata*.

Young ferns coupled with split-P application were effective in arsenic removal by *Pteris vittata*.

Keywords: Arsenic; Plant age; Phytoextraction; Hyperaccumulation; Hydroponic

Biotransformation

Sanket Joshi[a], Chirag Bharucha[a] and Anjana J. Desai [a]. ([a]Department of Microbiology and Biotechnology Centre, The Maharaja Sayajirao University of Baroda, Vadodara 390 002, Gujarat, India). Production of biosurfactant and antifungal compound by fermented food isolate *Bacillus subtilis* 20B. Bioresource Technology, Volume 99(11) (2008): 4603-4608

A biosurfactant producing strain, *Bacillus subtilis* 20B, was isolated from fermented food in India. The strain also showed inhibition of various fungi in *in-vitro* experiments on Potato Dextrose Agar medium. It was capable of growth at temperature 55 °C and salts up to 7%. It utilized different sugars, alcohols, hydrocarbons and oil as a carbon source, with preference for sugars. In glucose based minimal medium it produced biosurfactant which reduced surface tension to 29.5 mN/m, interfacial tension to 4.5 mN/m and gave stable emulsion with crude oil and *n*-hexadecane. The biosurfactant activity was stable at high temperature, a wide range of pH and salt concentrations for five days. Oil displacement experiments using biosurfactant containing broth in sand pack columns with crude oil showed 30.22% recovery. The possible application of organism as biocontrol agent and use of biosurfactant in microbial enhanced oil recovery (MEOR) is discussed.

Keywords: *Biosurfactant*; *Bacillus subtilis*; Surface tension; Interfacial tension; MEOR, Biocontrol agent

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Biosorption of cadmium (II) ions from aqueous solution onto immobilized cells of *Pycnoporus sanguineus* (*P. sanguineus*) was investigated in a batch system. Equilibrium and kinetic studies were conducted by considering the effect of pH, initial cadmium (II) concentration, biomass loading and temperature. Results showed that the uptake of cadmium (II) ions increased with the increase of initial cadmium (II) concentration, pH and temperature. Langmuir, Freundlich and Redlich–Peterson isotherm models were used to analyze the equilibrium data at different temperatures. Langmuir isotherm model described the experimental data well followed by Redlich–Peterson and Freundlich isotherm models. Biosorption kinetics data were fitted using pseudo-first, pseudo-second-order and intraparticle diffusion. It was found that the kinetics data fitted well the pseudo-second-order followed by intraparticle diffusion. Thermodynamic parameters such as standard Gibbs free energy (ΔG^0), standard enthalpy (ΔH^0) and standard entropy (ΔS^0) were evaluated. The result showed that biosorption of cadmium (II) ions onto immobilized cells of *P. sanguineus* was spontaneous and endothermic nature.

Keywords: Biosorption; Cadmium; *Pycnoporus sanguineus*; Isotherm; Kinetics

Salman Ahmady-Asbchin[a], Yves Andrès[a], Claire Gérente[a] and Pierre Le Cloirec[b]. ([a]Ecole des Mines de Nantes, GEPEA UMR CNRS, 6144 BP 20722, 44307 Nantes Cedex 3, France, [b]Ecole de Chimie de Rennes (ENSCR), UMR CNRS 6226, Sciences Chimiques, Campus de Beaulieu, Avenue du Général Leclerc, 35000 Rennes, France). Biosorption of Cu(II) from aqueous solution by *Fucus serratus*: Surface characterization and sorption mechanisms. Bioresource Technology, Volume 99(14) (2008): 6150-6155

In this work, the brown alga *Fucus serratus* (*FS*) used as a low cost sorbent has been studied for the biosorption of copper(II) ions in batch reactors. Firstly, the characterization of the surface functional groups was performed with two methods: a qualitatively analysis with the study of FT-IR spectrum and a quantitatively determination with potentiometric titrations. From this latter, a total proton exchange capacity of 3.15 mmol g^{-1} was extrapolated from the *FS* previously protonated. This value was similar to the total acidity of 3.56 mmol g^{-1} deduced from the Gran method. Using the single extrapolation method, three kinds of acidic functional groups with three intrinsic pK_a were determined at 3.5, 8.2 and 9.6. The point of zero net proton charge (PZNPC) was found close to pH 6.3. Secondly, the biosorption of copper ions was studied. The equilibrium time was about 350 min and the adsorption equilibrium data were well described by the Langmuir's equation. The maximum adsorption capacity has been extrapolated to 1.60 mmol g^{-1}. The release of calcium and magnesium ions was also measured in relation to the copper biosorption. Finally, the efficiency of this biosorbent in natural tap water for the removal of copper was also investigated. All these observations indicate that the copper biosorption on *FS* is mainly based on ion exchange mechanism and this biomass could be then a suitable sorbent for the removal of heavy metals from wastewaters.

Keywords: Biosorption; Heavy metal; Brown alga; Adsorption isotherms; Ion exchange capacity

Shailesh R. Dave [a], Kajal H. Gupta[a] and Devayani R. Tipre[a]. ([a]Department of Microbiology, School of Sciences, Gujarat University, Ahmedabad, Gujarat 380 009, India). Characterization of arsenic resistant and arsenopyrite oxidizing *Acidithiobacillus ferrooxidans* from Hutti gold leachate and effluents. Bioresource Technology, Volume 99(16) (2008): 7514-7520

Four arsenic resistant ferrous oxidizers were isolated from Hutti Gold Mine Ltd. (HGML) samples. Characterization of these isolates was done using conventional microbiological, biochemical and molecular methods. The ferrous oxidation rates with these isolates were 16, 48, 34 and 34 mg L^{-1} h^{-1} and 15, 47, 34 and 32 mg L^{-1} h^{-1} in absence and presence of 20 mM of arsenite (As^{3+}) respectively. Except isolate HGM 8, other three isolates showed 2.9–6.3% inhibition due to the presence of 20 mM arsenite. Isolate HGM 8 was able to grow in presence of 14.7 g L^{-1} of arsenite, with 25.77 mg L^{-1} h^{-1} ferrous oxidation rate. All the four isolates were able to oxidize iron and arsenopyrite from 20 g L^{-1} and 40 g L^{-1} refractory gold ore and 20 g L^{-1} refractory gold concentrate. Once the growth was established pH adjustment was not needed inspite of ferrous oxidation, which could be due to concurrent oxidation of pyrite. Isolate HGM 8 showed the final cell count of as high as 1.12×10^8 cells mL^{-1} in 40 g L^{-1} refractory gold ore. The isolates were grouped into one haplotypes by amplified ribosomal DNA restriction analysis (ARDRA). The phylogenetic position of HGM 8 was determined by 16S rDNA sequencing. It was identified as *Acidithiobacillus ferrooxidans* and strain name was given as SRHGM 1.

Keywords: Arsenic; Arsenopyrite; *Acidithiobacillus ferrooxidans*; Biooxidation; Refractory gold ore

Jing Chen, Yu-Guo Zheng[1] and Yin-Chu Shen (Institute of Bioengineering, Zhejiang University of Technology, Hangzhou 310032, People's Republic of China. [1]To whom correspondence should be addressed (email zhengyg@zjut.edu.cn). Biotransformation of *p*-methoxyphenylacetonitrile into *p*-methoxyphenylacetic acid by resting cells of *Bacillus subtilis.* Biotechnol. Appl. Biochem., 50(2008): 147–153

Resting cells of *Bacillus subtilis* ZJB-063 were used for the direct transformation of MOPAN (*p*-methoxyphenylacetonitrile) to MOPAA (*p*-methoxyphenylacetic acid), which is an important pharmaceutical intermediate. The *B. subtilis* ZJB-063 culture conditions for the production of nitrilase and the reaction conditions for this nitrilase-mediated conversion were optimized. The maximum production of nitrilase was achieved when glucose and a combination of ammonium sulfate and yeast powder were added as carbon and nitrogen sources respectively. Previously reported inducers were found to be unnecessary for the production of nitrilase from *B. subtilis* ZJB-063, which indicated that this nitrilase appeared to be constitutive. However, when ϵ-caprolactam (6-hexanolactam) was added as the inducer, *B. subtilis* ZJB-063 exhibited nitrile hydratase and amidase activity. The maximum conversion of MOPAN into MOPAA (specific activity 17.03 units·g^{-1}_{DCW}; DCW is dry cell weight) was observed in a solution containing 50 mM phosphate buffer (pH 7.0), 10 mM MOPAN, 2.7 mg DCW·ml^{-1} wet resting cells and 5% (v/v) DMSO for 4 h at 32 °C. MOPAN (10 mM) was completely converted into MOPAA (9.65 mM) in 5 h in shake flasks without the formation of *p*-methoxyphenylacetamide. The small deviation of MOPAA (9.65 mM) from the theoretical amount (10 mM) may be due to partial consumption of the products by *B. subtilis* ZJB-063. Both MOPAN and MOPAA inhibited the hydrolysis at concentrations above 15 mM. Scale up of the reaction to 200 ml in a bubble bioreactor shortened the reaction time compared with the reactions performed in shake flasks.

Keywords: arylacetic acids, *Bacillus subtilis*, biotransformation, constitutive nitrilase, high-value carboxylic acids, *p*-methoxyphenylacetic acid (MOPAA), *p*-methoxyphenylacetonitrile (MOPAN).

Abbreviations used: DCW, dry cell weight; MOPAA, *p*-methoxyphenylacetic acid; MOPAN, *p*-methoxyphenylacetonitrile.

Jim A. Field [a,] and Reyes Sierra-Alvarez[a]. ([a]Department of Chemical and Environmental Engineering, University of Arizona, PO Box 210011, Tucson, AZ 85721, USA). Microbial transformation and degradation of polychlorinated biphenyls. Environmental Pollution, Volume 155(1) (2008) : 1-12

This paper reviews the potential of microorganisms to transform polychlorinated biphenyls (PCBs). In anaerobic environments, higher chlorinated biphenyls can undergo reductive dehalogenation. *Meta*- and *para*-chlorines in PCB congeners are more susceptible to dechlorination than *ortho*-chlorines. Anaerobes catalyzing PCB dechlorination have not been isolated in pure culture but there is strong evidence from enrichment cultures that some *Dehalococcoides* spp. and other microorganisms within the *Chloroflexi* phylum can grow by linking the oxidation of H_2 to the reductive dechlorination of PCBs. Lower chlorinated biphenyls can be co-metabolized aerobically. Some aerobes can also grow by utilizing PCB congeners containing only one or two chlorines as sole carbon/energy source. An example is the growth of

Burkholderia cepacia by transformation of 4-chlorobiphenyl to chlorobenzoates. The latter compounds are susceptible to aerobic mineralization. Higher chlorinated biphenyls therefore are potentially fully biodegradable in a sequence of reductive dechlorination followed by aerobic mineralization of the lower chlorinated products.

Higher chlorinated biphenyls are potentially fully biodegradable in a sequence of anaerobic reductive dechlorination followed by aerobic mineralization of the lower chlorinated products.

Keywords: Biotransformation; PCB; Dehalogenation; Dechlorination; Organohalogens

Mitsuo Miyazawa [*], Tomohiko Takahashi, Kazuki Sakata, Isao Horibe. (Department of Applied Chemistry, Faculty of Science and Engineering, Kinki University, Kowakae, Higashiosaka-shi, Osaka 577-8502, Japan. [*]Correspondence to Mitsuo Miyazawa, Kinki University, Department of Applied Chemistry, Faculty of Science and Engineering, 3-4-1 Kowakae, Higashiosaka-shi, Osaka 577-8502, Japan. email: Mitsuo Miyazawa:miyazawa@apch.kindai.ac.jp). **Biotransformation of three aromadendrane-type sesquiterpenoids by *Aspergillus wentii.* Journal of Chemical Technology & Biotechnology, Volume 83(7) (2008): 1006 - 1011**

BACKGROUND: The biotransformation of sesquiterpenoids, which are a large class of naturally occurring compounds, using microorganisms as a biocatalyst to produce useful novel organic compounds was investigated. The biotransformation of sesquiterpenoids, (+)-aromadendrene (**1**), (-)-alloaromadendrene (**2**) and (+)-ledene (**3**) has been investigated using *Aspergillus wentii* as a biocatalyst.

Results: Compound **1** was converted to (-)-(10*S*,11*S*)-10,13,14-trihydroxyaromadendrane (**4**). Compound **2** was converted to (+)-(1*S*,11*S*)-1,13-dihydroxyaromadendrene (**5**) and (-)-5,11-epoxycadin-1(10)-en-14-ol (**6**). Compound **3** was converted to compound **6**, (+)-(10*R*,11*S*)-10,13-dihydroxyaromadendr-1-ene (**7**) and (+)-(10*S*,11*S*)-10,13-dihydroxyaromadendr-1-ene (**8**). The structure of the metabolic products has been elucidated on the basis of their spectral data

CONCLUSION: Compound **1** gave only one product that was hydroxylated at C-10, C-13 and C-14. By contrast, compounds **2** and **3** gave a number of products, one of which was common. The differences in oxidation of **1-3** are due to the configuration of the C-1 position. Compounds **4-8** were new compounds.

Keywords: *Aspergillus wentii* • (+)-aromadendrene • (-)-alloaromadendrene • (+)-ledene • biotransformation

Biomarker

Valeska Contardo-Jara[a,] and Claudia Wiegand[a, b]. ([a]Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Department of Inland Fisheries, Biochemical Regulation, Müggelseedamm 301, 12587 Berlin, Germany, [b]Humboldt University Berlin, Faculty of Biology, Unter den Linden 6, 10099 Berlin, Germany). **Molecular biomarkers of *Dreissena polymorpha* for evaluation of renaturation success of a formerly sewage polluted stream. Environmental Pollution, Volume 155(1) (2008) : 182-189**

The renaturation success of an urban stream, formally used for discharge of treated sewage waters was investigated by active biomonitoring with *Dreissena polymorpha* based on molecular biomarkers and compared to a semi-natural stream and laboratory controls. Response to pollution charges were analyzed by reverse transcriptase-PCR of heat-shock protein (hsp70), P-glycoprotein (P-gp), catalase (CAT) and pi class glutathione S-transferase (piGST). Hsp70 transcription was similarly induced at both sites, indicating protein damage. At the semi-natural stream CAT and P-gp were induced, indicating oxidative stress and increased discharge of pollutants, which correlated to high amounts of aluminum at this site. piGST was induced at one sampling date at the renaturated stream only, but identification of the causing pollutant was not achieved. Results confirm regeneration of the formerly sewage polluted stream, because induction of the tested biomarkers was either at or below the levels of the semi-natural stream.

A new application for environmental health assessment combining the use of species tolerant to pollution, Dreissena polymorpha, and molecular tools (RT-PCR) in active biomonitoring.

Keywords: Heat-shock protein; P-glycoprotein; Multi-xenobiotic-resistance mechanism; Catalase; Glutathione S-transferase

Biofertilizer

San-Lang Wang[a], Tsai-Yi Huang[a], Chun-Yuan Wang[a], Tzu-Wen Liang[a], Yue-Horng Yen[b] and Yusuke Sakata[c]. ([a]Graduate Institute of Life Sciences, Tamkang University, Taipei 251, Taiwan, [b]Department of Bioindustry Technology, Da-Yeh University, Changhwa 515, Taiwan, [c]Agricultural Sciences and Natural Resources, Kagoshima University, Kagoshima 890, Japan). **Bioconversion of squid pen by *Lactobacillus paracasei* subsp *paracasei* TKU010 for the production of proteases and lettuce growth enhancing biofertilizers. Bioresource Technology, Volume 99(13) (2008): 5436-5443**

A protease-producing bacterium, strain TKU010, was isolated from infant vomited milk and identified as *Lactobacillus paracasei* subsp. *paracasei*. A surfactant-stable protease, purified 64-fold from the third day culture supernatant to homogeneity in an overall yield of 11%, has a molecular weight of about 49,000. The enzyme degraded casein and gelatin, but did not degrade albumin, fibrin, and elastin. The enzyme activity was increased about 1.5-fold by the addition of 5 mM Ba^{2+}. However, Fe^{2+} and Cu^{2+} ions strongly inhibited the enzyme. The enzyme was maximally active at pH 10 and 60 °C and retained 94% and 71% activity in the presence of Tween 20 (2% w/v) and SDS (2 mM), respectively. The result of identification of TKU010 protease showed that nine tryptic peptides were identical to *Serratia* protease (serralysin) (GenBank accession number gi999638) with 35% sequence coverage. In comparison with the tryptic peptides of *L. paracasei* subsp. *paracasei* TKU012 protease, TKU010 protease possessed two additional peptides with sequences of AATTGYDAVDDLLHYHER and QTFTHEIGHALGLSHPGDYNAGEGNPTYR. The fourth day culture supernatant of TKU010 showed maximal activity of about 5-fold growth enhancing effect on lettuce weight, which was not shown with *L. paracasei* subsp *paracasei* TKU012.

Keywords: *Lactobacillus paracasei*; Extracellular protease; Squid pen; Biofertilizers; Chitin

Biocomposting

Qing-Hu Ma [a]. ([a] Key Laboratory of Photosynthesis and Environmental Molecular Physiology, Institute of Botany, Chinese Academy of Sciences, Beijing, China). Genetic Engineering of Cytokinins and Their Application to Agriculture. Critical Reviews in Biotechnology, Volume 28(3) (2008): 213 – 232

Cytokinins are master regulators of plant growth and development. They are involved in the regulation of many important physiological and metabolic processes. Recent progress in cytokinin research at the molecular level, including identification of related genes and cytokinin receptors, plus elucidation of signal transduction, has greatly increased our understanding of cytokinin actions. Although still in its infant stage, molecular breeding of crops with altered cytokinin metabolism, when combined with the transgenic approach, has shown very promising potential for application to agriculture. In this review we briefly introduce recent progress in cytokinin molecular biology, discuss applications of cytokinin genetic engineering to agriculture, and present implications and future research directions.

