ENVIS CENTER

on

ENVIRONMENTAL BIOTECHNOLOGY

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ENVIS CENTRE

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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 Centre. It is planned by the Ministry of Environment and Forest. Aim of this centre is to provide descriptive data 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 at the Ministry of Environment and Forest, Government of India, New Delhi.

This ENVIS Centre is established for studies on Environmental Biotechnology at the University of Kalyani, Department of Environmental Science, 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, consult with different journals, Annual reviews, Internet and to generate a database and create a website with this informations. View point of this journal abstract is to help the interested research workers, scientist, administrator and the public.

This is the 7^{th} publication of this ENVIS Centre. This contains the abstract of research papers collected in the area of Environmental Biotechnology from various journals published during June 2005 onwards. Here various topics like Bio-engineering, Bio-degradation, Bio-remediation, Bio-transformation etc. are covered. We are grateful to the various libraries and their staff for their extended cooperation in the collection of the articles.

Abstract Format

The format of the abstract is as follows:

Abstract : The abstracts were 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 author name. When the address of any other author is found, it is written after wards delimited by stop(.).

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

GENERAL INFORMATION

Abstract have been taken directly from source document like research report, journals, internet, seminars, proceedings, standards and patents. All the resources published within the year 2005.

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

Bioaccumulation: It studies address the buildup of bioaccumulative compounds through biomagnification and/or bioconcentration. 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 any time they are taken up and stored 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. These 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, anddegrade the organic contaminants into inert products.

Because the microorganisms already occur naturally in the environment they pose no contamination risk.

Bio-Transformation: This is a process of Biological changes of complex compound to simpler toxic to non-toxic or vice-versa. Several microorganism are capable of transforming a varity of compound founding nature but generally with respect to synthetic compound they are unable to show any appropriate action. Biotransfer appears to be one of the major detoxication method known so far.

Biomarker: It is a biological response to a chemical that gives a measure of exposure and, sometimes, of toxic effect. Biological markers found in crude oils and source rock extracts can provide molecular evidence of the correlation among oils and their sources.

Biofertilizer: To reduce the impact of excess chemical fertilizers in the field of agriculture the biofertilizer is 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 were 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 involves combining organic materials under conditions that enables them to decompose more quickly than they would in nature.

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 nature, there is no 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 will 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 will 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. A major focus for bioengineering is to improve the quality of life of people with medical conditions that restrict independent living and integration within the community.

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

Biotechnology Policy Issue: Biotechnology appears to be a 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 was made in diverse field of agriculture by applying Biotechnology. It includes development of genetically modified crops, genetically improvement in sericulture practices, improvement in Biofertilizer development and similar other aspects. Crop production against pest and disease stress resistance of crops also considered to be emerging area of Agricultural Biotechnology.

Bioenergy: In recent decades, efforts were made for evolving were non-polluting bioenergy sources or energy generation from organic waste or biomass. These are all ecofreindly solution. Biomass energy supply demand balances have become a component of energy sector analysis and planning and assumed greater importance in countries. These are variety of biological energy sources. Biomass, Biogas, Hydrogen are the example of Bioenergy.

ABBREVIATIONS USED IN ADDRESSES AND CITED JOURNALS

Acad	Academy	Chem	Chemistry
Adm	Administration	Chemi	Chemical
Admn	Administrative	Clini	Clinical
Adv	Advance	Co	Company
Agric	Agriculture	Coil	College
Agrici	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	Conti	Control
Appt	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
Biochemi	Biochemical	Dy	Deputy
Bioengng	Bioengineering	Eco	Ecology
Biol	Biological	Ecol	Ecological
BiometeO	Biometeorology	Econ	Economics
Biophys	Biophysics	Ecosys	Ecosystem
Biometeol	Biometeorological	Exotoxico	Ecotoxicology
Biotech	Biotechnique(s)	Endocrinol	Endocrinological
Biotechno	Biotechnology	Engng	Engineering
Biotechnol	Bitechnological	Engrs	Engineers
Bidg	Building	Env	Environment
Bot	Botany	Environ	Environmental
Boti	Botanical	Epidemic	Epidemiology
Br	Branch	Epidemiol	Epidemiological
Bull	Bulletin	Estb	Establishment
Cent	Centre	Ethnopharmaco	Ethnopharmacology
Centl	Central	Exot	Experiment

Expti	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
Geogri	Geographical	Occ	Occassional
Geol	Geological	Occupl	Occupational
Geosci	Geoscience	Oceanogr	Oceanogoraphy
Govt	Government	Org	Organic
Hist	History	Orgn	Organisation
Hlth	Health	Pharmaco	Pharmacology
Hort	Horticulture	Pharmacol	Pharmacological
Hosp	Hospital	Phyl	Physical
Hydro	Hydrology	Patho	Pathology
Hydrol	Hydrological	Pathol	Pathological
Immuno	Immunology	Petrochemi	Petrochemical
Immunol	Immunlogical	Petro	Petrology
Ind	Industry	PG	Post Graduate
Inf	Information	Phys	Physics
Inst	Institute	Physio	Physiology
Instn	Institution	Phytopath	Phytopathology
Int	International	Phytopathol	Phytopathological
Irrig	Irrigation	Plang	Planning
J	Journal	Polln	Pollution
Lab	Laboratory	Proc	Proceedings
Lett	Letter(s)	Prot	Protection
Ltd	Limited	Pub	Publication
Malario	Malariology	Pvt	Private
Malariol	Malariological	Qlty	Quality
Manag	Management	Qr	Quarter
Med	Medicine	Rad	Radiation
Medl	Medical	Radio	Radiology
Metab	Metabolism	Radiol	Radiological
Metall	Metallurgy	Rd	Road
Metallurg	Metallurgical	Recd	Received
Meteo	Meteorology	Reg	Region
Meteol	Meteorological	Regl	Regional
Microbio	Microbiology		