Keywords: agricultural applications; cytokinins; genetic engineering; molecular breeding

Biopesticides

Ting Yu[a], Hongyin Zhang[b], Xiaoling Li[a] and Xiaodong Zheng[a]. ([a]Department of Food Science and Nutrition, Zhejiang University, Hangzhou 310029, PR China, [b]College of Biological and Environmental Engineering, Jiangsu University, Zhenjiang 212013, PR China). Biocontrol of *Botrytis cinerea* in apple fruit by *Cryptococcus laurentii* and indole-3-acetic acid. Biological Control, Volume 46(2) (2008): 171-177

This study evaluated the effect of a yeast antagonist *Cryptococcus laurentii* and a plant regulator indole-3-acetic acid (IAA) on inhibition of *Botrytis cinerea* infection in harvested apple fruit. The results showed that the combined treatment with *C. laurentii* and IAA at 20 μg/ml was a more effective approach to reduce the gray mold rot in apple wounds than the *C. laurentii* alone. After 4 days of incubation, gray mold incidence in the combined treatment with *C. laurentii* and IAA was about 18%, which was a 50% reduction in incidence compared to the treatment with *C. laurentii* alone. Although IAA had no direct antifungal activity against *B. cinerea* infection when the time interval between IAA treatment and pathogen inoculation was within 2 h, application of IAA strongly reduced gray mold infection when IAA was applied 24 h prior to inoculation with *B. cinerea* in apple fruit wounds. Moreover, combination of IAA and *C. laurentii* stimulated the activities of superoxide dismutase, catalase and peroxidase with above 1.5-fold higher than that treatment with *C. laurentii* alone at 48 h. Therefore, combination of *C. laurentii* with IAA, which integrated the dual biological activity from the antagonistic yeast and plant regulator, might be developed to be a useful approach to control gray mold in harvested apple fruit.

Keywords: Apple; Biocontrol; *Cryptococcus laurentii*; Gray mold; Indole-3-acetic acid; Postharvest

Fernando García del Pino[1] and Ana Morton[1]. ([1]Departamento Biología Animal, Vegetal y Ecología Facultad de Biociencias, Universidad Autónoma de Barcelona, Bellaterra, Barcelona, 08193, Spain). Efficacy of Steinernema feltiae against the leek moth Acrolepiopsis assectella in laboratory and field conditions. BioControl, Volume 53(4) (2008): 643-650

The susceptibility of larvae of the leek moth, *Acrolepiopsis assectella* Zeller (Lepidoptera: Acrolepiidae) to different concentrations of an autochthonous strain of *Steinernema feltiae* (Rhabditida: Steinernematidae) was examined in laboratory experiments using Petri dishes. The efficacy of this strain in pots and field experiments was also evaluated. High mortality (80%–100%) of leek moth larvae was observed when these larvae were exposed to low concentrations (3×10^3 to 1×10^4 IJs/m^2) of *S. feltiae* under laboratory conditions. Foliar application of 30,000 IJs/leek in pot experiments caused a 98% reduction in leek moth larvae. Field experiments showed a 87.7% reduction of leek moth larvae with the nematode treatment, significantly higher than the 22% reduction with the *Bacillus thuringiensis* treatment. The efficacy of the treatments with *S. feltiae* in relation to the microhabitat of the leek moth larvae between the interfolded leaves of the leek is discussed.

Keywords: *Allium* spp. - Biological control - Entomopathogenic nematodes - Foliar application - Steinernematidae

Sankarasubramanian Harish[1, 2], Duraiswamy Saravanakumar[3], Ramalingam Radjacommare[3], E. G. Ebenezar[1] and K. Seetharaman[1]. ([1]Department of Plant Pathology, Agricultural College and Research Institute, Madurai, 625104, India, [2]*Present address:* Molecular Plant Virology Lab, Department of Plant Pathology, College of Agriculture and Natural Resources, National Chung Hsing University, Taichung, 402, Taiwan R.O.C, [3]Department of Plant Pathology, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore, 641 041, India). Use of plant extracts and biocontrol agents for the management of brown spot disease in rice. BioControl, Volume 53(3) (2008): 555-567

Fifty plant extracts, four oil cakes and eight antagonistic organisms were tested against *Bipolaris oryzae* (*Cochliobolus miyabeanus*), the causal agent of brown spot disease of rice. *In vitro* studies indicated that two leaf extracts, *Nerium oleander* and *Pithecolobium dulce* exerted the higher percent inhibition to mycelial growth (77.4, 75.1%) and spore germination (80.3, 80.0%) of *B. oryzae*. Among the four oil cake extracts tested *in vitro* against *B. oryzae*, neem cake extract showed the maximum inhibition percent to mycelial growth (80.18%) and spore germination (81.13%) of the pathogen followed by mahua cake extract, castor and gingelly cake extract. *Trichoderma viride* (Tv2*)* was significantly effective in inhibiting the mycelial growth (62.92%) and spore germination (77.03%) of the pathogen followed by *Trichoderma harzianum* (Th5) and *Trichoderma reesei* (Tr3). The promising leaf extracts, oil cake extracts and antagonistic microorganisms were further evaluated for their efficacies in disease management under glasshouse and field conditions. In glasshouse studies, post-infectional spraying of rice plants with neem cake extract, *N. oleander* leaf extract and *T. viride* (Tv2) was significantly effective in reducing the incidence of brown spot of rice by 66, 52 and 45 percent respectively. Two rounds of spraying of rice plants with neem cake extract, *N. oleander* leaf extract and *T. viride* (Tv2) in the field at initial appearance of disease and 15 days later reduced the incidence

of brown spot (70, 53 and 48% disease reduction respectively) and increased the yield by 23, 18 and 15 percent respectively.

Keywords: *Bipolaris oryzae* - Brown spot - Plant extract - Antagonistic microorganisms - Oil cake extract

J. M. Lynch. (School of Biomedical and Life Sciences, University of Surrey, Guildford, Surrey GU2 7XH, UK). Biocontrol Potential and its Exploitation in Sustainable Agriculture, Volume 1 Crop Diseases, Weeds and Nematodes. R.K. Upadhyay, K.G. Mukerji, B.P. Chamola (Eds.) Kluwer Academic/Plenum Publishers, New York, 294+xii pp, £86-25, ISBN 0-306-46460-8. Crop Protection. Volume 21(1) (2002): 79-80

Many books have been written on biocontrol. This collection of essays is as classical in its approach as any I have seen on this topic. The production of the book is similarly classical in style, with very few figures, diagrams and tables. The formatting is also rather flat. So what is different about this book that could tempt anybody into a purchase? The principal factor is that the three editors are Indian, the 42 contributors are Indian, and all the works described appears to have been done in India. Most of the Indian workers who have published internationally in this field are included in the book as authors. Simply to describe work from India is not of course in itself a good enough reason to purchase the book. However, Indian agriculture has some of their best illustrations of sustainability in the world. Biocontrol is potentially a very important component of sustainability and therefore it has much higher chance of being adopted where agricultural systems are driven in that direction. In India rural communities can be major protagonists of sustainable systems.

The range of topics covered in the book is wide. It starts with classical genetics and the topic of systemic induced resistance. It then moves into biocontrol of plant diseases for agricultural sustainability and plant disease management, followed by discussions about protoplast fusion technology and microbial iron chelators. There then follows a discussion of antiviral fungal proteins and mycoviruses and other viruses in crop disease management. There are two chapters on mycorrhizal fungi in biocontrol. This is followed by discussion of the use of fungi and bacteria to control phytonematodes. There are then two chapters on the control of weeds followed by five chapters on specific considerations of biocontrol in specific crops.

It has to be said that the level of presentation and analysis is variable. However, there are some very useful insights given on how biocontrol might be exploited. It is rather disappointing, however, that there is little critical analysis of the commercial exploitation even at the village level. This is very much a specialist book and it is quite expensive. It is unlikely to be purchased by individuals but for those institutions with researchers in this general field it should prove useful on the library shelf.

Daniel Jančula [1 2], Michaela Drábková [1 2], Jiří Černý [3], Marie Karásková [3], Radka Kořínková [3], Jan Rakušan [3], Blahoslav Maršálek [1 2 *]. ([1]Centre for Cyanobacteria and Their Toxins, Institute of Botany, Academy of Sciences of the Czech Republic, Květná 8, 60365 Brno, Czech Republic, [2]RECETOX, Masaryk University, Kamenice 126/3, 62500 Brno, Czech Republic, [3]Research Institute of Organic Synthesis (VÚOS PLC), Rybitví 296, 53218 Pardubice, Czech Republic. [*]Correspondence to Blahoslav Maršálek, Centre for Cyanobacteria and Their Toxins, Institute of Botany, Academy of Sciences of the Czech Republic, Květná 8, 60365 Brno, Czech Republic. email: Blahoslav Maršálek

marsalek@recetox.muni.cz). Algicidal activity of phthalocyanines - Screening of 31 compounds. Environmental Toxicology, Volume 23(2) (2008): 218 - 223

Phthalocyanines and their analogues show great potential as photodynamic agents producing reactive oxygen species (ROS), especially in medicine. However, their biocidal effects may also be employed to inhibit various undesirable organisms. This study explores their potential algicidal effects. The laboratory tests concern the effects of various phthalocyanine derivatives on the green alga *Pseudokirchneriella subcapitata* and cyanobacterium *Synechococcus nidulans*. Their effects on one example of the sensitive nontarget aquatic organism - crustacean *Daphnia magna* were also screened. Among 31 tested compounds, the cationic phthalocyanines substituted with heterocycle exhibited the strongest effects on phytoplankton species, some of them even below the level of 1 mg/L, while effects on crustaceans ranged from 3.6 to more than 50 mg/L. These results show that some phthalocyanine derivatives can act as potent algicides.

Keywords: phthatocyanines • algicide • cyanobacteria • water management

F. A. Kuta. (Department of Microbiology, Federal University of Technology, Minna, Nigeria. E-mail: kutafaruk@yahoo.com). Antifungal effect of Calotropis procera stem bark on *Epidermophyton flocosum* and *Trichophyton gypseum*. African Journal of Biotechnology Vol. 7 (13)(2008): 2116–2118

The antifugal activities of aqueous extract of *Calotropics procera* was determined against *Epidermophyton flocosum* and *Tricophyton gypseum* using agar diffusion techniques. The crude extract of *C. procera* showed activity on *E. flocosum* and *T. gypseum* at 4.0 mg/ml. The result of minimum inhibitory concentration (MIC) was 0.5 and 0.9 mg/ml and that of minimum fungicidal concentration (MFC) was 2.0 and 4.0 mg/ml, respectively. The result of the Ames test indicated that the crude extract is not mutagenic. Phytochemical screening of the crude extract revealed the presence of saponin, tannins, sequiterpene and alkaloids. The results of the study suggest that *C. procera* stem could be a potential source of chemotherapeutic drugs for the treatment of tinea associated with *E. flocosum* and *T. gypseum*.

Keywords: *Calotropis procera*, *Epidermophyton flocosum*, *Trichophyton gypseum*, mutagencity.

Oyeleke, S. B.[1*], Dauda, B. E. N.[2] and Boye, O. A.[1]. ([1]Department of Microbiology, Federal University of Technology, Minna, Nigeria, [2]Department of Chemistry, Federal University of Technology, Minna. Nigeria. *Corresponding author. E-mail: droyeleke@yahoo.com). Antibacterial activity of *Ficus capensis*. African Journal of Biotechnology Vol. 7 (10)(2008): 1414–1417

The leaves and stem bark of *Ficus capensis* were investigated for antibacterial activity against some selected organisms at a concentration of 2000 µg/ml using agar diffusion method. The crude leaf extract inhibited the growth of *Escherichia coli* and *Shigella* sp. but no activity against *Salmonella typhi*. The stem bark extracts also had activity against *E. coli* and *Shigella* sp. but no activity against *S. typhi*. The phytochemical screening of the extracts reveals the presence of alkaloids, balsams, taninins, carbohydrates, resins, flavonoids, Sterols and terpenes. Glycosides were absent in the leaf extract while the stem bark extract had glycosides. Both extracts did not posses free arthraquinones and saponins. The Minimum inhibitory concentration (MIC) of the extracts range from 500-2000 µg/ml. The fractions obtained from the thin layer chromatography

had no activity on the test organisms. The results from the activity of the crude extracts suggest that *F. capensis* could be used in treatment of diseases caused by these bacteria except *S. typhi*.

Keywords: *Ficus capensis*, antibacterial, phytochemical.

Virgilio Mojica-Marín[1]*, Hugo A. Luna-Olvera[2], Carlos Fco. Sandoval-Coronado[2], Benito Pereyra-Alférez[2], Lilia H. Morales-Ramos[2], Carlos E. Hernández-Luna[2] and Omar G. Alvarado-Gomez[3]. ([1]Facultad de Ciencias Químicas. Universidad Juárez Del Estado de Durango (UJED), Av. Veterinaria s/n, Circuito Universitario, CP. 34120. Durango, Dgo. México, [2]Facultad de Ciencias Biológicas. Universidad Autónoma De Nuevo León (UANL), Av. Pedro de Alba y Manuel L. Barragán, Ciudad Universitaria, CP. 66450, A.P. 414 y 2790 San Nicolás de los Garza, Nuevo León, México, [3]Facultad de Agronomía. Universidad Autónoma De Nuevo León (UANL), Carretera Zuazua -Marín Km 17.5, CP. 66700. Marín, Nuevo León, México. *Corresponding author. E-mail: vmojica@citologica.com, vmojicamx@yahoo.com.mx. Tel/Fax: (618) 1-30-11-11; 1-30-11-20). **Antagonistic activity of selected strains of *Bacillus thuringiensis* against *Rhizoctonia solani* of chili pepper. African Journal of Biotechnology Vol. 7 (9)(2008): 1271–1276**

The aim of this work was to determine, *in vitro*, the antagonistic effectiveness of 60 strains of *Bacillus thuringiensis* against damping-off and root and stem rot caused by *Rhizoctonia solani*. The strains were obtained from the International Collection of Entomopathogenic Bacillus at the FCB-UANL. During the *in vitro* dual culture assay only 16 of the strains displayed an inhibitory effect. Six strains were chosen to be screened simultaneously by volatile antibiotics, thermostability and seedling assay. In the volatile antibiotics assay, the strains GM-11 and GM-121 showed the best inhibitory effect over *R. solani* growth. None of the strains showed an efficient antagonistic effect during the thermoestability assay. In seedling assay, majority of the antagonistic isolates, GM-23, GM-11and GM-121, were effective in the reduction of *R. solani* infection. In addition, GM-23 increased the length of pepper seedlings. These results suggest that the *B. thuringiensis* strains studied have an excellent potential to be used as bio-control agents of *R. solani* in chili pepper.

Key words: Antagonist, biological control, damping-off, *Rhizoctonia solani*.

Josphat C. Matasyoh[1]*, Euty M. Wathuta[2], Samuel T. Kariuki[2], Regina Chepkorir[1] and Judith Kavulani[3]. ([1]Department of Chemistry, Egerton University, P. O. Box 536, Egerton 20107, Kenya, [2]Department of Biological Sciences, Egerton University, P. O. Box 536, Egerton 20107, Kenya, [3]Department of Biochemistry, Egerton University, P. O. Box 536, Egerton 20107, Kenya. *Corresponding author. E-mail: josphat2001@yahoo.com. Tel: 000254-722-871521). ***Aloe* plant extracts as alternative larvicides for mosquito control. African Journal of Biotechnology Vol. 7 (7) (2008): 912–915**

The larvicidal activity of extracts from *Aloe turkanensis*, *Aloe ngongensis* and *Aloe fibrosa* against the common malaria vector, *Anopheles gambie*, was determined. Ground *Aloe* leaves from the three plants were sequentially extracted with hexane, ethyl acetate, chloroform, acetone and methanol. Only the ethyl acetate extract of *A. turkanensis*, hexane, ethyl acetate, acetone, chloroform and methanol extracts of *A. ngongensis* and the hexane, acetone and methanol extracts of *A. fibrosa* showed activity. A series of concentrations of the extracts ranging from 0.05-2 mg/ml (0.005-0.2% w/v) were tested against third instar larvae and their percentage mortalities, LC_{50} values determined. The ethyl acetate soluble extract of *A. turkanensis* showed

very high larvicidal activity where 100% mortality was achieved at a concentration of 0.2 mg/ml and it had an LC_{50} of 0.11 mg/ml. All the extracts of *A. ngongensis* showed larvicidal activity to *A. gambie* larvae, but at higher concentration showing LC_{50}´s of 0.84 (0.55 – 1.27), 1.14 (0.72 – 2.28), 0.98 (0.78 – 1.27), 1.08 (0.90 – 1.28), 2.0 (1.85 – 2.36) for the hexane, ethyl acetate, chloroform, acetone and methanol, respectively. The three active fractions of *A. fibrosa* had very close LC_{50}´s ranging from 1.76 – 1.90 mg/ml. Thin layer chromatographic analysis (TLC) showed the presence of chromones and anthrones in the chloroform and ethyl acetate extracts. Application of these extracts to larval habitats may lead to promising results in malaria and mosquito management programmes.

Key words: *Aloe*, *anopheles gambie*, larvicidal activity.

Behzad Hajieghrari[1*], Mousa Torabi-Giglou[1], Mohammad Reza Mohammadi[2] and Mahdi Davari[3]. ([1]Department of Plant Production, Moghan Junior College of Agriculture, University of Mohaghegh – Ardabili, Ardabil, Iran, [2]Department of Plant Protection, Faculty of Agriculture, Islamic Azad University Branch, Varamin, Iran, [3]Department of Plant Protection, Faculty of Agriculture, University of Mohaghegh Ardabili, Ardabil, Iran. *Corresponding author. E-mail: bhajieghrari@uma.ac.ir. Tel: +989143186861.Fax: +984527463417). Biological potantial of some Iranian *Trichoderma* isolates in the control of soil borne plant pathogenic fungi. African Journal of Biotechnology Vol. 7 (8) (2008): 967–972

In this study the *in vitro* potential of six selected Iranian isolates of three species of *Trichoderma* (*Trichoderma hamatum* T614, *T. hamatum* T612, *Trichoderma harzianum* T447, *T. harzianum* T969, *Trichoderma virens* T523 and *Trichoderma* sp. T) were evaluated against five isolates of soil borne phytopathogenic fungi (*Fusarium graminearum*, *Rhizoctonia solani* (AG4 and AG5), *Macrophomina phaseoli* and *Phytophtora cacturum*) in dual culture techniques and through production of volatile and non-volatile inhibitors, and the pH and temperature effects on *Trichoderma* mycelial growth were also evaluated. All *Trichoderma* isolates had a marked statistical inhibitory effect on mycelial growth of the pathogens in dual culture compared with controls. Maximum inhibitions occurred in *F. graminearum*-*T. hamatum* T614 interaction. Significant pathogen colony growth inhibitions were observed when exposed to the trapped atmosphere from culture of the *Trichoderma*. *F. graminearum* was most susceptible to the volatile inhibitors produced by *T. hamatum* T612 (%inhibition = 48.65). Medium filtrate obtained the *Trichoderma* isolate culture also were effected on the pathogen species significantly. Maximum growth inhibition was observed in radial growth of *F. graminearum* by *T. hamatum* T612 non volatile metabolites (%inhibition = 38.3). Evaluation of pH and temperature effects on *Trichoderma* isolates mycelial growth showed that *Trichoderma* strains were found to be able to display activities under a wider range of pH values. Also, *Trichoderma* strains are mesophilic.

Key words: *Trichoderma* spp., biological potantial, soil borne phytopathogenic fungi, Iran.

Makut, M. D.*, Gyar, S. D., Pennap, G. R. I. and Anthony, P. (Microbiology Unit, Department of Biological Sciences, Nasarawa State University, P.M.B. 1022, Keffi, Nigeria. *Corresponding author. E-mail: makmakwin@yahoo.com). Phytochemical screening and antimicrobial activity of the ethanolic and methanolic extracts of the leaf and bark of *Khaya senegalensis.* African Journal of Biotechnology Vol. 7 (9) (2008): 1216–1219

Khaya senegalensis, a member of the family Meliaceae, is a plant commonly used by the local people of Nasarawa State of Nigeria for the treatment of dysentery, mucous diarrhoea and wound infections. The leaves and the bark of the plant were screened for their phytochemical properties and antimicrobial activity. Ethanol was used for the extraction of the active compounds. The test organisms were *Staphylococcus aureus, Steptococcus faecalis, Escherichia coli* and *Candida albicans*. Results of the phytochemical screening showed that saponins, tannins, alkaloids, glycosides, steriods, terpenoids and flavonoids were the active compounds present in the leaves and bark of the plant. The antimicrobial susceptibility test showed that *S. aureus, S. feacalis* and *C. albicans* were susceptible to both the leaf and bark extracts, while *E. coli* was not. The extracts were also found to be bactericidal to *S. aureus* and *S. feacalis*, and fungicidal to *C. albicans*. This study demonstrates the potentials of *K. senegalensis* as a source of antimicrobials that could be harness for use in the Health Care Delivery process.

Key words: *Khaya senegalensis*, antimicrobial activity, phytochemical.

Biodegradation

Partha Sarathi Majumder[a] and S.K. Gupta[a]. ([a]Centre for Environmental Science and Engineering, Indian Institute of Technology, Powai, Mumbai 400 076, India). Degradation of 4-chlorophenol in UASB reactor under methanogenic conditions. Bioresource Technology, Vol 99(10) (2008): 4169-4177

Treatment of simulated wastewater containing 40 mg/l of 4-chlorophenol (4-CP) was carried out in an upflow anaerobic sludge blanket (UASB) reactor under methanogenic condition. The performance of this test UASB reactor was evaluated in terms of 4-CP removal. Hydraulic retention time (HRT) and substrate:co-substrate ratio for the 4-CP removal was optimized by varying the influent flow rate (13–34.7 ml/min) and sodium acetate concentration (2–5 g/l), respectively. A control UASB reactor, which was not exposed to 4-CP was also operated under similar conditions. Organic loading rate (OLR) was varied in the range of 2–5.3 kg/m^3/d and 1.7–4.2 kg/m^3/d, respectively, for HRT and substrate:co-substrate ratio studies, respectively. The optimum HRT and substrate:co-substrate ratio for the removal of 4-CP was 12 h and 1:75, respectively. Removal of 4-CP achieved at optimum HRT and substrate:co-substrate ratio was 88.3 ± 0.7%. Removal of 4-CP occurred through dehalogenation and caused increase in chloride ion concentration in the effluent by 0.23–0.27 mg/mg 4-CP removed. The ring cleavage test showed the *ortho* mode of ring cleavage of 4-CP. Change in the elemental composition of the anaerobic biomass of UASB reactors was observed during the study period. Concentration of Ca^{2+} increased in the biomass and this could be attributed to the biosoftening. Specific methanogenic activity of the sludge of control and test UASB reactor was 0.832 g CH_4 COD/g VSS d and 0.694 g CH_4 COD/g VSS d, respectively.

Keywords: Upflow anaerobic sludge blanket (UASB); 4-Chlorophenol (4-CP); Methanogenic condition; Ring cleavage; Biosoftening

Michael M. Tauber[a, b], Georg M. Gübitz[b] and Astrid Rehorek[a]. ([a]University of Applied Sciences Cologne, Faculty of Process Engineering, Energy and Mechanical Systems, Department of Chemical Engineering and Plant Design, Betzdorfer Straße 2, D-50679 Cologne, Germany [b]University of Technology Graz, Institute for Environmental Biotechnology, Petersgasse 10, A-8010 Graz, Austria). Degradation of azo dyes by oxidative

processes – Laccase and ultrasound treatment. Bioresource Technology, Volume 99, Issue 10, July 2008, Pages 4213-4220

Azo dyes are of synthetic origin and their environmental fate is not well understood. They are resistant to direct aerobic bacterial degradation and form potentially carcinogenic aromatic amines by reduction of the azo group. This study shows that applying the oxidative processes of enzymatic treatment with laccase and ultrasound treatment, both alone and in combination, leads to dye degradation. Laccase treatment degraded both Acid Orange and Direct Blue dyes within 1–5 h but failed in the case of Reactive dyes, whereas ultrasound degraded all the dyes investigated (3–15 h). When applied as multi-stage combinations the treatments showed synergistic effects for dye degradation compared with individual treatments. Bulk light absorption (UV–Vis) and ion pairing HPLC were used for process monitoring. Additionally, mass spectrometry was used to elucidate the structures of intermediates arising from ultrasound treatment.

Keywords: Azo dyes; Laccase; Ultrasound; Ion pairing HPLC; Mass spectrometry

D.C. Kalyani[a], P.S. Patil[a], J.P. Jadhav[a] and S.P. Govindwar[a]. ([a]Department of Biochemistry, Shivaji University, Kolhapur 416 004, India). Biodegradation of reactive textile dye Red BLI by an isolated bacterium *Pseudomonas* sp. SUK1. Bioresource Technology, Vol 99(11) (2008): 4635-4641

A novel bacterial strain capable of decolorizing reactive textile dye Red BLI is isolated from the soil sample collected from contaminated sites of textile industry from Solapur, India. The bacterial isolate was identified as *Pseudomonas* sp. SUK1 on the basis of 16S rDNA analysis. The *Pseudomonas* sp. SUK1 decolorized Red BLI (50 mg l^{-1}) 99.28% within 1 h under static anoxic condition at pH range from 6.5 to 7.0 and 30 °C. This strain has ability to decolorize various reactive textile dyes. UV–Vis spectroscopy, FTIR and TLC analysis of samples before and after dye decolorization in culture medium confirmed decolorization of Red BLI. A significant increase in the activities of aminopyrine *N*-demethylase and NADH-DCIP reductase in cells obtained after decolorization indicates involvement of these enzymes in the decolorization process. Phytotoxicity testing with the seeds of *Sorghum vulgare* and *Phaseolus mungo*, showed more sensitivity towards the dye, while the products obtained after dye decolorization does not have any inhibitory effects.

Keywords: Isolation; Red BLI; Dye decolorization; Reactive textile dyes; Phytotoxicity

Neeru Kadian[a], Asha Gupta[b], Santosh Satya[a], Ramesh Kumari Mehta[c] and Anushree Malik[a]. ([a]Center for Rural Development and Technology, Indian Institute of Technology, New Delhi, India, [b]Department of Environmental Science and Engineering, Guru Jambheshwar University, Hisar, India [c]Department of Agronomy, CCS Agriculture University, Hisar, India). Biodegradation of herbicide (atrazine) in contaminated soil using various bioprocessed materials. Bioresource Technology, Volume 99(11) (2008): ages 4642-4647

The concept of biostimulation i.e. enhancing the intrinsic degradation potential of a polluted matrix via the addition of amendments, nutrients, or other limiting factors has been used for a wide variety of xenobiotics. The objective of this research work was to study the degradation of atrazine (25 ppm) in soil amended with biogas slurry, mushroom spent compost, farmyard

manure and sodium citrate as one of the chemical amendment. In the lab scale experiments carried out up to 21 days, atrazine in soil was extracted by column method and analyzed by HPLC. The atrazine dissipation was observed to be highest (34%) with biogas slurry. The study on synergistic effect of sodium citrate with farmyard manure showed a negative effect in initial phase, but dissipation gradually increased after 1st week (i.e. 32% degradation after 21 days). Although addition of organic manures has been an integral part of sustainable agriculture practices; the present findings give a new dimension of it's utilization for removal of persistent pesticides.

Keywords: Atrazine; Biostimulation; Bioprocessed materials (biogas slurry, farmyard manure, mushroom spent compost)

Ram Chandra[a], Ram Naresh Bharagava[a] and Vibhuti Rai[b]. ([a]Environmental Microbiology Section, Industrial Toxicology Research Centre, Post Box No. 80, M.G. Marg, Lucknow 226001, U.P., India, [b]School of Studies in Life Sciences, Pt. Ravi Shankar Shukla University, Raipur 492010, C.G., India). Melanoidins as major colourant in sugarcane molasses based distillery effluent and its degradation. Bioresource Technology, Volume 99(11) (2008): 4648-4660

Melanoidins are natural condensation products of sugar and amino acids produced by non-enzymatic Maillard amino–carbonyl reaction taking place between the amino and carbonyl groups in organic substances. Melanoidins extensively exist in food products, drinks and wastewaters released from distilleries and fermentation industries. Melanoidins are very important from the nutritional, physiological and environmental aspects and due to their structural complexity, dark colour and offensive odor, these pose serious threat to soil and aquatic ecosystem that release of melanoidins cause increased load of recalcitrant organic material to natural water bodies. This then causes the problems, like reduction of sunlight penetration, decreased photosynthetic activity and dissolved oxygen concentration whereas on land, it causes reduction in soil alkalinity and inhibition of seed germination. Further, due to the possibility of complexation reactions of introduced melanoidins with metal ions, they could influence the biogeochemical cycle of many constituents in natural waters. This review presents an overview to dramatic progress to understand the synthesis, chemical structure and degradation pathway of melanoidins as well as microbial strategies for the degradation and decolourisation of melanoidins.

Keywords: Melanoidins; Sugar cane molasses; Degradation; Chemical; Microorganism

Dongzhi Chen[a], Jianmeng Chen[a], Weihong Zhong[a] and Zhuowei Cheng[a]. ([a]College of Biological and Environmental Engineering, Zhejiang University of Technology, Hangzhou 310032, China). Degradation of methyl *tert*-butyl ether by gel immobilized *Methylibium petroleiphilum* PM1. Bioresource Technology, Volume 99(11) (2008): 4702-4708

Cells of *Methylibium petroleiphilum* PM1 were immobilized in gel beads to degrade methyl *tert*-butyl ether (MTBE). Calcium alginate, agar, polyacrylamide and polyvinvyl alcohol were screened as suitable immobilization matrices, with calcium alginate demonstrating the fastest MTBE-degradation rate. The rate was accelerated by 1.8-fold when the beads had been treated in physiological saline for 24 h at 28 °C. MTBE degradation in mineral salts medium (MSM) was accompanied by the increase of biomass. The half-life of MTBE-degradation activity for the encapsulated cells stored at 28 °C was about 120 h, which was obviously longer than that of free

cells (approximately 36 h). Efficient reusability of the beads up to 30 batches was achieved in poor nutrition solution as compared to only 6 batches in MSM. The immobilized cells could be operated in a packed-bed reactor for degradation of 10 mg L^{-1} MTBE in groundwater with more than 99% removal efficiency at hydraulic retention time of 20 min. These results suggested that immobilized cells of PM1 in bioreactor might be applicable to a groundwater treatment system for the removal of MTBE.

Keywords: Methyl *tert*-butyl ether; Immobilization; Alginate; Groundwater; *Methylibium petroleiphilum* PM1

D. Lindsay[a], M. Ntoampe[a] and V.M. Gray[a]. ([a]School of Molecular and Cell Biology, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa). **Biodegradation of sodium benzoate by a Gram-negative consortium in a laboratory-scale fluidized bed bioreactor. Bioresource Technology, Volume 99(11) (2008): 5115-5119**

Gram-negative bacteria with the potential to metabolize *n*-alkanes and cyclic hydrocarbons were isolated from local soils and identified using 16S rDNA sequence analysis. Three isolates (CS1CO, GL1CO, GCI1CO) were identified as strains of *Pseudomonas* (*P.*) *aeruginosa* and a further strain (DSS2) as *P. putida.* Isolates were co-cultured in a laboratory-scale fluidized bed biofilm bioreactor (FBBR) utilizing sodium benzoate as the sole carbon source, under two batch and/or one continuous growth conditions. Biofilm and planktonic bacterial growth dynamics were monitored by plate counts, and optical density measurements (230 nm) determined benzoate biodegradation. Overall higher attached and planktonic bacterial counts, and benzoate depletion, were determined under batch compared to continuous conditions, and the bioreactor performed better during the second batch phase when compared to the first batch phase. It thus appeared that both the planktonic and biofilm components of the system were necessary for the most successful sodium benzoate degradation in this system.

Keywords: Biodegradation; Biofilm; Fluidized bed bioreactor

J.K. Adesodun[a] and J.S.C. Mbagwu[b]. ([a]Department of Soil Science and Land Management, University of Agriculture, P.M.B 2240, Abeokuta 110001, Ogun-State, Nigeria, [b]Department of Soil Science, University of Nigeria, Nsukka, Enugu-State, Nigeria). **Biodegradation of waste-lubricating petroleum oil in a tropical alfisol as mediated by animal droppings. Bioresource Technology, Volume 99(13) (2008): 5659-5665**

This study evaluated the applicability of some organic wastes from animal droppings as bioremediation alternative for soils spiked with waste-lubricating oil (spent oil). The total hydrocarbon contents (THC) with time of sampling were markedly reduced with addition of cow dung (CD), poultry manure (PM) and pig wastes (PW). The general trend in the first year indicated that PW stimulated the highest net percentage loss in THC for soils polluted with 5000 mg kg^{-1} (0.5%SP) and 50,000 mg kg^{-1} (5%SP) oil levels. Poultry manure induced the highest reduction in soils polluted with medium, i.e. 2.5%SP (25,000 mg kg^{-1}) oil concentration. The overall net loss mediated by each organic waste in the 2nd year showed that PM addition was better irrespective of total oil loading. For example, at 3 months PM led to 16.1% and 14.6% net reduction in THC for soils treated with 50,000 mg kg^{-1} (5%) and 100,000 mg kg^{-1} (10%) total oil loading, respectively; whereas at same period, the performance of the organic wastes were relatively similar in soils with 10,000 mg kg^{-1} oil loading. At 6 and 12 months, PM reduced the oil levels better than CD and PW. Further evaluation by first-order kinetic model which

utilized combine data for the entire periods for each year indicated that PW was better at low oil pollution level, while PM performed better at high oil pollution levels. Overall, the differential performance of these organic amendments followed PM > PW > CD.

Keywords: Bioremediation; Waste-lubricating oil; Organic wastes; Total hydrocarbon content; Soil contamination

M.C. Tomei[a], C.M. Braguglia[a] and G. Mininni[a]. ([a]Water Research Institute, CNR, via Reno 1, 00198 Roma, Italy). Anaerobic degradation kinetics of particulate organic matter in untreated and sonicated sewage sludge: Role of the inoculum. **Bioresource Technology, Volume 99(14) (2008): 6119-6126**

Degradation kinetics of particulate matter in anaerobic digestion of secondary sludge, untreated and sonicated, was investigated by carrying out batch tests at different feed/inoculum ratio (*F*/*I*) (in the range of 0.1–4.0). Particulate COD degradation data were analysed using the four equations most widely utilized to model the hydrolysis process and the related kinetic parameters were evaluated. The increase of *F*/*I* results in a correspondent increase of the process rate up to one order of magnitude in the investigated interval for both untreated and sonicated sludge. The maximum step increase is observed in the range of 0.1–2.0 while for *F*/*I* varying from 2.0 to 4.0 only a modest enhancement of the process kinetics is detected. The effect of sonication on kinetics is not appreciable at low *F*/*I*, due to the low fraction of fed sludge and to the consequent strong substrate limitation, whereas at high *F*/*I* a slight increase is evidenced.

Keywords: Anaerobic digestion; Sewage sludge; Particulate matter degradation; Hydrolysis kinetics; Ultrasound treatment

S. Shokrollahzadeh[a], F. Azizmohseni[b], F. Golmohammad[a], H. Shokouhi[a] and F. Khademhaghighat[b]. ([a]Institute of Chemical Technologies, Iranian Research Organization for Science and Technology, No. 71, Forsat Street, Enghelab Avenue, P.O. Box 15815-3538, Tehran, Iran, [b]Institute of Biotechnology, Iranian Research Organization for Science and Technology, Tehran, Iran). Biodegradation potential and bacterial diversity of a petrochemical wastewater treatment plant in Iran. Bioresource Technology, Volume 99(14) (2008): 6127-6133

An activated sludge treatment was evaluated for its effectiveness in cleaning up a petrochemical wastewater in Iran. For assessing biodegradation potential of activated sludge, seven characteristics of wastewater (temperature, pH, dissolved oxygen, chemical oxygen demand, concentrations of ethylene dichloride, vinyl chloride, and total hydrocarbons) were monitored during six months. It was shown that dominant pollutants in order of magnitude were normal-alkanes (C_{10}–C_{21}), aromatics, and polycyclic hydrocarbons. The activated sludge treatment revealed maximum reduction of 89%, 99%, 92%, and 80% in COD, ethylene dichloride, vinyl chloride and total hydrocarbons concentrations, respectively. Preliminary screening of culturable petrochemical-degrading microorganisms of the activated sludge resulted in the collection of 67 bacterial and one mold species. Bacterial strains mainly belonged to *Pseudomonas*, *Flavobacterium*, *Comamonas*, *Cytophaga*, *Acidovorax*, *Sphingomonas*, *Bacillus* and *Acinetobacter* genera. The isolated mold was identified as *Trichoderma* sp.