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

Bioaccumulation

Anand P, Isar J, Saran S, Saxena RK. (Department of Microbiology, University of Delhi, South Campus, Benito Juarez Road, New Delhi 110 021, India). Bioaccumulation of copper by *Trichoderma viride*. Bioresour Technol. (2005) Nov 29; [Epub ahead of print]

Studies were carried out on interaction of Trichoderma viride with copper and reports bioaccumulation as a mechanism of copper tolerance during growth. There was a marked increase in the lag phase of the growth, which was concentration dependent. At a concentration of 100mg/L of CuCl(2).2H(2)O, 81% of Cu(II) were removed by 3.4g/L of the biomass in 72h. The process was temperature and pH dependent. The maximum copper bioaccumulation occurred at 30 degrees C, pH 5.0. Metabolic inhibitors such as sodium azide (NaN(3)) and 2,4-dinitrophenol (2,4-DNP) drastically reduced the extent of Cu(II) bioaccumulation. Electron microscopy and cell fractionation studies revealed that 70-80% of copper was present as a layer on the cell wall surface.

Fu CT, Wu SC. (Graduate Institute of Environmental Engineering, National Taiwan University, 71 Zhou Shan St. Taipei City 106, Taiwan; Department of Environmental Engineering, Vanung University, 1 Vanung Rd. Chungli City 325, Taiwan). Bioaccumulation of polychlorinated biphenyls in mullet fish in a former ship dismantling harbour, a contaminated estuary, and nearby coastal fish farms. Mar Pollut Bull. 51(8-12)(2005): 932-9.

This study investigated the bioaccumulation of polychlorinated biphenyls (PCBs) toward mullet fish (Liza macrolepis) living in former PCB contaminated areas, the Ann-Ping harbour and the Er-Jen estuary, and fish farms located near the above two areas in 2003. The PCB body burdens of collected fish samples are proportional to the contamination level of their locations with the following rank order (greatest to least) from the Er-Jen estuary, the Ann-Ping harbour to the fish farms. Concentration of PCBs of the estuarine mullet has been approximately decreased to one-half of the peak concentration of the 1990s. Although the concentration of PCBs in farmed fish inhabiting near the two contaminated areas was greater than the average of those of fish from local fish markets in Taiwan, no particularly great contamination level was observed in their bodies. Using the less chlorinated PCB fraction (triCB+tetraCB)/total PCBs as the indicator of the origins of PCBs, fish near former contaminated areas had greater body burdens of the more chlorinated PCB congeners, while the farmed fish exhibited a PCB pattern more like that known to originate from air-water exchange with less chlorinated PCBs predominating. Although the PCB contamination has been stopped for a decade, the residual contaminants, supposedly existing in soil and sediments, still contribute to the body burden of fish residing in the estuary and the harbour.

Bhaskar PV, Bhosle NB. (National Institute of Oceanography, Dona Paula, GOA-403 004, India). Bacterial extracellular polymeric substance (EPS): A carrier of heavy metals in the marine food-chain. Environ Int. (2005) Oct 25; [Epub ahead of print]

The ecological implications of metal binding properties of bacterial EPS and its possible role in the bioaccumulation of pollutants in the marine food-chain was investigated using a partially purified and chemically characterized microbial EPS isolated from a species of Marinobacter.

Various factors influencing metal sorption by the EPS including the influence of initial metal concentrations, incubation time, pH and sodium chloride concentrations on binding of lead (Pb(2+)) and copper (Cu(2+)) were evaluated. The bacterial EPS selectively bound more amount of Cu(2+) per mg of EPS than Pb(2+). Both copper and lead were sorbed more at near neutral pH than acidic pH. The sorption of Cu(2+) increased with increasing copper concentration. The estimated maximum binding ability (MBA) of the EPS was 182 nmol copper and 13 nmol lead mg(-)(1) EPS. However, the sorption of these metals decreased with the increase in sodium chloride concentration. Furthermore, up to 35% of (14)C-labeled Marinobacter was ingested by a benthic polychaete Hediste diversicolor. On an average, 29% of the ingested EPS was absorbed into tissues and 49% of the EPS was respired. It was apparent that the animals used the EPS as a source of energy and nutrition. The labile nature of the bacterial EPS and its ability to bind heavy metals might route the bound metals through the marine food chain, thereby transferring and aiding bioaccumulation of metal pollutants in the higher trophic animals.

Carlson DL, Hites RA. (School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana 47405, USA). Polychlorinated biphenyls in salmon and salmon feed: global differences and bioaccumulation. Environ Sci Technol. 39(19)(2005):7389-95.

Concentrations of 160 polychlorinated biphenyl (PCB) congeners or congener groups were determined in approximately 600 farmed Atlantic salmon from around the world and wild (ocean-caught) Pacific salmon from the Northeast Pacific. Concentrations and PCB congener profiles were analyzed to provide insight into the sources and uptake of PCBs in salmon as well as regional differences. Although total PCB concentrations in wild salmon appeared to be correlated to total lipid content, the increased proportion of total lipids in the farmed salmon could not account for the much greater PCB concentrations. We investigated the PCB congener patterns of hundreds of salmon samples using principal component analysis to further illuminate regional and species differences. Three major PCB patterns were observed, in most wild fish (except British Columbia and Oregon chinook), in farmed fish from the Atlantic, and in most farmed fish from the Pacific. The PCB congener profiles of farmed salmon often closely corresponded to a sample of commercial feed purchased in the same region, indicating that the feed is likely to be the major source of PCBs for farmed salmon. In such cases where PCB profiles in fish and feed were similar, a comparison of congener concentrations in fish and the feed showed that the majority of congeners, with some notable exceptions, were bioaccumulative to the same extent, irrespective of physical properties.