Keywords: Activated sludge; Biological treatment; Biodegradation; Petrochemical wastewater; Bacterial diversity

Jun Xu[a, b], Min Yang[c], Jiayin Dai[a], Hong Cao[a], Canping Pan[b], Xinghui Qiu[a] and Muqi Xu[a]. ([a]Institute of Zoology, Chinese Academy of Sciences, Beijing, PR China, [b]College of Science, China Agricultural University, Beijing, PR China, [c]Research Centre of Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing, PR China). Degradation of acetochlor by four microbial communities. Bioresource Technology, Volume 99(16) (2008): 7797-7802

Four microbial communities capable of degrading acetochlor, designated A, D, E, and J, were obtained from acetochlor-contaminated soil and sludge. Acetochlor at an initial concentration of 55 mg/L was completely degraded by the four mixed cultures after 4 days. At 80 mg/L acetochlor, more than 99% degradation was observed with D, 84% with A and E, and 88% with J after 9 days. There are primary eight strains of bacteria in community A, three in community D, E, and J, respectively. No single isolate was able to degrade acetochlor efficiently. The acetochlor biodegradation products were identified by gas chromatography–mass spectrometry. The probable degradative pathways of acetochlor involved dechlorination, hydroxylation, deethoxymethylation, cyclization, carboxylation, and decarboxylation. Propachlor, alachlor, and metolachlor, which are also the main components of the chloroacetanilide herbicide, could be degraded by the four mixed cultures to some degree. Given the high degradation rates observed here, the four mixed cultures obtained may be useful in the degradation processes of acetochlor.

Keywords: Acetochlor; Degradation; Microbial communities; Bacteria

B.V. Chang[a], C.L. Liu[a], S.Y. Yuan[a], C.Y. Cheng[b] and W.H. Ding[b]. ([a]Department of Microbiology, Soochow University, Taipei 111, Taiwan, [b]Department of Chemistry, National Central University, Chung-Li 320, Taiwan). Biodegradation of nonylphenol in mangrove sediment. International Biodeterioration & Biodegradation, Volume 61(4) (2008): 325-330

This study investigated the biodegradation of nonylphenol (NP) in mangrove sediments collected at five sites along the Tanshui River in northern Taiwan. NP biodegradation rate constants (k_1) and half-lives ($t_{1/2}$) ranged from 0.039 to 0.139 day^{-1} and 5.0 to 17.8 days, respectively. The biodegradation of NP was enhanced by the addition of yeast extract, hydrogen peroxide, brij 35, sodium chloride, or cellulose. However, NP biodegradation was inhibited by the addition of humic acid, heavy metals, or phthalic acid esters (PAEs). Of the microorganism strains isolated from the mangrove sediment, we found that strains A9, A10 and A13 (all identified as *Bacillus* sp.) expressed the best biodegrading ability. NP biodegradation rate constants (k_1) and half-lives ($t_{1/2}$) by the three strains ranged from 0.291 to 0.630 day^{-1} and 1.1 to 2.4 days, respectively. The highest NP biodegradation rate was found in the sediment with the inoculation containing strains A9, A10 and A13, whereas the sediment without any inoculation had the lowest biodegradation rate.

Keywords: Nonylphenol; Mangrove; Sediments; Biodegradation; Taiwan

HongLi Huang[a], GuangMing Zeng [a], Lin Tang[a], HongYan Yu[a], XingMei Xi[a], ZhaoMeng Chen[a] and GuoHe Huang[a]. ([a]College of Environmental Science and Engineering, Hunan University, Changsha 410082, People's Republic of China). Effect of biodelignification of rice straw on humification and humus quality by *Phanerochaete chrysosporium* and *Streptomyces badius*. International Biodeterioration & Biodegradation, Volume 61(4) (2008): 331-336

The effect of biodelignification of rice straw by two different ligninolytic organisms, *Phanerochaete chrysosporium* (white-rot fungus) and *Streptomyces badius* (actinomycetes), on humus quality was investigated during a 56-day incubation at 30 °C. Lignin degradation, the release of humic extract (HE), humic acid (HA) and fulvic acid (FA), E4/E6 ratio of HA, and humification index (HI, HA/FA) were measured during the incubation. Lignin was degraded by both organisms, but to different extents. Lignin was degraded to 41% and 31% by *P. chrysosporium* and *S. badius*, respectively. HE released by *P. chrysosporium* and *S. badius* were, respectively, 2.10 and 2.13 times larger than that in the control at the maximum values. A significant correlation between lignin degradation and humus-related parameters involving HA fraction showed that both organisms are converting lignin to humic substances.

Keywords: *Phanerochaete chrysosporium*; *Streptomyces badius*; Lignin; Humus

Jianbo Zhang[a], Xiaopeng Liu[a], Zhenqiang Xu[a], Hui Chen[a] and Yuxiang Yang[b]. ([a]Department of Environmental Sciences, College of Environmental Sciences, Peking University, Beijing 100871, China, [b]College of Chemistry and Pharmaceutics, East China University of Science and Technology, Shanghai 200237, China) Degradation of chlorophenols catalyzed by laccase. International Biodeterioration & Biodegradation, Volume 61(4) (2008): 351-356

The degradations of 2,4-dichlorophenol (2,4-DCP), 4-chlorophenol (4-CP) and 2-chlorophenol (2-CP) catalyzed by laccase were carried out. The optimal condition regarding degradation efficiency was also discussed, which included reaction time, pH value, temperature, concentration series of chlorophenols and laccase. Results showed that the capability of laccase was the best, while to oxidize 2,4-DCP among the above-mentioned chlorophenols. Within 10 h, the removal efficiency of 2,4-DCP, 2-CP and 4-CP could reach 94%, 75% and 69%, respectively. The optimal pH for laccase to degrade chlorophenols was around 5.5. The increase of laccase concentration or temperature might result in the degradation promotion. The trends of degradation percentage were various among these three chlorophenols with the concentration increase of chlorophenols. Degradation of 2,4-DCP is a first-order reaction and the reaction activation energy is about 44.8 kJ mol^{-1}. When laccase was immobilized on chitosan, crosslinked with glutaraldehyde, the activity of immobilized laccase was lower than that of free laccase, but the stability improved significantly. The removal efficiency of immobilized laccase to 2,4-DCP still remained over 65% after six cycles of operation.

Keywords: Chlorophenol; Laccase; Catalytic degradation; Immobilized enzyme

C.G. van Ginkel[a], R. Geerts[a], P.D. Nguyen[a] and C.M. Plugge[b]. ([a]Akzo Nobel Technology and Engineering, Velperweg 76, 6824 BM Arnhem, The Netherlands, [b]Laboratory of Microbiology, Wageningen University, Dreijenplein 10, 6703 HB Wageningen, The Netherlands). Biodegradation pathway of l-glutamatediacetate by *Rhizobium radiobacter* strain BG-1. International Biodeterioration & Biodegradation, Volume 62(1) (2008): 31-37

An aerobic bacterium was isolated from activated sludge in a medium containing l-glutamate-*N*,*N*-diacetate (l-GLDA) as sole carbon and energy source. The isolate was identified as a *Rhizobium radiobacter* species. Besides l-GLDA, the strain utilized nitrilotriacetate (NTA) and proposed intermediates in l-GLDA metabolism such as glyoxylate and l-glutamate. l-GLDA-grown cells oxidized l-GLDA, l-glutamate but not iminodiacetate (IDA), and *trans*-ketoglutaconate, indicating removal of a carboxymethyl group as an initial degradation reaction.

The removal of the first carboxymethyl group of l-GLDA is catalyzed by an NADH-dependent mono-oxygenase. The oxidative deamination of l-glutamate by a dehydrogenase resulting in the formation of oxoglutarate was also detected in cell-free extracts of *R. radiobacter* sp. A pathway for the metabolism of l-GLDA *R. radiobacter* sp. is proposed: First, l-GLDA leads to l-glutamate-*N*-monoacetate (l-GLMA) which in turn leads to l-glutamate. Then, l-glutamate leads to oxoglutarate, an intermediate of the TCA cycle.

Keywords: l-Glutamatediacetate; Chelating agent; Biodegradation; Intermediates; Mono-oxygenase

Gangming Xu[a, b], Wei Zheng[c], Yingying Li[c], Shenghui Wang[d], Jingshun Zhang[c] and Yanchun Yan[d]. ([a]Institute of Microbiology, Chinese Academy of Sciences, Beijing 100101, PR China, [b]Graduate School of the Chinese Academy of Sciences, Beijing 100039, PR China, [c]College of Life Sciences, Shandong Agricultural University, Tai'an 271018, PR China, [d]Graduate School, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China). **Biodegradation of chlorpyrifos and 3,5,6-trichloro-2-pyridinol by a newly isolated *Paracoccus* sp. strain TRP. International Biodeterioration & Biodegradation, Volume 62(1) (2008): 51-56**

A bacterium, isolated from activated sludge and named strain TRP, could biodegrade chlorpyrifos and 3,5,6-trichloro-2-pyridinol. Phenotypic features, physiological and chemotaxonomic characteristics, and phylogenetic analysis of 16S rRNA sequence revealed that the isolate belongs to the genus of *Paracoccus*. Strain TRP could also degrade pyridine, methyl parathion and carbonfuran when provided as sole carbon and energy sources. Native-PAGE and enzymatic degradation assay of the cell-free extracts indicated that an alternative degradation mechanism might involve an inducible enzyme. Degradation study of chlorpyrifos by strain TRP was examined by GC–MS and HPLC; no persistent accumulated metabolite was observed. To the best of our knowledge, this is the first report of a bacterium that could completely mineralize chlorpyrifos. This isolate will be potentially useful in biotreatment of wastewaters and bioremediation of contaminated soils.

Keywords: Chlorpyrifos; 3, 5, 6-Trichloro-2-pyridinol; Degrading bacterium; *Paracoccus* sp.; Complete mineralization

Mikhail Baboshin[1, 2], Vladimir Akimov[1, 2], Boris Baskunov[1], Timothy L. Born[3], Shahamat U. Khan[3] and Ludmila Golovleva[1, 2]. ([1]G.K. Skryabin Institute of Biochemistry and Physiology of Microorganisms RAS, Prospekt Nauki, 5, Pushchino, Moscow region, Russia, [2]Pushchino State University, Prospekt Nauki, 3, Pushchino, Moscow region, Russia, [3]Department of Chemistry and Biochemistry, George Mason University, 4400, [3]University Drive, Fairfax, VA 22030-4444, USA). **Conversion of polycyclic aromatic hydrocarbons by *Sphingomonas* sp. VKM B-2434. Biodegradation, Volume 19(4) (2008): 567-576**

A versatile bacterial strain able to convert polycyclic aromatic hydrocarbons (PAHs) was isolated, and a conversion by the isolate of both individual substances and PAH mixtures was investigated. The strain belonged to the *Sphingomonas* genus as determined on the basis of 16S rRNA analysis and was designated as VKM B-2434. The strain used naphthalene, acenaphthene, phenanthrene, anthracene and fluoranthene as a sole source of carbon and energy, and cometabolically oxidized fluorene, pyrene, benz[*a*]anthracene, chrysene and benzo[*a*]pyrene. Acenaphthene and fluoranthene were degraded by the strain via naphthalene-1,8-dicarboxylic

acid and 3-hydroxyphthalic acid. Conversion of most other PAHs was confined to the cleavage of only one aromatic ring. The major oxidation products of naphthalene, phenanthrene, anthracene, chrysene, and benzo[*a*]pyrene were identified as salicylic acid, 1-hydroxy-2-naphthoic acid, 3-hydroxy-2-naphthoic acid, *o*-hydroxyphenanthroic acid and *o*-hydroxypyrenoic acid, respectively. Fluorene and pyrene were oxidized mainly to hydroxyfluorenone and dihydroxydihydropyrene, respectively. Oxidation of phenanthrene and anthracene to the corresponding hydroxynaphthoic acids occurred quantitatively. The strain converted phenanthrene, anthracene, fluoranthene and carbazole of coal-tar-pitch extract.

Keywords: Bioconversion - Biodegradation - PAHs - *Sphingomonas*

Xabier Sevillano[1], José R. Isasi[1] and Francisco J. Peñas[1] ([1]Department of Chemistry and Soil Science, University of Navarra, 31080 Pamplona, Spain). Feasibility study of degradation of phenol in a fluidized bed bioreactor with a cyclodextrin polymer as biofilm carrier. Biodegradation, Volume 19(4) (2008): 589-597

This work is focused on the evaluation of a β-cyclodextrin polymer as a carrier medium in a fluidized bed bioreactor treating aqueous phenol as a model pollutant. The insoluble polymer support was obtained in the shape of spherical beads by crosslinking β-cyclodextrin with epichlorohydrin. A batch of swollen polymer particles was loaded into the reactor and inoculated with a mixed bacterial culture. Bacterial growth on the polymer beads was initially stimulated by glucose addition to the medium, and then gradually replaced with phenol. The operational variables studied after the acclimation period included phenol load, hydraulic residence time and recirculation flow rate. Low hydraulic residence times and moderate phenol loads were applied. The elimination capacity was usually about 1.0 kg-phenol/m^3d, although a maximum of 2.8 kg-phenol/m^3d was achieved with a retention time of only 0.55 h. The depuration efficiency was not affected by the recirculation flow rate in the range studied. Neither operational nor support stability problems were detected during the operation. A high degree of expansion was achieved in the bioreactor due to the hydrogel nature of the cyclodextrin polymer and, consequently, a low energy requirement was necessary to fluidize the bed.

Keywords: Phenol - Cyclodextrin polymer - Fluidized bed bioreactor

Ainhoa Caro[1], Karina Boltes[1], Pedro Letón[1] and Eloy García-Calvo[1]. ([1]Dpto. Química Analítica e Ingeniería Química, Facultad de Ciencias, Universidad de Alcalá, Madrid, 28871, Spain). Description of by-product inhibiton effects on biodesulfurization of dibenzothiophene in biphasic media Biodegradation, Volume 19(4) (2008): 599-611

As several authors have reported previously, the Biodesulfurization of hydrodesulfurization recalcitrants, such as dibenzothiophene, is not yet commercially viable because mass transfer limitations and feedback inhibition effects are produced during the conversion. This work has been focused to investigate the inhibition process in aqueous and oil-water systems with two different aerobic biocatalysts types, *Rhodococcus erythropolis* IGTS8 and *Pseudomonas putida* CECT 5279. The results obtained have proven that global DBT desulfurization process using CECT 5279 was not clearly deactivated due to final product accumulation, under the experimental conditions assayed. Consistently, the desulfurization pattern has been described with the Michaelis-Menten equation, determining the kinetic parameters. On other hand, the assays have shown that important mass transfer limitations produced the decrease of the yields obtained with this $Gram^-$ strain in biphasic media. With strain IGTS8 it was observed lower

mass transfer problems, but contrary the reaction was severely affected by the final product accumulation, in both aqueous and biphasic systems. Therefore it has been proposed an enzymatic kinetic model with competitive inhibition to describe the BDS evolution pattern when this Gram$^+$ strain was used.

Keywords: Biodesulfurization - Dibenzothiophene - Inhibition - Kinetic model - *Pseudomonas* sp. CECT 5279 - *Rhodococcus* sp. IGTS8

Tsering Stobdan[1, 2], Amita Sinha[1], Ravindra Pal Singh[1] and Dilip Kumar Adhikari[1]. ([1]Biotechnology Area, PEACBD, Indian Institute of Petroleum, Dehradun, 248005, India, [2]*Present address:* FRL (DRDO), Leh, Ladakh, India). **Degradation of pyridine and 4-methylpyridine by Gordonia terrea IIPN1. Biodegradation, Volume 19(4) (2008): 481-487**

Gordonia terrea IIPN1 was isolated and characterized from soils collected at petroleum drilling sites. The strain was able to catabolize pyridine and 4-methylpyridine as sole carbon and nitrogen source. The strain failed to catabolize other pyridine derivatives. Growing cells completely degraded 30 mM of pyridine in 120 h with growth yield of 0.29 g g^{-1}. Resting Cells grown on 5 mM pyridine degraded 4-methylpyridine without a lag time and vice versa. Supplementary carbon and nitrogen source did not significantly change the specific growth rate and degradation rate by the resting cells.

Keywords: Biodegradation - *Gordonia* - 4-methylpyridine - Pyridine

Akihiro Kurosumi[1], Erika Kaneko[2] and Yoshitoshi Nakamura[1]. ([1]Department of Life System, Institute of Technology and Science, University of Tokushima, 2-1 Minamijosanjia-cho, Tokushima 770-8506, Japan, [2]Department of Physiology, Kanazawa University Graduate School of Medicine, 13-1 Takaramachi, Kanazawa Ishikawa, 920-8640, Japan). **Degradation of reactive dyes by ozonation and oxalic acid-assimilating bacteria isolated from soil. Biodegradation, Volume 19(4) (2008): 489-494**

Ozonation and treatment of wastewaters with oxalic acid-assimilating bacterium was attempted for the complete degradation of reactive dyes. Oxalic acid-assimilating bacterium, *Pandoraea* sp. strain EBR-01, was newly isolated from soil under bamboo grove and was identified to be a member of the genus *Pandoraea* by physicochemical and biochemical tests including 16S rDNA sequence analysis. The bacterium was grown optimally at pH 7 and temperature of 30°C under the laboratory conditions. Reactive Red 120 (RR120), Reactive Green 19 (RG19), Reactive Black 5 (RB5) and Remazol Brilliant Blue R (RBBR) were used in degradation experiments. At the initial reactive dye concentrations of 500 mg/l and the ozonation time of 80 min, it was confirmed that 75–90 mg/l oxalic acid was generated from reactive dyes by ozonation. Microbial treatment using EBR-01 greatly decreased the amount of oxalic acid in the mixture after 48 h, but it was not removed completely. TOC/TOC_0 of reactive dye solutions was also decreased to 80–90% and 20–40% by ozonation and microbial treatment using EBR-01, respectively. The study confirmed that consecutive treatments by ozone and microorganisms are efficient methods to mineralize reactive dyes.