Moreno-Jimenez E, Gamarra R, Carpena-Ruiz RO, Millan R, Penalosa JM, Esteban E. (Seccion de Quimica Agricola, Facultad de Ciencias, C-VII, Universidad de Madrid, 28049 Madrid, Spain). Mercury bioaccumulation and phytotoxicity in two wild plant species of Almaden area. Chemosphere. (2005) Nov 14; [Epub ahead of print]

Mercury is a widely distributed environmental pollutant, able to induce toxicity in living organisms, including higher plants. Some plant species are able to grow in mine sites, like the Almaden zone in Spain. Our study focus on two of these plant species, Rumex induratus and Marrubium vulgare and their responses to natural Hg exposure. Total Hg concentration in the soil below the plants could be classified as toxic, although the available fraction was low. Hg availability was higher for the M. vulgare than for the R. induratus plot. Hg concentrations in field plants of R. induratus and M. vulgare grown on these soils can be considered as phytotoxic, although no symptoms of Hg toxicity were observed in any of them. According to the BAF ([Hg](tissue)/[Hg](avail)), R. induratus showed a higher ability in Hg uptake and translocation to

shoots, as well as higher concentrations of MDA and -SH:Hg ratios, so that this plant is more sensitive to Hg than M. vulgare. The resistance to Hg and the capability to extract Hg from the soil make both M. vulgare and R. induratus good candidates for Hg phytoremediation of contaminated soils.

Levy JL, Stauber JL, Adams MS, Maher WA, Kirby JK, Jolley DF. (Centre for Environmental Contaminants Research, Commonwealth Scientific and Industrial Research Organization, Energy Technology, Private Mail Bag 7, Bangor, New South Wales 2234, Australia. jacqueline.levy@csiro.au). Toxicity, biotransformation, and mode of action of arsenic in two freshwater microalgae (Chlorella sp. and Monoraphidium arcuatum). Environ Toxicol Chem. 24(10)(2005): 2630-9.

The toxicity of As(V) and As(III) to two axenic tropical freshwater microalgae, Chlorella sp. and Monoraphidium arcuatum, was determined using 72-h growth rate-inhibition bioassays. Both organisms were tolerant to As(III) (72-h concentration to cause 50% inhibition of growth rate [IC50], of 25 and 15 mg As[III]/L, respectively). Chlorella sp. also was tolerant to As(V) with no effect on growth rate over 72 h at concentrations up to 0.8 mg/L (72-h IC50 of 25 mg As[V]/L). Monoraphidium arcuatum was more sensitive to As(V) (72-h IC50 of 0.25 mg As[V]/L). An increase in phosphate in the growth medium (0.15-1.5 mg PO4(3-)/L) decreased toxicity, i.e., the 72-h IC50 value for M. arcuatum increased from 0.25 mg As(V)/L to 4.5 mg As(V)/L, while extracellular As and intracellular As decreased, indicating competition between arsenate and phosphate for cellular uptake. Both microalgae reduced As(V) to As(III) in the cell, with further biological transformation to methylated species (monomethyl arsonic acid and dimethyl arsinic acid) and phosphate arsenoriboside. Less than 0.01% of added As(V) was incorporated into algal cells, suggesting that bioaccumulation and subsequent methylation was not the primary mode of detoxification. When exposed to As(V), both species reduced As(V) to As(III); however, only M. arcuatum excreted As(III) into solution. Intracellular arsenic reduction may be coupled to thiol oxidation in both species. Arsenic toxicity most likely was due to arsenite accumulation in the cell, when the ability to excrete and/or methylate arsenite was overwhelmed at high arsenic concentrations. Arsenite may bind to intracellular thiols, such as glutathione, potentially disrupting the ratio of reduced to oxidized glutathione and, consequently, inhibiting cell division.

Smitkova H, Huijbregts MA, Hendriks AJ. (Department of Food Preservation and Meat Technology, Faculty of Food and Biochemical Technology, Institute of Chemical Technology, Prague, Technicka 5, 166 28 Prague 6 - Dejvice, Czech Republic). Comparison of three fish bioaccumulation models for ecological and human risk assessment and validation with field data. SAR QSAR Environ Res. 16(5)(2005):483-93.

This article compares two bioconcentration Quantitative Structure Activity Relationships (QSARs) for fish applied in human risk assessments with the mechanistic bioaccumulation model OMEGA and field data. It was found that all models are virtually similar up to a Kow of 10(6). For substances with a Kow higher than 10(6), the fish bioconcentration curve in the risk assessment model EUSES decreases parabolically. In contrast, OMEGA bioaccumulation outcomes approximately show a linear increase, based on mechanistic bioconcentration and biomagnification properties of chemicals. The OMEGA-outcomes are close to the fish bioconcentration outcomes of the risk assessment model CalTOX. For very hydrophobic substances, field accumulation data in freshwater and marine fish species are closer to OMEGA- and CalTOX-outcomes compared to EUSES. The results also show that it is important to include biomagnification in fish and lipid content of fish in human exposure models.

Kim SK, Lee BS, Wilson DB, Kim EK. (Department of Biological Engineering, Inha University, Incheon 402-751, Korea). Selective cadmium accumulation using recombinant Escherichia coli. J Biosci Bioeng. 99(2)(2005): 109-14.

Recombinant Escherichia coli JM109 (pZH3-5/pMT), harboring a manganese transport gene (mntA) and a metal-sequestering protein (metallothionein [MT]) gene, was cultivated to accumulate cadmium (Cd) in an aqueous phase. Isopropyl beta-D-thiogalactoside (IPTG)-induced cells showed rapid Cd(2+) ion accumulation (90% of maximum accumulation in 15 min) and had an accumulation six times higher than that of the control. Under optimum conditions, i.e., pH 7, 37 degrees C and 0.5 (OD600), 1.5 mM IPTG induction resulted in the accumulation of 21.5 micromol Cd/g dry cell. Storage at 37 degrees C for 24 h had no effect on the accumulation. Significantly, Cd was selectively accumulated in a solution containing an equal concentration of three other metals, resulting in more than 90% of the total accumulated metals being Cd. The accumulation of Cd was reduced by the presence of Mn2+ ion whereas no significant effect was observed with Cu2+, Zn2+ and Pb2+ ions. A chelator, EDTA, had no effect on the accumulation up to 100 mM. The bioaccumulation rate followed Michaelis-Menten kinetics (Vm=2.7 micromol Cd2+/min.g dry cell, Km=0.67 microM). The equilibrium isotherm showed a Langmuir isotherm. In the membrane reactor experiment, 1 mg/l Cd in an inlet solution decreased to 0.2 mg/l in the effluent, removing 80% of Cd, continuously. These results indicated the potentials of a genetically modified microorganism for the highly selective accumulation of Cd at a low concentration and the future application to the removal and recovery of Cd.

Wei CY, Chen TB. (Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, 11A Datun Road, Anwai, Beijing 100101, China). Arsenic accumulation by two brake ferns growing on an arsenic mine and their potential in phytoremediation. Chemosphere. (2005) Nov 16; [Epub ahead of print]

In an area near an arsenic mine in Hunan Province of south China, soils were often found with elevated arsenic levels. A field survey was conducted to determine arsenic accumulation in 8 Cretan brake ferns (Pteris cretica) and 16 Chinese brake ferns (Pteris vittata) growing on these soils. Three factors were evaluated: arsenic concentration in above ground parts (fronds), arsenic bioaccumulation factor (BF; ratio of arsenic in fronds to soil) and arsenic translocation factor (TF; ratio of arsenic in fronds to roots). Arsenic concentrations in the fronds of Chinese brake fern were 3-704mgkg(-1), the BFs were 0.06-7.43 and the TFs were 0.17-3.98, while those in Cretan brake fern were 149-694mgkg(-1), 1.34-6.62 and 1.00-2.61, respectively. Our survey showed that both ferns were capable of arsenic accumulation under field conditions. With most of the arsenic being accumulated in the fronds, these ferns have potential for use in phytoremediation of arsenic contaminated soils.

Liu YJ, Ding H, Zhu YG. (Beijing Centre for Physical and Chemical Analysis, Beijing 100089, China. liuyanju@hotmail.com). Metal bioaccumulation in plant leaves from an industrious area and the botanical garden in Beijing. J Environ Sci (China). 17(2)(2005): 294-300.

The concentrations of Fe, Mn, Al, Zn, Pb, Ni, Cr, and As were measured in soils and leaves from 21 plant species growing on hills near the Beijing Steel Factory (BSF) and 17 plant species in the Beijing Botanical Garden (BBG). The results showed that soils from BSF were Zn contaminated according to the threshold of natural background of China. There was a metal contamination of the soils by Ni, and Cr in BSF comparing with those in BBG. The comparison between

concentrations of metals in leaves from both sites indicated that, in general, accumulation of metals in the leaves of the same species was significantly different between the two sites. Even within the same locality each species accumulation of metals was significantly variable. The study aimed to screen landscape plants for the capacity to clean-up toxic metals in soils, and developed an overall metal accumulation index (MAI) for leaves and then categorized the MAI that can be applied broadly in the selection of species in polluted areas. To do this, the spectrum of MAI values were divided into four classes: strongly accumulated (SA or grade I), moderately accumulated (MA or grade II), intermediately accumulated (IA or grade III), and weakly accumulated (WA or grade IV). The results showed that elemental association between Fe, Al, Ni, and As was generally highly correlated with each other in the sampling sites. This may suggest their common biochemical characteristics. Generally, those species containing strong and moderate accumulation in both sites are considered including Vitex negundo, Broussonetia papyrifera, Ulmus pumila, and Rubia cordifolia. At BSF and other industrial sites with a similar ecosystem, strong and moderate accumulation species include Sophora japonica, Ampelopsis aconitifolia var. glabra, Platycladus orientalis, Wikstroemia chamaedaphne, Cleistogenes squarrosa, Grewia biloba, and in BBG, in addition Setaria viridis, Cotinus coggygria, Lespedeza floribunda, Rhamnus parvifolia, Lespedeza tomentosa.

Bargagli R, Agnorelli C, Borghini F, Monaci F. (Dipartimento di Scienze Ambientali, Universita di Siena, Via P.A. Mattioli, 4; 53100 Siena, Italy. bargagli@unisi.it). Enhanced deposition and bioaccumulation of mercury in Antarctic terrestrial ecosystems facing a coastal polynya. Environ Sci Technol. 39(21)(2005): 8150-5.