Keywords: Ozonation - Reactive dye - Decolorization - Oxalic acid-assimilating bacteria

Maria Unell[1], Karolina Nordin[2, 3], Cecilia Jernberg[3, 4], John Stenström[1] and Janet K. Jansson[1]. ([1]Department of Microbiology, Swedish University of Agricultural

Sciences, Box 7025, 750 07 Uppsala, Sweden, [2]Department of Biochemistry and Biophysics, Stockholm University, 106 91 Stockholm, Sweden, [3]School of Life Sciences, Södertörn University College, 141 89 Huddinge, Sweden, [4]Department of Laboratory Medicine, Karolinska Institute, Huddinge University Hospital, 171 76 Stockholm, Sweden). Degradation of mixtures of phenolic compounds by Arthrobacter chlorophenolicus A6. Biodegradation, Volume 19(4) (2008): 495-505

In this study the chlorophenol-degrading actinobacterium, *Arthrobacter chlorophenolicus* A6, was tested for its ability to grow on mixtures of phenolic compounds. During the experiments depletion of the compounds was monitored, as were cell growth and activity. Activity assays were based on bioluminescence output from a luciferase-tagged strain. When the cells were grown on a mixture of 4-chlorophenol, 4-nitrophenol and phenol, 4-chlorophenol degradation apparently was delayed until 4-nitrophenol was almost completely depleted. Phenol was degraded more slowly than the other compounds and not until 4-nitrophenol and 4-chlorophenol were depleted, despite this being the least toxic compound of the three. A similar order of degradation was observed in non-sterile soil slurries inoculated with *A. chlorophenolicus*. The kinetics of degradation of the substituted phenols suggest that the preferential order of their depletion could be due to their respective pKa values and that the dissociated phenolate ions are the substrates. A mutant strain (T99), with a disrupted hydroxyquinol dioxygenase gene in the previously described 4-chlorophenol degradation gene cluster, was also studied for its ability to grow on the different phenols. The mutant strain was able to grow on phenol, but not on either of the substituted phenols, suggesting a different catabolic pathway for the degradation of phenol by this microorganism.

Keywords: *Arthrobacter chlorophenolicus* - Bioremediation - 4-Bromophenol - 4-Chlorophenol - Mixed substrates - 4-Nitrophenol

Gerd Ulrich Balcke[1, 2], Silke Wegener[1, 3], Bärbel Kiesel[4], Dirk Benndorf[5], Michael Schlömann[3] and Carsten Vogt[6]. ([1]Department of Hydrogeology, UFZ, Helmholtz Centre for Environmental Research, Theodor-Lieser-Strasse 4, 06120 Halle/Saale, Germany, [2]Metanomics GmbH, Tegeler Weg 33, 10589 Berlin, Germany, [3]TU Bergakademie Freiberg, Environmental Microbiology, Interdisciplinary Ecological Centre, 09596 Freiberg, Germany, [4]Department of Environmental Microbiology, UFZ, Helmholtz Centre for Environmental Research, Permoserstrasse 15, 04318 Leipzig, Germany, [5]Department of Proteomics, UFZ, Helmholtz Centre for Environmental Research, Permoserstrasse 15, 04318 Leipzig, Germany, [6]Department of Isotope Biogeochemistry, UFZ, Helmholtz Centre for Environmental Research, Permoserstrasse 15, 04318 Leipzig, Germany). Kinetics of chlorobenzene biodegradation under reduced oxygen levels. Biodegradation, Volume 19(4) (2008): 507-518

Focussing on the role of chlorocatechol 1,2-dioxygenase (CC12O), an oxygen-dependent key enzyme in the aerobic catabolism of chlorobenzene (CB), *Pseudomonas veronii* strain UFZ B549, *Acidovorax facilis* strain UFZ B530, and a community of indigenous groundwater bacteria were amended with CB degradation under either oxic or hypoxic conditions. All cultures readily degraded CB at high oxygen availability, but had differing abilities to completely degrade CB when exposed to oxygen limitation. For the three cultures very distinct oxygen half-saturation constants (0.3–11.7 μM) for the respective CC12Os were obtained and protein analysis showed that high affinity-type *A. facilis* and low affinity-type *P. veronii* express CC12Os, which belong to different structural clusters. From this a functional relation between CC12O type and the

ability to cope with efficient ring fission under oxygen limitation is anticipated. Extremely high oxygen affinities for CC12Os support the assumption that truly oxic environments are not an essential requirement to degrade chloro(aromatic) compounds. Tiny quantities of oxygen permanently re-supplied will sufficiently maintain the growth of microaerophilic specialists with the ability to transform chloro(aromatics) via catechol intermediates.

Keywords: Hypoxic - Kinetics - Chlorobenzene - Optode - Chlorocatechol 1,2-dioxygenase - Oxygen affinity

M.M. Ballesteros Martín[a], J.A. Sánchez Pérez[a], J.L. García Sánchez[a], L. Montes de Oca[a], J.L. Casas López[a], I. Oller[b] and S. Malato Rodríguez[b]. ([a]Departamento de Ingeniería Química, Universidad de Almería, 04120 Almería, Spain, [b]Plataforma Solar de Almería-CIEMAT, Carretera de Senés km 4, 04200 Tabernas, Almería, Spain). Degradation of alachlor and pyrimethanil by combined photo-Fenton and biological oxidation. Journal of Hazardous Materials, Volume 155(1-2) (2008): 342-349

Biodegradability of aqueous solutions of the herbicide alachlor and the fungicide pyrimethanil, partly treated by photo-Fenton, and the effect of photoreaction intermediates on growth and DOC removal kinetics of the bacteria *Pseudomonas putida* CECT 324 are demonstrated. Toxicity of 30–120 mg L^{-1} alachlor and pyrimethanil has been assayed in *P. putida*. The biodegradability of photocatalytic intermediates found at different photo-treatment times was evaluated for each pesticide. At a selected time during batch-mode phototreatment, larger-scale biodegradation kinetics were analysed in a 12 L bubble column bioreactor. Both alachlor and pyrimethanil are non-toxic for *P. putida* CECT 324 at the test concentrations, but they are not biodegradable. A ~100 min photo-Fenton pre-treatment was enough to enhance biodegradability, the biological oxidation response being dependent on the pesticide tested. The different alachlor and pyrimethanil respiration and carbon uptake rates in pre-treated solutions are related to change in the growth kinetics of *P. putida*. Reproducible results have shown that *P. putida* could be a suitable microorganism for determining photo-Fenton pre-treatment time.

Keywords: Alachlor; Pyrimethanil; Photo-Fenton; Biodegradability; *Pseudomonas putida*

J. Saien [a] and S. Khezrianjoo[a]. ([a]Department of Applied Chemistry, Bu-Ali Sina University, Hamedan 65174, Iran). Degradation of the fungicide carbendazim in aqueous solutions with UV/TiO_2 process: Optimization, kinetics and toxicity studies. Journal of Hazardous Materials, Volume 157(2-3) (2008): 269-276

An attempt was made to investigate the potential of UV-photocatalytic process in the presence of TiO_2 particles for the degradation of carbendazim ($C_9H_9N_3O_2$), a fungicide with a high worldwide consumption but considered as a "priority hazard substance" by the Water Framework Directive of the European Commission (WFDEC). A circulating upflow photo-reactor was employed and the influence of catalyst concentration, pH and temperature were investigated. The results showed that degradation of this fungicide can be conducted in the both processes of only UV-irradiation and UV/TiO_2; however, the later provides much better results. Accordingly, a degradation of more than 90% of fungicide was achieved by applying the optimal operational conditions of 70 mg L^{-1} of catalyst, natural pH of 6.73 and ambient temperature of 25 °C after 75 min irradiation. Under these mild conditions, the initial rate of degradation can be described well by the Langmuir–Hinshelwood kinetic model. Toxicological assessments on the obtained samples were also performed by measurement of the mycelium growth inhibition of

Fusarium oxysporum fungus on PDA medium. The results indicate that the kinetics of degradation and toxicity are in reasonably good agreement mainly after 45 min of irradiation; confirming the effectiveness of photocatalytic process.

Keywords: Photocatalytic degradation; Carbendazim; TiO_2; Kinetics; Toxicity; Pesticide

Anil Kumar Mathur[a], C.B. Majumder[b], Shamba Chatterjee[c] and Partha Roy[c]. ([a]Biotechnology Department, Motilal Nehru National Institute of Technology, Allahabad 211004, India, [b]Chemical Engineering Department, Indian Institute of Technology Roorkee, Roorkee 247667, India, [c]Biotechnology Department, Indian Institute of Technology Roorkee, Roorkee 247667, India). Biodegradation of pyridine by the new bacterial isolates *S. putrefaciens* and *B. sphaericus.* Journal of Hazardous Materials, Volume 157(2-3) (2008): 335-343

In this study, two bacterial strains capable of utilizing pyridine as a sole carbon source were isolated from biofilters. Based on the biochemical test, the organisms were identified as *Shewanella putrefaciens* and *Bacillus sphaericus*. In liquid cultures, *S. putrefaciens* and *B. sphaericus* degraded pyridine quite effectively up to 500 mg L^{-1}. *S. putrefaciens* degrades 500 mg L^{-1} of pyridine completely within 140 h, whereas the *B. sphaericus* degrades 500 mg L^{-1} of pyridine only nearly 75% and takes a longer duration of 150 h. *S. putrefaciens* used pyridine as sole carbon and energy source better than *B. sphaericus*. Monod's and Haldane's inhibitory growth models were used to obtain maximum specific growth rate (μ_{max}), half saturation (K_s) and substrate inhibition (K_i) constant for pyridine by using *S. putrefaciens* and *B. sphaericus*. The high value of K_i for *S. putrefaciens* than *B. sphaericus* indicates that the inhibition effect can be observed only in a high concentration range. The *S. putrefaciens* degrades pyridine with a faster rate than *B. sphaericus*. *S. putrefaciens* can be used effectively for the treatment of pyridine bearing wastewater and as an inoculum in a biofilter treating pyridine-laden gas.

Keywords: Pyridine; *Bacillus sphaericus*; *Shewanella putrefaciens*; Growth rate; The half saturation coefficient

Utkarsha Shedbalkar[a], Rhishikesh Dhanve[a] and Jyoti Jadhav [a]. ([a]Department of Biochemistry, Shivaji University, Vidyanagar, Kolhapur 416004, India). Biodegradation of triphenylmethane dye cotton blue by *Penicillium ochrochloron* MTCC 517. Journal of Hazardous Materials, Volume 157(2-3) (2008): 472-479

Triphenylmethane dyes belong to the most important group of synthetic colorants and are used extensively in the textile industries for dying cotton, wool, silk, nylon, etc. They are generally considered as the xenobiotic compounds, which are very recalcitrant to biodegradation. *Penicillium ochrochloron* decolorizes cotton blue (50 mg l^{-1}) within 2.5 h under static condition at pH 6.5 and temperature 25 °C. TLC, FTIR and HPLC analysis confirms biodegradation of cotton blue. FTIR spectroscopy and GC–MS analysis indicated sulphonamide and triphenylmethane as the final products of cotton blue degradation. The pH, temperature and maturity of biomass affected the rate of decolorization. Presence of lignin peroxidase, tyrosinase and aminopyrine N-demethylase activities in the cell homogenate as well as increase in the extracellular activity of lignin peroxidase suggests the role of these enzymes in the decolorization process. The phytotoxicity and microbial toxicity studies of extracted metabolites suggest the less toxic nature of them.

Keywords: *Penicillium ochrochloron*; Cotton blue; Biodegradation; Lignin peroxidase; Aminopyrine N-demethylase

Abhrajyoti Ghosh[1, 2], Krishanu Chakrabarti[1] and Dhrubajyoti Chattopadhyay[1, 2]. ([1]Department of Biochemistry, University of Calcutta, 35, Ballygunge Circular Road, Kolkata, 700019, West Bengal, India, [2]Dr. B C Guha Centre for Genetic Engineering and Biotechnology, University of Calcutta, 35, Ballygunge Circular Road, Kolkata, 700019, West Bengal, India). Degradation of raw feather by a novel high molecular weight extracellular protease from newly isolated Bacillus cereus DCUW. Journal of Industrial Microbiology and Biotechnology, Volume 35(8) (2008): 825-834

Biotreatment of feather wastes and utilization of the degraded products in feed and foodstuffs has been a challenge. In the present study, we have demonstrated the degradation of feather waste by *Bacillus cereus* DCUW strain isolated during a functional screening based microbial diversity study on East Calcutta Wetland Area. A high molecular weight keratinolytic protease from feather degrading DCUW strain was purified and characterized. Moreover, utilization of degraded products during feather hydrolysis was developed and demonstrated. The purified keratinolytic protease was found to show pH and temperature optima of 8.5 and 50 °C, respectively. PMSF was found to inhibit the enzyme completely. The purified enzyme showed molecular weight of 80 kDa (from SDS-PAGE). The protease was found to have broad range substrate specificities that include keratin, casein, collagen, fibrin, BAPNA and gelatin. The protease was identified as minor extracellular protease (Vpr) by RT-PCR and northern blotting techniques. This is the first report describing the characterization of minor extracellular protease (Vpr) and its involvement in feather degradation in *B. cereus* group of organisms.

Keywords: Feather degradation - Serine protease - *Bacillus cereus* DCUW - Reverse transcription PCR(RT-PCR) - Minor extracellular protease (Vpr)

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The objective of the experiment was to use starch processing waste as an alternative growth medium for cultivation of mycelia of the mushroom *Phellinus linteus* and to find an optimum condition under solid-state cultivation. Response surface analysis along with a central composite design was successfully applied to approximate the simultaneous effects of the substrate concentration (16–36 g l^{-1}), pH (4.5–6.5), and temperature (25–35 °C) on the mycelial growth rate. In the model, pH and temperature significantly affected the mycelial growth but substrate concentration did not. The optimal substrate concentration, pH, and temperature for maximizing growth rate of *P. linteus* mycelia were found to be 16.5 g l^{-1}, pH 6.0, and 29.7 °C, respectively. Subsequent verification of these levels agreed with model predictions and the maximum mycelial growth rate at these conditions was 6.1 ± 0.8 mm day^{-1}. Therefore, the results of the experiments suggest that starch processing waste could be utilized as a growth substrate for the cultivation of the mushroom mycelia of *P. linteus*, enhancing the usefulness of this byproduct of

the starch manufacturing industry. This approach is likely to be useful for establishing similar parameters for the cultivation of other fungi.

Keywords: *Phellinus linteus* - Starch processing waste - Response surface analysis - Optimization - Mycelium - Solid-state cultivation

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Butyrate-degrading bacteria in four methanogenic sludges were studied by RNA-based stable isotope probing. Bacterial populations in the ^{13}C-labeled rRNA fractions were distinct from unlabeled fractions, and *Syntrophaceae* species, *Tepidanaerobacter* sp., and *Clostridium* spp. dominated. These results suggest that diverse microbes were active in butyrate degradation under methanogenic conditions.

Qi YANG[a, b], Hai-Tao SHANG[a], Hui-Di LI[a], Hong-Bo XI[a] and Jian-Long WANG[c]. ([a]School of Water Resources and Environment, China University of Geoscience, Beijing 100083, China, [b]Laboratory of Geomicrobiology, China University of Geoscience, Beijing 100083, China, [c]Laboratory of Environmental Technology, INET, Tsinghua University, Beijing 100084, China). Biodegradation of Tetrachlorothylene Using Methanol as Co-metabolic Substrate[1]. Biomedical and Environmental Sciences, Volume 21(2) (2008): 98-102

Objective

To investigate the biodegradation of tetrachloroethylene (PCE) using methanol as electron donor by acclimated anaerobic sludge.

Methods

HP-6890 gas chromatograph (GC), together with HP-7694 autosampler, was used to analyze the concentration of PCE and intermediates.

Results

PCE could be decholrinated reductively to DCE *via* TCE, and probably further to VC and ethylene. The degradation of PCE and TCE conformed to first-order reaction kinetics. The reaction rate constants were 0.8991 d^{-1} and 0.068 d^{-1}, respectively, and the corresponding half-

life were 0.77 d and 10.19 d, respectively. TCE production rate constant was 0.1333 d^{-1}, showing that PCE was degraded more rapidly than TCE.

Conclusion

Methanol is an electron donor suitable for PCE degradation and the cometabolic electron donors are not limiting factors for PCE degradation.

Keywords: Tetrachloroethylene; Anaerobic cometabolism; Biodegradation

Aamer Ali Shah[a], Fariha Hasan[a], Abdul Hameed[a] and Safia Ahmed[a]. ([a]Department of Microbiology, Quaid-i-Azam University, Islamabad, Pakistan). Biological degradation of plastics: A comprehensive review. Biotechnology Advances, Volume 26(3) (2008): 246-265

Lack of degradability and the closing of landfill sites as well as growing water and land pollution problems have led to concern about plastics. With the excessive use of plastics and increasing pressure being placed on capacities available for plastic waste disposal, the need for biodegradable plastics and biodegradation of plastic wastes has assumed increasing importance in the last few years. Awareness of the waste problem and its impact on the environment has awakened new interest in the area of degradable polymers. The interest in environmental issues is growing and there are increasing demands to develop material which do not burden the environment significantly. Biodegradation is necessary for water-soluble or water-immiscible polymers because they eventually enter streams which can neither be recycled nor incinerated. It is important to consider the microbial degradation of natural and synthetic polymers in order to understand what is necessary for biodegradation and the mechanisms involved. This requires understanding of the interactions between materials and microorganisms and the biochemical changes involved. Widespread studies on the biodegradation of plastics have been carried out in order to overcome the environmental problems associated with synthetic plastic waste. This paper reviews the current research on the biodegradation of biodegradable and also the conventional synthetic plastics and also use of various techniques for the analysis of degradation in vitro.

Keywords: Biodegradation; Synthetic plastics; Biodegradable plastics; Analysis of degradation

Jae Woong Hwang[1, 2], Cha Yong Choi[2], Sunghoon Park[3] and Eun Yeol Lee[4]. ([1]Technical Consulting Team, Environmental Management Corporation, Incheon, 404-708, Korea, [2]Department of Chemical and Biological Engineering, Seoul National University, Seoul, 151-746, Korea, [3]Department of Chemical Engineering, Pusan National University, Busan, 609-735, Korea, [4]Department of Chemical Engineering and Green Energy Center, Kyung Hee University, Yongin, Gyeonggi-do, 446-701, Korea). Biodegradation of gaseous styrene by Brevibacillus sp. using a novel agitating biotrickling filter. Biotechnology Letters, Volume 30(7) (2008): 1207-1212

A novel biofilter with an agitator to control excessive biomass accumulation, the agitating biotrickling filter (ABTF) system, was developed for treatment of gaseous styrene using *Brevibacillus* sp. as the sole microorganism the ABTF exhibited an elimination capacity of 3 kg styrene m^{-3} day^{-1}. After 110 days, the biodegradation efficiency decreased because of the clogging. The excess biomass was effectively removed by agitation. After the first agitation step, 42.4 g biomass was eliminated, and the removal efficiency increased from 60% to 95%. Stable

operation of the ABTF was achieved by controlling the biomass accumulation via the agitation of the filter bed.