Mercury emitted by anthropogenic and natural sources occurs in the atmosphere mostly in the gaseous elemental form, which has a long lifetime in tropical and temperate regions. Once deposited in terrestrial and aquatic ecosystems the metal is partly re-emitted into the air, thus assuming the characteristics of global pollutants such as persistent volatile chemicals. In polar regions, during and after the sunrise, the photochemically driven oxidation of gaseous Hg by reactive halogens may result in areas of greatly enhanced Hg deposition. Mercury concentrations in soils, lichens, and mosses collected in a stretch between 74 degrees 30' S and 76 degrees 00' S, in ice-free coastal areas of Victoria Land facing the Terra Nova Bay coastal polynya, were higher than typical Antarctic baselines. The finding of enhanced Hg bioaccumulation in Antarctic terrestrial ecosystems facing a coastal polynya strongly supports recent speculations on the role of ice crystals ("frost flowers") growing in polynyas as a dominant source of sea salt aerosols and bromine compounds, which are involved in springtime mercury depletion events (MDEs). These results raise concern aboutthe possible environmental effects of changes in regional climate and sea ice coverage, and on the possible role of Antarctica as a sink in the mercury cycle.

Sun Y, Yu H, Zhang J, Yin Y, Shi H, Wang X. (State Key Laboratory of Pollution Control and Resources Reuse, School of Environment, Nanjing University, Nanjing, Jiangsu 210093, People's Republic of China; School of Chemistry and Environmental Science, Nanjing Normal University, Nanjing 210097, People's Republic of China). Bioaccumulation, depuration and oxidative stress in fish Carassius auratus under phenanthrene exposure. Chemosphere. (2005) Nov 14; [Epub ahead of print]

In this study, laboratory experiment was carried out to determine phenanthrene bioaccumulation, depuration in whole fish and oxidative stress in the liver of freshwater fish Carassius auratus. Fish were exposed to 0.05mg/l phenanthrene for different periods, while one control group was

designated for each exposure group. Some fish after 7days of exposure were transferred to diluted water. The concentrations of phenanthrene in fish were analyzed by HPLC. Twenty-four hours after the exposure, reactive oxygen species (ROS) were trapped by phenyl-tert-butylnitrone and detected by electron paramagnetic resonance (EPR). The activities of superoxide dismutase (SOD), catalase (CAT), and glutathione-s-transferase (GST) were also determined. The concentrations of phenanthrene in fish increased rapidly shortly after the start of the exposure, reached a maximum level at the 2days, and then it declined quickly to low-level-steady state. The elimination process of phenanthrene could be divided into two periods-a fast elimination period following a slower loss period. The elimination curve could be fitted mathematically as the sum of two exponential functions according to two-compartment model: C(t)=2.72e(-1.065t)+0.68e(-0.0364t). The PBN-radical adducts were detected in fish liver samples following the exposure 24h. The hyperfine splitting constants for the PBN-radical adducts were a(N)=13.5G, a(H)=1.77G and g value was 2.0058, which were consistent with those of PBN/()OH. The results indicated that the hydroxyl radical was probably significantly induced during the exposure of phenanthrene, as compared to the control group. The changes of activities of the antioxidant enzymes also were observed. In addition, after fish were removed from phenanthrene exposure, the recovery status of these antioxidant indices was explored. These results clearly indicated phenanthrene could be accumulated in fish and similar redox cyclings were produced, resulting in the changes of the activities of the antioxidant enzymes and the production of ROS with the oxidative stress.

Ferrara G, Loffredo E, Senesi N. (Dipartimento di Scienze delle Produzioni Vegetali, University of Bari, Via Amendola 165/A, 70126, Bari, Italy, ferrara.g@agr.uniba.it). Phytotoxic, clastogenic and bioaccumulation effects of the environmental endocrine disruptor bisphenol A in various crops grown hydroponically. Planta. (2005) Nov 15;1-7 [Epub ahead of print]

The effects of the endocrine disruptor bisphenol A (BPA) at concentrations of 10 and 50 mg l(-1) were evaluated on the germination and morphology, micronuclei (MN) content in root tip cells and BPA bioaccumulation of hydroponic seedlings of broad bean (Vicia faba L.), tomato (Lycopersicon esculentum Mill.), durum wheat (Triticum durum Desf.) and lettuce (Lactuca sativa L.) after 6 and 21 days of growth. In general, BPA at any dose used did not inhibit germination and early growth (6 days) of seedlings of the species examined, with the exception of primary root length of tomato which decreased at the higher BPA dose. In contrast, an evident phytotoxicity was induced by BPA in all species after 21 days of growth with evident morphological anomalies and significant reductions of the lengths and fresh and dry weights of shoots and roots of seedlings. With respect to the nutrient medium without seedlings, BPA concentration decreased markedly during the growth period in the presence of broad bean and tomato seedlings, and limitedly in the presence of durum wheat and, especially, lettuce. Further, the presence of BPA measured in roots and shoots of broad bean and tomato after 21-day growth indicated that bioaccumulation of BPA had occurred. The number of MN in broad bean and durum wheat root tip cells increased markedly by treatment with BPA at both concentrations, thus suggesting a potential clastogenic activity of BPA in these species.

Bioremediation

Pankaj Krishna[1], M. Sudhakara Reddy[1] and S. K. Patnaik[2]. (Department of Biotechnology, Thapar Institute of Engineering & Technology, Patiala, 147 004, India, National Aluminium Company, M & R Complex, Damanjodi, Orissa, India, vasu70@yahoo.com). *Aspergillus Tubingensis* Reduces the pH of the Bauxite Residue (Red Mud) Amended Soils. Water, Air, & Soil Pollution, Volume 167, Numbers 1-4 (2005), 201 - 209

Bauxite residue (red mud), a poor substrate for plant growth because of very high pH, salinity and sodicity, is required to be revegetated. The possibility of using *Aspergillus tubingensis* (AT1), a phosphate solubilizer in red mud amended soils to reduce the alkalinity of the red mud was studied in the present study. *A. tubingensis* was tested for its ability to grow at high pH and in different concentrations of aluminium (Al), iron (Fe) and sodium (Na). The results showed that *A. tubingensis* was able to grow at high pH and reduce the alkalinity of the nutrient medium and also to accumulate different metals in the mycelium. The pH values of the red mud amended soils were also significantly reduced (by 2–3 units) by *A. tubingensis*, which resulted in maize growth improvement. These results suggest that *A. tubingensis* plays an important role in reducing the pH of the red mud and also helps in promoting the plant growth in it.