Keywords: Agitating biotrickling filter - Biofilter - *Brevibacillus* - Styrene - Volatile organic carbon

Maria S. Holtze[a], Sebastian R. Sørensen[a], Jan Sørensen[b] and Jens Aamand[a]. ([a]Department of Geochemistry, Geological Survey of Denmark and Greenland (GEUS), Øster Voldgade 10, 1350 Copenhagen K, Denmark, [b]Department of Ecology, Faculty of Life Sciences, Copenhagen University, Thorvaldsensvej 40, 1871 Frederiksberg C, Denmark). Microbial degradation of the benzonitrile herbicides dichlobenil, bromoxynil and ioxynil in soil and subsurface environments – Insights into degradation pathways, persistent metabolites and involved degrader organisms. Environmental Pollution, Volume 154(2) (2008): 155-168

The benzonitriles dichlobenil, bromoxynil and ioxynil are important broad-spectrum or selective herbicides used in agriculture, orchards and public areas worldwide. The dichlobenil metabolite 2,6-dichlorobenzamide is the most frequently encountered groundwater contaminant in Denmark, which suggests that the environmental fate of these three structurally related benzonitrile herbicides should be addressed in detail. This review summarises the current knowledge on microbial degradation of dichlobenil, bromoxynil and ioxynil with particular focus on common features of degradation rates and pathways, accumulation of persistent metabolites and diversity of the involved degrader organisms.

The benzonitrile herbicides dichlobenil, bromoxynil and ioxynil are liable to degrade to persistent metabolites posing a potential water contaminant problem.

Keywords: Benzonitrile herbicides; Degradation pathways; Metabolites; Groundwater contamination; Review

Mari Nyyssönen[a], Reetta Piskonen[1, a] and Merja Itävaara[a]. ([a]Technical Research Centre of Finland, Espoo, Finland). Monitoring aromatic hydrocarbon biodegradation by functional marker genes. Environmental Pollution, Volume 154(2) (2008): 192-202

The development of biological treatment technologies for contaminated environments requires tools for obtaining direct information about the biodegradation of specific contaminants. The potential of functional gene array analysis to monitor changes in the amount of functional marker genes as indicators of contaminant biodegradation was investigated. A prototype functional gene array was developed for targeting key functions in the biodegradation of naphthalene, toluene and xylenes. Internal standard probe based normalization was introduced to facilitate comparison across multiple samples. Coupled with one-colour hybridization, the signal normalization improved the consistency among replicate hybridizations resulting in better discrimination for the differences in the amount of target DNA. During the naphthalene biodegradation in a PAH-contaminated soil slurry microcosm, the normalized hybridization signals in naphthalene catabolic gene probes were in good agreement with the amount of naphthalene-degradation genes and the production of $^{14}CO_2$. Gene arrays provide efficient means for monitoring of contaminant biodegradation in the environment.

Functional gene array analysis coupled with one-colour hybridization and internal standard based signal normalization provides efficient tool for monitoring contaminant biodegradation processes.

Keywords: Aromatic hydrocarbon; Biodegradation; Monitoring; Functional gene; Gene array

Khanitta Somtrakoon[1], Sudarat Suanjit[2], Prayad Pokethitiyook[3], Maleeya Kruatrachue[3], Hung Lee[4] and Suchart Upatham[5]. ([1]Biological Science Program, Faculty of Science, Burapha University, Chonburi, 20131, Thailand, [2]Department of Microbiology, Faculty of Science, Burapha University, Chonburi, 20131, Thailand, [3]Department of Biology, Faculty of Science, Mahidol University, Rama VI Road, Bangkok, 10400, Thailand, [4]Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1, [5]Department of Medical Science, Faculty of Science, Burapha University, Chonburi, 20131, Thailand. Khanitta Somtrakoon (Corresponding author), Email: neung186@hotmail.com, Suchart Upatham (Corresponding author), Email: upatham@buu.ac.th). **Enhanced Biodegradation of Anthracene in Acidic Soil by Inoculated Burkholderia sp. VUN10013. Current Microbiology, Volume 57(2) (2008): 102-106**

The ability of *Burkholderia* sp. VUN10013 to degrade anthracene in microcosms of two acidic Thai soils was studied. The addition of *Burkholderia* sp. VUN10013 (initial concentration of 10^5 cells g^{-1} dry soil) to autoclaved soil collected from the Plew District, Chanthaburi Province, Thailand, supplemented with anthracene (50 mg kg^{-1} dry soil) resulted in complete degradation of the added anthracene within 20 days. In contrast, under the same test conditions but using autoclaved soil collected from the Kitchagude District, Chanthaburi Province, Thailand, only approximately 46.3% of the added anthracene was degraded after 60 days of incubation. In nonautoclaved soils, without adding the VUN10013 inocula, 22.8 and 19.1% of the anthracene in Plew and Kitchagude soils, respectively, were degraded by indigenous bacteria after 60 days. In nonautoclaved soil inoculated with *Burkholderia* sp. VUN10013, the rate and extent of anthracene degradation were considerably better than those seen in autoclaved soils or in uninoculated nonautoclaved soils in that only 8.2 and 9.1% of anthracene remained in nonautoclaved Plew and Kitchagude soils, respectively, after 10 days of incubation. The results showed that the indigenous microorganisms in the pristine acidic soils have limited ability to degrade anthracene. Inoculation with the anthracene-degrading *Burkholderia* sp. VUN10013 significantly enhanced anthracene degradation in such acidic soils. The indigenous microorganisms greatly assisted the VUN10013 inoculum in anthracene degradation, especially in the more acidic Kitchagude soil.

Stephane Uroz [1] & Jussi Heinonsalo [2] . ([1] INRA/UHP UMR 1136 'Interactions Arbres Micro-organismes', Centre INRA de Nancy, Champenoux, France; and [2] Department of Applied Chemistry and Microbiology, Faculty of Agriculture and Forestry, University of Helsinki, Helsinki, Finland. Correspondence: Stephane Uroz, INRA-UHP, Interactions Arbres Micro-organismes, UMR 1136, 54280 Champenoux, France. Tel.: +33 3 83 39 41 49, fax: +33 3 83 39 40 69; e-mail: uroz@nancy.inra.fr). **Degradation of *N*-acyl homoserine lactone quorum sensing signal molecules by forest root-associated fungi. FEMS Microbiology Ecology, Volume 65(2) (2008): 271 - 278**

A collection of mycorrhizal and nonmycorrhizal root-associated fungi coming from forest environments was screened for their ability to degrade *N*-acyl homoserine lactones (AHL) or to

prevent AHL recognition by producing quorum sensing inhibitors (QSI). No production of QS-inhibitors or -activators was detected using the two biosensors *Chromobacterium violaceum* CV026 and *Agrobacterium tumefaciens* in the culture supernatant of these fungi. However, the ability to degrade C6- and 3O,C6-HSL was detected for three fungal isolates. Acidification assay revealed that the AHL were degraded by a lactonase activity for two of these isolates. These results demonstrated for the first time that the forest root-associated fungi are capable of degrading the AHL signal molecules.

Keywords: *N*-acyl homoserine lactone • AHL degradation • forest root associated fungi • quorum sensing • lactonase

Kai-Chee Loh[a] and Bin Cao[a]. ([a]Department of Chemical and Biomolecular Engineering, National University of Singapore, 4 Engineering Drive 4, Singapore 117576, Singapore). Paradigm in biodegradation using *Pseudomonas putida*—A review of proteomics studies Enzyme and Microbial Technology, Volume 43(1) (2008): 1-12

Pseudomonas putida has been extensively studied as a paradigm in environmental biotechnology due to its capabilities in catabolizing various aromatic compounds. In addition to the fate of these aromatic compounds, the physiological status of the bacterial cells involved is another important aspect in biodegradation processes. In recent years, proteomics that deals with the high-throughput analysis of gene products directly at the protein level has been shown as a powerful tool to explore bacterial physiology in biodegradation processes. Through proteomics approaches, the understanding of global metabolic and regulatory alterations in response to various environmental stimuli or phenotypic changes after metabolic engineering has been facilitated. In this review, we summarize the proteomics tools in environmental applications and the proteomics studies of *P. putida* in bioremediation. The technological and methodological advances in *P. putida* proteome research and the physiological responses to different environmental conditions revealed by proteomics as well as *P. putida* catabolic pathway elucidation through proteomics are discussed.

Keywords: Proteomics; *Pseudomonas putida*; Biodegradation; Catabolic pathway; Physiological response

Abbreviations: BLAST, basic local alignment search tool; CBB, Coomassie Brilliant Blue; CF, chromatofocusing; 2-DE, two-dimensional gel electrophoresis; DIGE, fluorescence difference gel electrophoresis; ESI, electrospray ionization; ICAT, isotope-coded affinity tag; IEF, isoelectric focusing; IPG, immobilized pH gradient; iTRAQ, isobaric tags for relative and absolute quantification; MALDI, matrix-assisted laser desorption/ionization; MS, mass spectrometry; *m*/*z*, mass-to-charge ratio; NCBI, National Center for Biotechnology Information; pI, isoelectric point; PMF, peptide mass fingerprinting; PSD, post-source decay; PTM, post-translational modification; RP, reverse phase; ToF, time-of-flight

M. Yunus Pamukoglu[a] and Fikret Kargi[a]. ([a]Department of Environmental Engineering, Dokuz Eylul University, Buca, 35160 Izmir, Turkey). Biodegradation kinetics of 2,4,6-trichlorophenol by *Rhodococcus rhodochrous* in batch culture. Enzyme and Microbial Technology, Volume 43(1) (2008): 43-47

Kinetics of biodegradation of 2,4,6-trichlorophenol (TCP) by pure culture of *Rhodococcus rhodochrous* (DSM 43241) was investigated in batch culture. Batch experiments were performed

with different initial TCP concentrations between 50 and 400 mg L^{-1} at pH 7 and 30 °C in the presence of basal salts medium containing glucose. Percent TCP and toxicity removals decreased with increasing initial TCP concentration due to toxic effects of TCP. The rate and the extent of TCP degradation increased with TCP concentration up to150 mg L^{-1} indicating no TCP inhibition at low TCP concentrations. TCP concentrations above 150 mg L^{-1} resulted in decreases both in the rate and extent of TCP degradation due to toxic effects of high TCP contents. The kinetics of TCP biodegradation was modeled by relating the initial TCP degradation rates with the initial TCP concentrations using the non-competitive inhibition model. The kinetic constants were determined by using the experimental data. Percent toxicity removal was also quantified along with TCP removal which decreased with increasing initial TCP concentrations due to toxic effects of TCP.

Keywords: Biodegradation; Kinetics; *Rhodococcus rhodochrous*; 2,4,6-Trichlorophenol (TCP)

Adriano Pinto Mariano*, Richard Clayton Tomasella, Luciano Marcondes de Oliveira, Jonas Contiero and Dejanira de Franceschi de Angelis. (Departamento de Bioquímica e Microbiologia - Instituto de Biociências (IB) - Universidade Estadual Paulista (UNESP). *Corresponding author. E-mail: adrianomariano@yahoo.com.br. Fax: +55-1935264176). **Biodegradability of diesel and biodiesel blends. African Journal of Biotechnology Vol. 7 (9) (2008): 1323–1328**

The biodegradability of pure diesel and biodiesel and blends with different proportions of biodiesel (2% (commercial); 5% and 20%) was evaluated employing the respirometric method and the redox indicator 2,6-dichlorophenol indophenol (DCPIP) test. In the former, experiments simulating the contamination of natural environments (soil from a petrol station or water from a river) were carried out in Bartha biometer flasks (250 ml), and used to measure the microbial CO_2 production. With the DCPIP test, the capability of three inocula to biodegrade the blends was tested. Results show that although biodiesel is more easily and faster biodegraded than diesel oil, among the blends evaluated (2%, 5% and 20%), only the blend with higher concentration of biodiesel presented biodegradability significantly different from diesel and it was not verified an improvement on the biodegradation of the diesel by means of co-metabolism.

Keywords: Biodiesel, diesel, blend, biodegradability, bioremediation.

Emerhi, E. A., Ekeke, B. A. and Oyebade, B. A.*. (Department of Forestry and Environment, Rivers State University of Science and Technology, Port Harcourt, Nigeria. *Corresponding author. E-mail: oyebadeb@yahoo.com, bukkibadef@yahoo.com). **Biodegrading effects of some rot fungi on *Pinus caribaea* wood. African Journal of Biotechnology Vol. 7 (10) (2008): 1512–1515**

Wood samples were collected from a ten-year old plantation of *Pinus caribaea* (morelet) in Ijaiye Forest Reserve, 38 km northwest of Ibadan, Nigeria. The wood samples were inoculated separately with two species of white-rot fungi; *Corioliopsis polyzona* and *Pleurotus squarrosulus*, and two species of brown-rot fungi; *Lentinus lepideus* and *Gleophyllum, striatum*. Wood weight loss due to biodegradation varied from 1.5 – 48.1% for *Corioliopsis polyzona*, 9.6 – 58.0% for *Pleurotus squarrosulus,* 40.4 – 78.1% for *Lentinus lepideus* and 6.8 – 49.2% for *Gleophyllum striatum* degrading activities. The mode of wood degradation was peculiar with each fungus. Wood decay varied along the tree bole but was not related to height above the ground. The results indicated that biodegradation by rot fungi differs in intensity according to the

fungus species and this suggested that preservative impregnation and retention may be the best way to control the rots to make *P. caribaea* a utility wood.

Keywords: *Pinus caribaea*, wood decay, wood preservation

L. A. Nwaogu[1]*, G. O. C. Onyeze[1] and R. N. Nwabueze[2]. ([1]Department of Biochemistry, Federal University of Technology, Owerri, Nigeria, [2]Department of Microbiology, Federal University of Technology, Owerri, Nigeria. *Corresponding author. E-mail: nwogulinus@yahoo.com). Degradation of diesel oil in a polluted soil using *Bacillus subtilis*. African Journal of Biotechnology Vol. 7 (12) (2008): 1939–1943

Diesel oil, left standing in a laboratory for six months, was used as source for the isolation of *Bacillus subtilis, Bacillus cereus, Trichoderma harzanium* and *Trichothercium roseum*. These organisms were found to be hydrocarbon degraders. On further testing, it was found that *B. subtilis* had higher potential to utilize diesel oil as carbon source. Soil samples were polluted with diesel oil at a loading rate of 5% (v/w) (oil/soil). These soil samples, together with the unpolluted control samples, were seeded with the *B. subtilis* isolate. The degradation of the diesel oil was monitored over a twenty-seven -day period, using gravimetric method. The rates of degradation of diesel oil by the isolate at the end of day one, day twelve and day twenty-seven were 5.8×10^{-4}, 1.83×10^{-3} and 1.05×10^{-3} g/h, respectively.

Keywords: Degradation, diesel oil, *Bacillus subtilis, Bacillus cereus, Trichoderma harzanium*, *Trichothercium roseum.*

R. Manikandan*, H. J. Prabhu and P. Sivashanmugam. (Department of Chemical Engineering, National Institute of Technology,Tiruchirappalli-620015, India. *Corresponding author. E-mail: rmanikandan1968@gmail.com, rmanikandan1968@yahoo.com). Biodegradation of 2,4-dichlorophenol using *Mycoplana dimorpha* extracts and evaluation of kinetic parameters. African Journal of Biotechnology Vol. 7 (12) (2008): 2038–2048

Twenty seven combinations of process variables were developed and used to produce crude extracts of *Mycoplana dimorpha*. Crude extracts containing 2,4-dichlorophenol degrading enzymes, were immobilized on sodium alginate beads and degradation studies was conducted in a packed bed column. The rate of degradation of 2,4-dichlorophenol by immobilized crude extracts of was measured at different time intervals and it was found that 82 to 86% of 2,4-dichlorophenol can be decomposed with different initial concentrations in 30 min. The *K*m and *V*max values were determined.

Keywords: 2,4-Dichlorophenol, degradation, crude extract, *Mycoplana dimorpha,* immobilization, packed bed column.

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The environmental persistence, toxicity and/or carcinogenicity of chlorinated aliphatic compounds (CAHs) and their potential for bioaccumulation in food chains has made them of serious environmental concern. The frequency of a mixture of these compounds encountered in most contaminated sites has warranted investigation into their fate in contaminated sites. In this study, therefore, the biodegradation of a mixture of CAHs; namely, carbon tetrachloride (CCl_4), 1,2-dichloroethane (DCA) and dichloromethane (DCM), in contaminated water microcosms was investigated. The mixture of CAHs investigated was observed to be simultaneously degraded in both microcosms with up to 86.28% CCl_4, 44.64% DCM and 52.34% DCA degradation observed in the untreated microcosms. The degradation rate constants of the CAHs ranged variously between 0.168 – 1.234 $week^{-1}$ for CCl_4; 0.175 – 0.832 $week^{-1}$ for DCM; and 0.232 – 0.588 $week^{-1}$ for DCA in both water microcosms with higher degradation generally observed in New Germany Wastewater compared to those in Northern Wastewater. Findings from this study also suggest that biostimulation and/or bioaugmentation is required to speed up the biodegradation process, depending on the available nutrients and the presence or absence of microbial population capable of CAHs' metabolism at the contaminated sites.

Keywords: Bioaugmentation, biodegradation, biostimulation, chlorinated aliphatic hydrocarbons, microcosms.

Biosensor

Zhihui Dai[a], Hongyan Bai[a], Mei Hong[a], Yinyan Zhu[a], Jianchun Bao[a] and Jian Shen[a]. ([a]Jiangsu Key Laboratory of Biofunctional Materials, College of Chemistry and Environmental Science, Nanjing Normal University, Nanjing 210097, PR China). A novel nitrite biosensor based on the direct electron transfer of hemoglobin immobilized on CdS hollow nanospheres. Biosensors and Bioelectronics, Volume 23(12) (2008): 1869-1873

A novel nitrite biosensor based on the direct electron transfer of hemoglobin (Hb) immobilized on CdS hollow nanospheres (HS-CdS) modified glassy carbon electrode was constructed. The direct electron transfer of Hb showed a pair of redox peaks with a formal potential of −286 mV (vs. SCE) in 0.1 M pH 7.0 phosphate buffer solution. It was a surface-controlled electrode process involving a single proton transfer coupled with a reversible one-electron transfer for each heme group of Hb. HS-CdS had a large specific surface area and good biocompatibility and had a better electrochemical response than that of solid spherical CdS. The immobilized Hb on HS-CdS displayed an excellent response to NO_2^- with one irreversible electrode process for NO reduction. Under optimal conditions, the biosensor could be used for the determination of NO_2^- with a linear range from 0.3 to 182 μM and a detection limit of 0.08 μM at 3σ based on the irreversible reduction of NO. HS-CdS provided a good matrix for protein immobilization and had a promising application in constructing sensors.