M. C. Costa[1] and J. C. Duarte[2]. (FERN, Universidade do Algarve, Campus de Gambelas, 8005-139 Faro, Portugal, INETI, UME, Dep. de Biotecnologia, Estrada do Paço do Lumiar nº22, 1649-038 Lisboa, Portugal, mcorada@ualg.pt). Bioremediation of Acid Mine Drainage Using Acidic Soil and Organic Wastes for Promoting Sulphate-Reducing Bacteria Activity on a Column Reactor. Water, Air, & Soil Pollution, Volume 165, Numbers 1-4, (2005), 325 - 345

Acid mine drainage (AMD) is a serious environmental problem resulting from extensive sulphide mining activities. The old copper mine of S. Domingos in Southeast Portugal is an example of such a situation. The abandoned open-pit from the mining operations resulted in the creation of a large pit lake with acidic water (pH□2) and high contents of sulphate and heavy metals. Sulphate-reducing biological processes have been studied as a remediation technology for this problem. A new application based on a simple and semi-continuous process for the treatment of S. Domingos AMD has been presented herein. Experiments using bench scale fixed-bed column bioreactors were carried out to evaluate the efficiency of the process. Sewage, anaerobic sludge and soil from the mining area were tested as solid matrices and/or inocula, as well as sources of complex organic substrates. The addition of lactose as a supplementary carbon source, easily available at zero cost or at negative cost in the effluents of the local cheese industries, was also tested. The data obtained indicate that it is possible to use the matrices tested for the production of sulphide by sulphate reduction, and that the regular addition of lactose is effective. Results showed that the process is efficient for the precipitation of the main dissolved metals, for the reduction in the sulphate content and, most importantly, for the neutralization of the AMD. Moreover, the use of soil as solid support also showed the possibility of using this process for the decontamination of both waters and soils.

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Antioxidant and antibacterial activities of lichen *Usnea ghattensis in vitro* Biotechnology Letters, : Volume 27, Number 14, July (2005), 991 - 995

Various solvent extracts of the lichen *Usnea ghattensis* showed good antioxidant activity. A methanol extract prevented lipid peroxidation by 87% followed by 65% in Trolox at 20 μg/ml. It also showed superoxide anion scavenging activity and free radical scavenging activity 56% and 73%, respectively. The known antioxidants butylated hydroxytoluene (BHT), butylated hydroxyanisol (BHA) and quercetin at similar concentrations showed superoxide anion scavenging activity of 68, 59 and 47% and free radical scavenging activity 83, 77 and 69%, respectively. In addition, these extracts were inhibitory against *Bacillus licheniformis, Bacillus megaterium, Bacillus subtilis* and *Staphylococcus aureus* with MIC values of 5–10 μg/ml.

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Although resistance of microorganisms to Hg(II) salts has been widely investigated and resistant strains have been reported from many eubacterial genera, there are few reports of mercuric ion resistance in extremophilic microorganisms. Moderately thermophilic mercury resistant bacteria were selected by growth at 62 °C on Luria agar containing $HgCl_2$. Sequence analysis of 16S rRNA genes of two isolates showed the closest matches to be with *Bacillus pallidus* and *Ureibacillus thermosphaericus*. Minimum inhibitory concentration (MIC) values for $HgCl_2$ were 80 μg/ml and 30 μg/ml for these isolates, respectively, compared to 10 μg/ml for *B. pallidus* H12 DSM3670, a mercury-sensitive control. The best-characterised mercury-resistant *Bacillus* strain, *B. cereus* RC607, had an MIC of 60 μg/ml. The new isolates had negligible mercuric reductase activity but removed Hg from the medium by the formation of a black precipitate, identified as HgS by X-ray powder diffraction analysis. No volatile H_2S was detected in the headspace of cultures in the absence or presence of Hg^{2+}, and it is suggested that a new mechanism of Hg tolerance, based on the production of non-volatile thiol species, may have potential for decontamination of solutions containing Hg^{2+} without production of toxic volatile H_2S.

S. Labana[1], O. V. Singh[1], A. Basu[1], G. Pandey[1] and R. K. Jain[1]. (Institute of Microbial Technology, Sector 39-A, Chandigarh, 160 036, India. Email: **rkj@imtech.res.in). A microcosm study on bioremediation of *p*-nitrophenol-contaminated soil using *Arthrobacter protophormiae* RKJ100. Applied Microbiology and Biotechnology, Vol. 68, (3) (2005): 417 – 424.**

p-Nitrophenol (PNP), a toxic nitroaromatic compound, can build up in soils due to extensive usage of nitrophenolic pesticides and hence needs to be removed. *Arthrobacter protophormiae* RKJ100, a PNP-degrading organism, was used in this work to study factors affecting its growth, and then evaluated for its capacity to degrade PNP in soil microcosms. Molasses (10%) treated with 0.1% potassium hexacyanoferrate was found to be a suitable and cheap carbon source for inoculum preparation. Induction studies showed that PNP depletion was quicker when cells were induced by pre-exposure to PNP. The efficiency of PNP degradation in soil by strain RKJ100 was seen to be dependent on pH, temperature, initial PNP concentration and inoculum size. Microcosm studies performed with varying concentrations (1.4–210 ppm) of PNP-spiked soils showed that strain RKJ100 could effectively degrade PNP over the range 1.4–140 ppm. A cell density of 2×10^8 colony forming units/g soil was found to be suitable for PNP degradation over a

temperature range of 20–40°C and at a slightly alkaline pH (7.5). Our results indicate that strain RKJ100 has potential for use in in situ bioremediation of PNP-contaminated sites. This is a model study that could be used for decontamination of sites contaminated also with other compounds.

Esmaeil S. AL-Saleh and Christian Obuekwe. (Microbiology Program, Department of Biological Sciences, P.O. Box 5969, Safat 13060, Faculty of Science, Kuwait University, State of Kuwait). Inhibition of hydrocarbon bioremediation by lead in a crude oil-contaminated soil. International Biodeterioration & Biodegradation, Vol. 56, (1), (2005): 1-7.

Analyses of soil samples revealed that the level of lead (total or bioavailable) was three-fold greater in crude oil contaminated than in uncontaminated Kuwaiti soils. Investigation of the possible inhibitory effect of lead on hydrocarbon degradation by the soil microbiota showed that the number of hydrocarbon-degrading bacteria decreased with increased levels of lead nitrate added to soil samples, whether oil polluted or not. At 1.0 mg lead nitrate g^{-1} dry soil, the number of degraders of hexadecane, naphthalene and crude oil declined by 14%, 23% and 53%, respectively. In a similar manner, the degradation and mineralization of different hydrocarbons decreased with increased lead content in cultures, although the decreases were not significantly different (P>0.05). The dehydrogenase activities of soil samples containing hydrocarbons as substrates also declined with an increase in the lead content of soil samples.

Judith Bender[a] and Peter Phillips [b]. ([a]Research Center for Science and Technology, Clark Atlanta University, Atlanta, GA 30314, USA, [b]Department of Biology, Winthrop University, Rock Hill, SC 29733, USA). Microbial mats for multiple applications in aquaculture and bioremediation. Bioresource Technology, Vol. 94(3)(2004): 229-238.

Microbial mats occur in nature as stratified communities of cyanobacteria and bacteria, but they can be cultured on large-scale and manipulated for a variety of functions. They are complex systems, but require few external inputs. The functional uses of mats broadly cover the areas of aquaculture and bioremediation. Preliminary research also points to promising uses in agriculture and energy production. Regarding aquaculture, mats were shown to produce protein, via nitrogen fixation, and were capable of supplying nutrition to tilapia (*Oreochromis niloticus*). Current research is examining the role of mats in the nitrification of nutrient-enriched effluents from aquaculture. Most research has addressed bioremediation, within which two majors categories of contaminants were examined: metals and radionuclides, and organic contaminants. Mats sequester or precipitate metals/radionuclides by surface absorption or by conditioning the surrounding chemical environment, thus bioconcentrating the metal/radionuclide in a small volume. Organic contaminants are degraded and may be completely mineralized. For agriculture mats hold promise as a soil amendment and nitrogen fertilizer. The use of mats in biohydrogen production has been verified, but is in a preliminary phase of development. We propose a comprehensive closed system based on microbial mats for aquaculture and waste management.

Pinaki Sar, Sufia K. Kazy[1] and S. F. D'Souza . (Corresponding author. Present address: Centre for Biotechnology, Biological Science Group, Birla Institute of Technology and Science, Pilani 333 031, Rajasthan, India, [1] Present address: Centre for Biotechnology, Biological Science Group, Birla Institute of Technology and Science, Pilani 333 031, Rajasthan, India. Nuclear Agriculture and Biotechnolgy Division, Bhabha Atomic

Research Centre, Mumbai 400 085, India). Radionuclide remediation using a bacterial biosorbent. International Biodeterioration & Biodegradation, Vol. 54(2-3)(2004): 193-202.

A *Pseudomonas* strain, characterized as part of a project to develop a biosorbent for removal of toxic radionuclides from nuclear waste streams, was a potent accumulator of uranium (VI) and thorium (IV), with the metal sequestration process being unaffected by culture age, presence of carbon/energy source and metabolic inhibitor but sensitive to the composition of the growth medium. Further characterization of radionuclide biosorption using lyophilized biomass revealed rapid cation binding of >90% within 1–10 min of contact and complete removal of U and Th was observed at initial concentrations up to 100 mg l^{-1}. Initial solution pH strongly affected radionuclide biosorption with an optimum at pH 4.0–5.0. High affinity, efficient and high capacity uranium and thorium binding was indicated, with maximum loading of 541 mg U g^{-1} dry mass or 430 mg Th g^{-1} dry mass. Good conformity of sorption data with the Langmuir model suggests monolayered U and Th binding. Sorption in presence of several interfering cations and anions indicates a specific U and Th binding by the biomass with significant antagonism offered only by iron (III). Transmission electron microscopy and energy dispersive X-ray fluorescence analysis of metal loaded biomass revealed intracellular U and Th sequestration. More than 90% of biomass-bound radionuclide was recovered using sodium or calcium carbonate. For continuous process application an immobilized biomass system was developed and tested with multiple cycles of sorption–desorption. Overall, the biosorbent appeared suitable for realistic bioremediation.