Keywords: Nitrite; Biosensor; Direct electron transfer; Hemoglobin; CdS hollow nanospheres

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A biosensor based on pyruvate oxidase (POX) enzyme was developed for the investigation of the effect of thiamine (vitamin B_1) molecule on the activity of the enzyme. The biosensor was prepared with a chemical covalent immobilization method on the dissolved oxygen (DO) probe by using gelatin and cross-linking agent, glutaraldehyde. POX catalyzes the degradation of pyruvate to acetylphosphate, CO_2 and H_2O_2 in the presence of phosphate and oxygen. Thiamine is an activator for POX enzyme and determination method of the biosensor was based on this effect of thiamine on the activity of the enzyme. The biosensor responses showed increases in the presence of thiamine. Increases in the biosensor responses were related to thiamine concentration. Thiamine determination is based on the assay of the differences on the biosensor responses on the oxygenmeter in the absence and the presence of thiamine. The biosensor response depend linearly on thiamine concentration between 0.025 and 0.5 μM with 2 min response time. In the optimization studies of the biosensor the most suitable enzyme amount was found as 2.5 U cm^{-2} and also phosphate buffer (pH 7.0; 50 mM) and 35 °C were obtained as the optimum working conditions. In the characterization studies of the biosensor some parameters such as activator and interference effects of some substances on the biosensor response and reproducibility were carried out.

Keywords: Thiamine; Biosensor; Pyruvate oxidase; Enzyme electrode; Vitamin B_1 determination

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The mechanisms involving insulin and anti-hypertensive drugs regulation for in vivo cerebral glucose metabolism are not well-understood. This might be due to lack of direct means of measuring cerebral glucose. It is known that the continuous delivery of glucose to the brain is critical for its normal metabolic function. In this study, we report the effect of insulin and anti-hypertensive drugs on glucose level in the striatum of rats. The rats were divided into two groups, i.e. hyperglycemia (14.8 ± 0.3 mM plasma glucose) and diabetic (10.8 ± 0.2 mM plasma glucose). A custom-built glucose microsensor was implanted at coordinates A/P 1.0 from bregma, M/L +2.5 and D/V −5.0 (from dura) in the striatum. The amperometric response obtained at +0.23 V vs. Ag|AgCl corresponded to the glucose level in striatum. By varying the concentrations of protaminc zinc insulin infused into the rats, striatum glucose level was found to remain constant throughout, i.e. 9.8 ± 0.1 and 4.7 ± 0.1 mM for hyperglycemic rats and for diabetic rats, respectively. However, infusion of valsartan and felodipine has lowered the striatum glucose level significantly. These findings agreed with the hypothesis that suggested striatum glucose uptake do not depend on insulin but is clearly dependant on anti-hypertensive drugs administration.

Keywords: Insulin; Anti-hypertensive drugs; Cerebral glucose; Microsensor; Diabetic; Hyperglycemic

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[b]Department of Chemistry, University College Cork, Cork, Ireland). Biosensor technology: Technology push versus market pull. Biotechnology Advances, Volume 26(5) (2008): 492-500

Biosensor technology is based on a specific biological recognition element in combination with a transducer for signal processing. Since its inception, biosensors have been expected to play a significant analytical role in medicine, agriculture, food safety, homeland security, environmental and industrial monitoring. However, the commercialization of biosensor technology has significantly lagged behind the research output as reflected by a plethora of publications and patenting activities. The rationale behind the slow and limited technology transfer could be attributed to cost considerations and some key technical barriers. Analytical chemistry has changed considerably, driven by automation, miniaturization, and system integration with high throughput for multiple tasks. Such requirements pose a great challenge in biosensor technology which is often designed to detect one single or a few target analytes. Successful biosensors must be versatile to support interchangeable biorecognition elements, and in addition miniaturization must be feasible to allow automation for parallel sensing with ease of operation at a competitive cost. A significant upfront investment in research and development is a prerequisite in the commercialization of biosensors. The progress in such endeavors is incremental with limited success, thus, the market entry for a new venture is very difficult unless a niche product can be developed with a considerable market volume.

Keywords: Electrochemical biosensor; Optical biosensor; Glucose; Microarray; Commercial activities; Technology barrier

Maria del Busto-Ramos[1], Michael Budzik[1], Carlos Corvalan[1], Mark Morgan[1], Ronald Turco[2], David Nivens[1] and Bruce Applegate[1]. ([1]Department of Food Science, Purdue University, 745 Agriculture Mall Dr., West Lafayette, IN 47907–2009, USA, [2]Department of Agronomy, Purdue University, West Lafayette, IN 47907–2009, USA). Development of an online biosensor for in situ monitoring of chlorine dioxide gas disinfection efficacy. **Applied Microbiology and Biotechnology, Volume 78(4) (2008): 573-580**

A prototype bioluminescence-based biosensor was designed and constructed to evaluate the antimicrobial efficacy of chlorine dioxide (ClO_2) gas under various treatment conditions. The biosensor consisted of a bioluminescent bioreporter (*Pseudomonas fluorescens* 5RL), an optical transducer (photomultiplier tube), and a light-tight chamber housing, the bioreporter and the transducer. The bioluminescent recombinant *P. fluorescens* 5RL in the biosensor allowed for online monitoring of bioluminescence during ClO_2 gas disinfection. Experiments were performed to evaluate the effects of the two key physical parameters associated with ClO_2 disinfection: relative humidity (40, 60, 80%) and ClO_2 gas concentration (0.5, 1.0, 1.6, 2.1 mg/l) on the bioreporter. Results showed that increasing concentrations of ClO_2 gas corresponded to a faster decrease in luminescence. The rates of luminescence decrease from *P. fluorescens* 5RL, and the log reduction time (LRT, time required to obtain 1-log reduction in luminescence) were calculated for each treatment tested. The LRT values of luminescence were 103, 78, 53, and 35 s for 0.5, 1.0, 1.6, and 2.1 mg/l of ClO_2 gas treatment, respectively, at 78% relative humidity. The gas concentration which caused a tenfold change in LRT (z value) for luminescence of *P. fluorescens* 5RL was 3.4 mg/l of ClO_2. The prototype biosensor showed potential for many

applications, such as monitoring real-time microbial inactivation and understanding parameters that influence the efficacy of gaseous decontamination procedures.

Keywords: Chlorine dioxide gas - Disinfection efficacy - Online sensor

S. Anastasiadou[a], M. Papagianni [a], G. Filiousis[a], I. Ambrosiadis[a] and P. Koidis[a]. ([a]Department of Hygiene and Technology of Food of Animal Origin, School of Veterinary Medicine, Aristotle University of Thessaloniki, Thessaloniki 54006, Greece). Growth and metabolism of a meat isolated strain of *Pediococcus pentosaceus* in submerged fermentation: Purification, characterization and properties of the produced pediocin SM-1. Enzyme and Microbial Technology, Volume 43(6) (2008): 448-454

The meat isolate *Pediococcus pentosaceus*, characterized as *P. pentosaceus* Mees 1934, produces a bacteriocin which was characterized in this study. The molecule was found to have the pediocin characteristics (with respect to N-terminal sequence and the presence of the characteristic consensus motif –YGNGV–), a molecular mass of 5.370 Da, and was designated as pediocin SM-1. The new bacteriocin is inhibitory to several food spoilage and food-born pathogens, shows a remarkable stability to heat and cold treatments, as well as to a wide pHs range, but it appears to be sensitive to proteases. Its mode of action appears to be bactericidal. Fermentation studies carried out in a stirred tank bioreactor revealed that semi-aerobic conditions (60% dissolved oxygen saturation) enhance production and fermentation rate analysis indicate primary metabolite kinetics for growth under the particular conditions. Pediocin SM-1, produced by a food-grade microorganism, exhibits the characteristics of a potential biopreservative and can be efficiently produced by fermentation.

Keywords: *Pediococcus pentosaceus*; Pediocin; Bacteriocin; Biopreservative

Guangming Wen[a], Jun Zheng[a], Chungui Zhao[a], Shaomin Shuang[a], Chuan Dong[a] and Martin M.F. Choi[b]. ([a]Research Center of Environmental Science and Engineering, School of Chemistry and Chemical Engineering, Shanxi University, Taiyuan 030006, PR China, [b]Department of Chemistry, Hong Kong Baptist University, Kowloon Tong, Hong Kong SAR, PR China). A microbial biosensing system for monitoring methane. Enzyme and Microbial Technology, Volume 43(3) (2008): 257-261

A microbial biosensing system for the measurement of methane has been developed using an immobilized mixed culture of *Pseudomonas aeruginosa* and *Klebsiella* sp. together with a dissolved oxygen (O_2) sensor. When methane was applied to the biosensing system, the dissolved O_2 content decreased until a steady-state was reached. The biosensing system response depends linearly on methane concentration between 1.0 and 5.0% (v/v) with a detection limit of 0.3% (v/v) (S/N = 3) and a 100-s response time. Phosphate buffer (pH 7.0, 25 mM) and room temperature (20–25 °C) were chosen as the optimum working conditions. Some parameters including pH, temperature, operational and storage stability were studied in detail for characterization of the biosensing system.

Keywords: Methane; Microbial biosensing; Dissolved oxygen sensor

Bioengineering

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Considerable progresses have taken place both in the methodology available to study changes in intracellular cytosolic calcium and in our understanding of calcium signaling cascades. It is generally accepted that the global calcium signal system functions importantly in coping with plant abiotic stresses, especially drought stress, which has been proved further by the recent transgenic and molecular breeding reports under soil water deficits. In plant cells, calcium plays roles as a universal transducer coupling a wide range of extracellular stimuli with intracellular responses. Different extracellular stimuli trigger specific calcium signatures: dynamics, amplitude and duration of calcium transients specify the nature, implication and intensity of stimuli. Calcium-binding proteins (sensors) play a critical role in decoding calcium signatures and transducing signals by activating specific targets and corresponding metabolic pathways. Calmodulin (CAM) is a calcium sensor known to regulate the activity of many mammalian proteins, whose targets in plants are now being identified. Higher plants possess a rapidly growing list of CAM targets with a variety of cellular functions. Nevertheless, many targets appear to be unique to higher plant cells and remain characterized, calling for a concerted effort from plant and animal scientists to elucidate their functions. To date, three major classes of plant calcium signals encoding elements in the calcium signal system, including calcium-permeable ion channels,Ca^{2}+/ H^{+} antiporters and Ca^{2}+-ATPases, are responsible for drought stress signal transduction directly or indirectly. This review summarizes the current knowledge of calcium signals involved in plant abiotic stresses and presents suggestions for future focus areas of study.

Keywords: Plant calcium signal system (PCSS); CaM; Drought; Soil water deficit; Molecular breeding

Louise Hecker*[1], Luda Khait†, Michael J. Welsh‡ and Ravi Birla†. (*Applied Physics Program, University of Michigan, Biomedical Science Research Building, 109 Zina Pitcher Place, Rm. 2338, Ann Arbor, MI 48109, U.S.A., †Section of Cardiac Surgery, University of Michigan, Ann Arbor, MI 48109, U.S.A., and ‡Department of Cell and Development Biology, University of Michigan, Ann Arbor, MI 48109, U.S.A. [1]To whom correspondence should be addressed (email lhecker@umich.edu). Bioengineering functional human aortic vascular smooth-muscle strips *in vitro*. Biotechnol. Appl. Biochem. 50(2008):155–163

The contraction and relaxation of VSM (vascular smooth muscle) are responsible for the maintenance of vascular tone, which is a major determinant of blood pressure. However, the molecular events leading to the contraction and relaxation of VSM are poorly understood. The development of three-dimensional bioengineered tissues provides an opportunity to investigate the molecular events controlling vascular tone *in vitro*. In the present study we used fibrin-gel casting to bioengineer functional VSM strips from primary human aortic VSM cells. Our

bioengineered VSM strips are functionally similar to VSM *in vivo* and remained viable in culture for up to 5 weeks. VSM strips demonstrate spontaneous basal tone and can generate an active force (contraction) of up to 85.2 μN on stimulation with phenylephrine. Bioengineered VSM strips exhibited Ca^{2+}-dependent contraction and calcium-independent relaxation. The development of functional bioengineered VSM tissue provides a new *in vitro* model system that can be used to investigate the molecular events controlling vascular tone.

Key words: cell culture, contractile force, three-dimensional (3D) construct, tissue engineering, vascular smooth muscle, vascular tone 3.

Abbreviations used: DMEM, Dulbecco's modified Eagle's medium; ECM, extracellular matrix; H/E, haematoxylin and eosin; PDMS, polydimethylsiloxane; PE, phenylephrine; VSM, vascular smooth muscle.

Pollen Biotechnology

A. Reardon[a], A. Divjan[a], M.S. Perzanowski[a] and G.L. Chew[a]. ([a]Columbia University, Mailman School of Public Health, New York, NY). Determinants of Aeroallergen-specific IgE in a New York Birth Cohort of Puerto Rican Children. Journal of Allergy and Clinical Immunology, Volume 121(2)(1) (2008): S19

Rationale

Compared with other Latino groups, Puerto Rican children have a high prevalence of asthma and differing patterns of allergic sensitization.

Methods

With an inner-city birth cohort of 274 New York City-born Puerto Rican children selected on maternal history of atopy/asthma settled dust levels of cockroach, mouse, cat, and dust mite allergen and the development of specific IgE against these four aeroallergens are being measured. To date, we have allergen-specific IgE for 82 children who have reached age 4 and their mothers.

Results

By age 4, 23% of the children were seroatopic (i.e. ≥0.35 IU/ml to any of the measured aeroallergen), specifically sensitized to cockroaches (7%), mice (7%), cats (10%), and dust mites (10%). Children had greater odds of seroatopy when mothers were sensitized to dust mites (OR = 4.0 [1.3-12.1]) or cats (OR = 3.3 [1.1-9.7]). Neither maternal cockroach nor mouse sensitization was significantly associated with children's seroatopy. Allergen concentrations in dust were not significantly associated with children's seroatopy. Nonetheless, none of the 12 children who were born into a home with cats developed IgE to any of the aeroallergens as compared with 27% seroatopy among those who were not born in a home with a cat.

Conclusions

Puerto Rican children whose mothers are sensitized to dust mites or cats have greater odds of developing IgE specific for at least one of the tested indoor allergens. Cat ownership appeared to be inversely associated with sensitization at this age. Further study of this cohort will examine how socio-cultural factors influence allergic sensitization.

Volker Kummer[a] and Wolf R. Thiel[b]. ([a]Hessian Agency of Environment and Geology (HLUG), Rheingaustr. 186, 65203 Wiesbaden, Germany, [b]Commission on Air Pollution Prevention of VDI an DIN – Standards Committee, Düsseldorf, Germany). Bioaerosols – Sources and control measures. International Journal of Hygiene and Environmental Health, Volume 211(3-4) (2008): 299-307

In every field of activity where organic material is being handled, emissions of dust, gases, odor as well as bioaerosols are bound to arise. For this reason, waste management facilities or else agricultural enterprises are potential emission sources of bioaerosols. The dispersion of bioaerosols from waste treatment facilities and their health impacts continue to be the subject of numerous discussions. This article addresses organizational and engineering measures for the mitigation of bioaerosol emissions. The required scale of emission reduction and the choice of microbiological parameters have to be assessed with respect to location and facility type.

Keywords: Bioaerosols; Emission sources; Mitigation; Standardization; Abatement measures; Biofilters

Biotechnology Policy Issue

Sonja Merten[a] and Tobias Haller[b, 1]. ([a]Institute of Social and Preventive Medicine, University of Basle, Steinengraben 49, 4051 Basle, Switzerland, [b]Institute of Social Anthropology, University of Zurich, Andreasstrasse 17, 8050 Zürich, Switzerland). Property rights, food security and child growth: Dynamics of insecurity in the Kafue Flats of Zambia. Food Policy, Volume 33(5) (2008): 434-443

This paper provides arguments for discussions of the role of property rights for food security and child nutrition in rural Africa. The results are drawn from a case study in the Kafue Flats of Zambia. They show that unclear jurisdictional boundaries and weak authorities facilitated re-negotiations of property rights related to natural resources in the context of the Southern African food crisis 2002–2003. Access to natural resources was skewed towards the more powerful. On average, food intake was temporarily 50% lower than the annual mean, compared to a less than 10% decrease in the lean season 2003–2004. Large inequalities existed between different clusters of villages, according to the history of immigration and ethnicity. Yet the variability was greatest within villages. Households, which reported increasing difficulties with access to natural resources, had less diversified income-generating activities, lower food intake and more children showing impaired growth. Discussions addressing the growing disparities in rural areas should focus on a realistic implementation and enforcement of property rights in context of situated local power-relations, next to the harmonization of different tenure systems related to natural resources.

Keywords: Property rights; Food security; Famine; Livelihoods; Zambia

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This paper examines the impact of climatic change on the level of total agricultural production of Sub-Saharan Africa (SSA) and non-Sub-Sahara Africa (NSSA) developing countries. In doing so it uses a new cross-country panel climatic dataset in an agricultural production framework. The results show that climate, measured as changes in country-wide rainfall and temperature, has been a major determinant of agricultural production in SSA. In contrast, NSSA countries appear not to be affected by climate in the same manner. Simulations using the estimates suggest that the detrimental changes in climate since the 1960s can account for a substantial portion of the gap in agricultural production between SSA and the rest of the developing world.

Keywords: Climate change; Agricultural production; Sub-Saharan Africa

Agricultural Biotechnology

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The entire subject of GM organisms and GM technology is saddled with different opinions, considerable frustrations, and a growing sense of ethical and environment concerns, globally. The question then is: should opinions and perceptions about GM crops stand the way of technologies that can potentially improve the survival and quality of life for millions of people in Africa? Scientists must help provide an answer to this question by ensuring that debate on GM crops addresses facts not opinions so as to respond to society's concern. This essay is intended to give an overview of the GM food technology and assesses the benefits and risks to Africans.

Keywords: Benefits, concerns, food security, genetically modified plant.

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This study monitored the influence of arsenic-contaminated irrigation water on alkaline soils and arsenic uptake in agricultural plants at field level. The arsenic concentrations in irrigation water ranges from <0.005 to 1.014 mg L^{-1} where the arsenic concentrations in the soils were measured from 6.1 to 16.7 mg As kg^{-1}. The arsenic content in different parts of plants are found in the order of roots > shoots > leaves > edible parts. The mean arsenic content of edible plant material (dry weight) were found in the order of onion leaves (0.55 mg As kg^{-1}) > onion bulb (0.45 mg As kg^{-1}) > cauliflower (0.33 mg As kg^{-1}) > rice (0.18 mg As kg^{-1}) > brinjal (0.09 mg As kg^{-1}) > potato (<0.01 mg As kg^{-1}).

The arsenic content in soil and plants is influenced by the degree of arsenic amount in irrigated water.

Keywords: Agricultural plant; Arsenic; Irrigation; Soil

Bioenergy

Yohei Isayama[a] and Shiro Saka[a]. ([a]Department of Socio-Environmental Energy Science, Graduate School of Energy Science, Kyoto University, Yoshida-honmachi, Sakyo-ku, Kyoto 606-8501, Japan). Biodiesel production by supercritical process with crude bio-methanol prepared by wood gasification. Bioresource Technology, Volume 99(11) (2008): 4775-4779

In order to prepare a genuine biodiesel, it is essential to use methanol prepared from biomass but not natural gas for biodiesel production. Thus, we have proposed to use crude bio-methanol produced by wood gasification for biodiesel production. Since such a bio-methanol contains some impurities, an effect of its impurities was studied on the biodiesel production by supercritical method. In general, impurities in crude bio-methanol are reported to include methyl formate, ethanol, 1-butanol, diisopropyl ether, water, etc. Triglycerides and oleic acids were, thus, treated with these impurities under supercritical conditions. As a result, it was found that methyl formate, ethanol and 1-butanol could convert them to fatty acid alkyl esters (BDF), whereas no conversion was achieved with diisopropyl ether. Thus, crude bio-methanol can be used for BDF production as a substitute for methanol from fossil resources. However, due to more efficient reaction, crude bio-methanol can be more applicable to the two-step supercritical methanol process, consisting of hydrolysis of triglycerides and subsequent esterification of fatty acids, compared with the one-step supercritical methanol process, where transesterification of triglycerides is a major reaction.

Keywords: Biodiesel; Crude bio-methanol; Supercritical process; Wood gasification; Triglycerides

Tae Hyun Kim[a], Frank Taylor[a] and Kevin B. Hicks[a]. ([a]Crop Conversion Science and Engineering Research Unit, Eastern Regional Research Center, Agricultural Research Service, US Department of Agriculture, 600 E. Mermaid Lane, Wyndmoor, PA 19038, United States). Bioethanol production from barley hull using SAA (soaking in aqueous ammonia) pretreatment ☆. Bioresource Technology, Volume 99(13) (2008) :5694-5702

Barley hull, a lignocellulosic biomass, was pretreated using aqueous ammonia, to be converted into ethanol. Barley hull was soaked in 15 and 30 wt.% aqueous ammonia at 30, 60, and 75 °C for between 12 h and 11 weeks. This pretreatment method has been known as "soaking in aqueous ammonia" (SAA). Among the tested conditions, the best pretreatment conditions observed were 75 °C, 48 h, 15 wt.% aqueous ammonia and 1:12 of solid:liquid ratio resulting in saccharification yields of 83% for glucan and 63% for xylan with 15 FPU/g-glucan enzyme loading. Pretreatment using 15 wt.% ammonia for 24–72 h at 75 °C removed 50–66% of the original lignin from the solids while it retained 65–76% of the xylan without any glucan loss.

Addition of xylanase along with cellulase resulted in synergetic effect on ethanol production in SSCF (simultaneous saccharification and co-fermentation) using SAA-treated barley hull and recombinant *E. coli* (KO11). With 3% w/v glucan loading and 4 mL of xylanase enzyme loadings, the SSCF of the SAA treated barley hull resulted 24.1 g/L ethanol concentration at 15 FPU cellulase/g-glucan loading, which corresponds to 89.4% of the maximum theoretical yield based on glucan and xylan.

SEM results indicated that SAA treatment increased surface area and the pore size. It is postulated that these physical changes enhance the enzymatic digestibility in the SAA treated barley hull.

Keywords: Bioenergy; Lignocellulosic biomass; Aqueous ammonia; Lignin removal; SAA

Lisa M. Gieg, Kathleen E. Duncan, and Joseph M. Suflita* (Department of Botany and Microbiology and Institute for Energy and the Environment, University of Oklahoma, Norman, Oklahoma 73019. * Corresponding author. Mailing address: Department of Botany and Microbiology, University of Oklahoma, 770 Van Vleet Oval, Rm. 135, Norman, OK 73019. Phone: (405) 325-3771. Fax: (405) 325-7619. E-mail: jsuflita@ou.edu). **Bioenergy Production via Microbial Conversion of Residual Oil to Natural Gas. Applied and Environmental Microbiology, Vol. 74(10) (2008): 3022-3029**

World requirements for fossil energy are expected to grow by more than 50% within the next 25 years, despite advances in alternative technologies. Since conventional production methods retrieve only about one-third of the oil in place, either large new fields or innovative strategies for recovering energy resources from existing fields are needed to meet the burgeoning demand. The anaerobic biodegradation of *n*-alkanes to methane gas has now been documented in a few studies, and it was speculated that this process might be useful for recovering energy from existing petroleum reservoirs. We found that residual oil entrained in a marginal sandstone reservoir core could be converted to methane, a key component of natural gas, by an oil-degrading methanogenic consortium. Methane production required inoculation, and rates ranged from 0.15 to 0.40 μmol/day/g core (or 11 to 31 μmol/day/g oil), with yields of up to 3 mmol CH_4/g residual oil. Concomitant alterations in the hydrocarbon profile of the oil-bearing core revealed that alkanes were preferentially metabolized. The consortium was found to produce comparable amounts of methane in the absence or presence of sulfate as an alternate electron acceptor. Cloning and sequencing exercises revealed that the inoculum comprised sulfate-reducing, syntrophic, and fermentative bacteria acting in concert with aceticlastic and hydrogenotrophic methanogens. Collectively, the cells generated methane from a variety of petroliferous rocks. Such microbe-based methane production holds promise for producing a clean-burning and efficient form of energy from underutilized hydrocarbon-bearing resources.

Calliope Panoutsou[a], Irene Namatov[b], Vassilis Lychnaras[b] and Anastasia Nikolaou[b]. ([a]Imperial College, Centre for Energy Policy and Technology, London SW7 2AZ, UK, [b]Centre for Renewable Energy Sources (CRES), 19th km Marathonos Avenue, 19009 Pikermi, Greece). Biodiesel options in Greece. Biomass and Bioenergy, Volume 32(6) (2008) : 473-481

Following European Directive (2003/30/EC) on the promotion of the use of biofuels or other renewable fuels for transport dated May 2003, the Greek Government recently conducted a study on biofuels in Greece as part of the National report for the Directive. According to this, biodiesel will be the main biofuel for the Greek transport sector with bioethanol playing a much more minor role. The amount of biodiesel required to satisfy the indicative target of 2% (on a lower calorific basis) for the year 2005 is estimated to be ca. 42,560 tonnes, while the amount to satisfy the indicative target of 5.75% for the year 2010 is estimated to be ca. 135,585 tonnes. This paper will analyse the resources available for biodiesel production and identify the most realistic options under technical, economic and environmental perspectives.

Keywords: Biodiesel; Greece; Costs; Land use

Egidio Viola [a], Mariangela Cardinale[a], Rosalia Santarcangelo[a], Antonio Villone[a] and Francesco Zimbardi[a]. ([a]ENEA, Renewable Energy and Innovative Cycles Units, Biomass Section, Policoro (MT) cp 1 75025, Italy). Ethanol from eel grass via steam explosion and enzymatic hydrolysis. **Biomass and Bioenergy, Volume 32(7) (2008): 613-618**

Zostera marina was investigated for ethanol production. The examined plant contained 30% of glucan. It was pretreated by steam explosion and the best conditions were assessed by a 2^3 full factorial design with repeated centre point. Temperature, time of pretreatment and oxalic acid load were selected as experimental factors. The experimental data of water-soluble sugar recovery and enzymatic saccharification of the insoluble residue were analysed by the response surface regression procedure, which provided significant models with R^2=0.98. The best results (5.06 g of soluble sugars and 52.9 g of glucose, respectively, from 100 g of exploded material and 100 g of insoluble fibre) were attained at pretreatment of 180 °C, 300 s and 2 wt% of oxalic acid. Fermentation tests of the hydrolysed fibre were carried out and the ethanol production was optimised by varying the enzyme load, the amount of yeast and the solid concentration. In the best cases 243 g of ethanol was produced per kg of Zostera fibre and the concentration of 4.7 v% was attained in tests of high-solid load.

Keywords: Carbohydrates; Ethanol; Steam explosion; *Zostera marina*; Experimental design; Response surface; Oxalic acid

Simone Bastianoni[a], Fazio Coppola[a], Enzo Tiezzi[a], Andrea Colacevich[b], Francesca Borghini[b] and Silvano Focardi[b]. ([a]Department of Chemical and Biosystems Sciences, Siena University, via della Diana, 2A, 53100 Siena, Italy [b]Department of Environmental Sciences, Siena University, via Mattioli 4, 53100 Siena, Italy). Biofuel potential production from the Orbetello lagoon macroalgae: A comparison with sunflower feedstock. Biomass and Bioenergy, Volume 32(7) (2008): 619-628

The diversification of different types and sources of biofuels has become an important energy issue in recent times. The aim of this work is to evaluate the use of two kinds of renewable feedstocks in order to produce biodiesel. We have analyzed the potential production of oil from

two species of macroalgae considered as waste coming out from a lagoon system involved in eutrophication and from sunflower seeds. We have tested oil extraction yields of both feedstock. Furthermore, a comparison has been carried out based on the emergy approach, in order to evaluate the sustainability and environmental performance of both processes. The results show that, under present conditions, considering oil extraction yields, the production of oil from sunflower seeds is feasible, because of the lower value of transformity of the final product with respect to macroalgae. On the other hand, the results demonstrate that with improvements of oil extraction methodology, macroalgae could be considered a good residual biomass usable for biofuel production.

Keywords: Lipids; *Chaetomorpha linum*; *Gracilariopsis longissima*; *Helianthus annuus*; Emergy

C. Paul Mitchell[a]. ([a]University of Aberdeen, Aberdeen, UK). Biofuels for Transport, The Worldwatch Institute , Earthscan, London (2007) 480pp., £44.95, Hardback, ISBN 1844074226/978184407228. Biomass and Bioenergy, Volume 32(7) (2008): 654-655

Biofuels for transport is a topic that is never far from the front pages of the newspapers as the perceived widespread adoption of cropping systems to produce feedstocks to produce biofuels displaces food and fibre crops and is encroaching on tropical rainforests, thereby impacting biodiversity. This book, published under the auspices of a project commissioned by the German Federal Ministry of Food, Agriculture and Consumer Protection BMELV, is therefore very timely.

We are taken through a compendium of global statistics and biofuel policies, provided with primers on production, conversion and end-use systems before coverage of economic, land use and environmental issues. All this is very useful and will be a valuable source of information for the decision makers at which the book is targeted. However, one is still left with the concern that the projected long-term benefits of moving to biofuels for transport might not be realised or even whether there are in fact such benefits to be realised.

We have already seen a significant increase in the trade in biofuels, consequential (some would argue) increases in the price of basic foodstuffs attributed to biofuels and a first sight of the un-intentional consequences of the switch to biofuels.

There are undoubted scientific challenges to be overcome to realise the transition from a fossil-fuelled transport system to one mainly fuelled by biofuels, and society is naturally becoming increasingly concerned that the transition should be smooth and that indigenous peoples are nor displaced and biodiversity lost as a consequence.

This book will help inform the debate by providing appropriate information and by not shying away from results that indicate that ethanol fuels in some circumstances might not be as environmentally benign as some might have us believe.

J. M. Tront[1], J. D. Fortner[2], M. Plötze[1], J. B. Hughes[2, 3] and A. M. Puzrin[1]. ([1]Institute for Geotechnical Engineering, ETH Zurich Switzerland, Wolfgang-Pauli Strasse 15, 8093 Zurich, Switzerland, [2]School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA 30332, USA, [3]School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, GA 30332, USA). Microbial fuel cell

technology for measurement of microbial respiration of lactate as an example of bioremediation amendment. Biotechnology Letters, Volume 30(8) (2008) : 1385-1390

Microbial fuel cell (MFC) based sensing was explored to provide for the development of an in situ bioremediation monitoring approach for substrate concentrations and microbial respiration rates. MFC systems were examined in column systems where *Shewanella oneidensis* MR1 used an external electron acceptor (an electrode) to metabolize lactate (a bioremediation additive) to acetate. Column systems were operated with varying influent lactate concentrations (0–41 mM) and monitored for current generation (0.01–0.39 mA). Biological current generation paralleled bulk phase lactate concentration both in the influent and in the bulk phase at the anode; current values were correlated to lactate concentration at the anode ($R^2 = 0.9$), The electrical signal provided real-time information for electron donor availability and biological activity. These results have practical implications for efficient and inexpensive real-time monitoring of in situ bioremediation processes where information on substrate concentrations is often difficult to obtain and where information on the rate and nature of metabolic processes is needed.

Keywords: Anaerobic respiration - Bioremediation - In situ sensing - Microbial fuel cell

Abhijeet P. Borole[1], Hugh O'Neill[2, 3], Costas Tsouris[4] and Scott Cesar[5] ([1]Biosciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6226, USA, [2]Center for Structural Molecular Biology, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6226, USA, [3]Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6226, USA, [4]Nuclear Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6226, USA, [5]Oak Ridge Associated Universities, Oak Ridge, TN 37830, USA). A microbial fuel cell operating at low pH using the acidophile Acidiphilium cryptum. Biotechnology Letters, Volume 30(8) (2008): 1367-1372

For the first time, a microbial fuel cell has been developed using an acidophile, *Acidiphilium cryptum*, as the anode biocatalyst. Electricity production using its natural electron acceptor, iron, as the electron mediating agent at pH values ≤4.0 was demonstrated. Accumulation of Fe(III) at the electrode, however, restricted current output. The combination of nitrilotriacetic acid and Phenosafranin as electron mediators increased the power output to 12.7 mW/m^2 in a two-chamber air-sparged fuel cell. Direct electron transfer from the microorganisms to the anode was also investigated but was not detected under the conditions studied.

Keywords: *Acidiphilium cryptum* - Acidophile - Biofuel cell - Electricity - Mediated electron transfer

Jing-Ke Weng[a], Xu Li[a], Nicholas D Bonawitz[a] and Clint Chapple[a]. ([a]Department of Biochemistry, Purdue University, 175 South University Street, West Lafayette, IN 47907-2063, United States). Emerging strategies of lignin engineering and degradation for cellulosic biofuel production. Current Opinion in Biotechnology, Volume 19(2) (2008): 166-172

Ethanol and other biofuels produced from lignocellulosic biomass represent a renewable, more carbon-balanced alternative to both fossil fuels and corn-derived or sugarcane-derived ethanol. Unfortunately, the presence of lignin in plant cell walls impedes the breakdown of cell wall polysaccharides to simple sugars and the subsequent conversion of these sugars to usable fuel.

Recent advances in the understanding of lignin composition, polymerization, and regulation have revealed new opportunities for the rational manipulation of lignin in future bioenergy crops, augmenting the previous successful approach of manipulating lignin monomer biosynthesis. Furthermore, recent studies on lignin degradation in nature may provide novel resources for the delignification of dedicated bioenergy crops and other sources of lignocellulosic biomass.

Satoshi Katahira[a], Meguru Ito[a], Hisae Takema[b], Yasuya Fujita[a], Takanori Tanino[b], Tsutomu Tanaka[c], Hideki Fukuda[c] and Akihiko Kondo[b]. ([a]Department of Molecular Science and Material Engineering, Graduate School of Science and Technology, Kobe University, Japan, [b]Department of Chemical Science and Engineering, Graduate School of Engineering, Kobe University, 1-1, Rokkodaicho, Nada-ku, Kobe 657-8501, Japan, [c]Organization of Advanced Science and Technology, Kobe University, Japan). Improvement of ethanol productivity during xylose and glucose co-fermentation by xylose-assimilating *S. cerevisiae* via expression of glucose transporter Sut1. Enzyme and Microbial Technology, Volume 43(2) (2008): 115-119

Enhancing the sugar uptake ability of the yeast *Saccharomyces cerevisiae* is a potentially important factor for efficient ethanol production during fermentation of lignocellulosic biomass. Here, we attempted to express a *Pichia stipitis* gene encoding a sugar transporter*, SUT1*, in a xylose-assimilating *S. cerevisiae* strain that expresses xylose reductase, xylosedehydrogenase and xylulokinase. We next investigated xylose fermentation, glucose fermentation and glucose and xylose co-fermentation using the Sut1-expressing *S. cerevisiae* strain. Expression of Sut1 in xylose-assimilating *S. cerevisiae* increased both xylose uptake ability and ethanol productivity during xylose fermentation. Moreover, glucose uptake ability and ethanol productivity during glucose fermentation also increased by expressing of Sut1. The yield of ethanol during xylose and glucose co-fermentation by the Sut1-expressing yeast strain (0.44 g/g-consumed sugar) was significantly higher than that of the parental strain (0.39 g/g-consumed sugar).

Keywords: *Saccharomyces cerevisiae*; Xylose fermentation; Co-fermentation; Transporter; Sut1

Name of Journals

1. Acta Biotechnologica
2. Aerobiologia
3. Annual Review-Plant Pathology
4. Annual Review- Ecology and Systematics
5. Annual Review-Biochemistry
6. Annual Review-Biomedical Engineering
7. Annual Review-Biophysics and Biomolecular Structure
8. Annual Review-Microbiology
9. Annual Review-Pharmacology and Toxicology
10. Annual Review-Phytopathology
11. Annual Review-Physiology
12. Annual Review-Plant Physiology
13. Annual Review-Public Health
14. African Journal of Biotechnology
15. Applied and Environmental Microbiology
16. Applied Microbiology & Biotechnology
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18. Allergy
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28. Biomedical and Environmental Sciences
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