C. J. Cunningham[a], I. B. Ivshina[b], V. I. Lozinsky[c], M. S. Kuyukina[b] and J. C. Philp [d]. ([a]Contaminated Land Assessment & Remediation Research Centre (CLARRC), Faraday Building, The King's Buildings, University of Edinburgh EH9 3JL, Scotland, UK, [b]Institute of Ecology and Genetics of Microorganisms of the RAS, Laboratory of Alkanotrophic Microorganisms, 13 Golev Street, Perm 614081, Russia, [c] Institute of Organoelement Compounds of the RAS, Laboratory for Cryochemistry of (Bio)Polymers, 28 Vavilov Street, Moscow 119991, Russia, [d] School of Life Sciences, Napier University, 10 Colinton Road, Edinburgh EH10 5DT, Scotland, UK). Bioremediation of diesel-contaminated soil by microorganisms immobilised in polyvinyl alcohol. International Biodeterioration & Biodegradation, Vol. 54(2-3)(2004): 167-174.

It is argued that bioaugmentation is best reserved for particularly recalcitrant contaminants where an autochthonous population may be missing, and that selection has produced the microbial diversity required for clean-up of less recalcitrant contaminants. However, biodegradable contaminants may persist as a result of sub-optimal environmental conditions such as temperature, pH, electron acceptor availability and biotic factors such as predation by protozoa. A role for immobilised-cell bioaugmentation may therefore still be envisaged for the bioremediation of, say, persistent fuel spills under such conditions, or in extreme environments. In this laboratory-scale study we examined the potential of immobilised hydrocarbon-degrading microorganisms for the clean up of diesel-contaminated soil. We used polyvinyl alcohol (PVA) cryogelation as an entrapment technique and microorganisms indigenous to the site. We constructed laboratory biopiles to compare immobilised bioaugmentation with liquid culture bioaugmentation and biostimulation. In terms of percentage removal of diesel after 32 days, the immobilised systems were found to be the most successful, with greatest removal in a co-immobilisation system containing PVA-entrapped microorganisms and a synthetic oil absorbent. Least success was achieved with a commercial liquid bioaugmentation agent containing

surfactants and having a low pH, which also produced significant phytotoxicity. Other advantages of PVA cryogelation are discussed.

Nirmala Bardiya and Jae-Ho Bae. (Department of Civil and Environmental Engineering and Geosystem Engineering, Inha University, 253 Yonghyun-Dong, Nam-Gu, Inchon 402-751, South Korea, Received 14 October 2003; revised 19 May 2004; accepted 2 September 2004. Available online 26 October 2004). Bioremediation potential of a perchlorate-enriched sewage sludge consortium. Chemosphere, Vol. 58(1)(2005): 83-90.

The purpose of this work was to explore the reductive bioremediation potential of a perchlorate-enriched facultative anaerobic consortium. Rapid perchlorate reduction and bacterial growth were observed up to 1.84 g l^{-1} of perchlorate, but not at 3.82 g l^{-1} due to the toxicity. The specific growth rate of the mixed consortium was 0.1 h^{-1}. The consortium co-reduced perchlorate and nitrate with acetate as e^- donor and carbon source. The presence of nitrate slowed down the perchlorate reduction rate. The other e^- acceptors utilized include oxygen, chlorate, Cr(VI), and selenate. Over 95% of the 16 mg l^{-1} of added Cr(VI) was reduced within 24 h of incubation with a high-density perchlorate-grown consortium. However, the consortium failed to couple growth with reduction of nitrite, sulfate, thiosulfate, and sulfite. During the search for autotrophic perchlorate reduction, many consortia from very diverse natural sources could not use sulfur compounds such as thiosulfate as e^- donor.

P.V.O. Trindade[a], L.G. Sobral[b], A.C.L. Rizzo[b], S.G.F. Leite[c] and A.U. Soriano[a]. ([a]Petrobras Research Center (CENPES), Quadra 7, Ilha do Fundão, Rio de Janeiro, RJ, CEP 21949-900, Brazil, [b]Center for Mineral Technology, Ilha da Cidade Universitaria, Ministry of Science & Technology (CETEM/MCT), Av. Ipê, 900, Ilha do Fundão, Rio de Janeiro, RJ, CEP 21941-590, Brazil, [c]School of Chemistry, Technology Center, Federal University of Rio de Janeiro, Ilha do Fundão, Rio de Janeiro, RJ, CEP 21949-900, Brazil). Bioremediation of a weathered and a recently oil-contaminated soils from Brazil: a comparison study. Chemosphere, Vol, 58(4)(2005): 515-522.

The facility with which hydrocarbons can be removed from soils varies inversely with aging of soil samples as a result of weathering. Weathering refers to the result of biological, chemical and physical processes that can affect the type of hydrocarbons that remain in a soil. These processes enhance the sorption of hydrophobic organic contaminants (HOCs) to the soil matrix, decreasing the rate and extent of biodegradation. Additionally, pollutant compounds in high concentrations can more easily affect the microbial population of a recently contaminated soil than in a weathered one, leading to inhibition of the biodegradation process. The present work aimed at comparing the biodegradation efficiencies obtained in a recently oil-contaminated soil (spiked one) from Brazil and an weathered one, contaminated for four years, after the application of bioaugmentation and biostimulation techniques. Both soils were contaminated with 5.4% of total petroleum hydrocarbons (TPHs) and the highest biodegradation efficiency (7.4%) was reached for the weathered contaminated soil. It could be concluded that the low biodegradation efficiencies reached for all conditions tested reflect the treatment difficulty of a weathered soil contaminated with a high crude oil concentration. Moreover, both soils (weathered and recently contaminated) submitted to bioaugmentation and biostimulation techniques presented biodegradation efficiencies approximately twice as higher as the ones without the aforementioned treatment (natural attenuation).

J. Jeyasingh and Ligy Philip. (Department of Civil Engineering, Indian Institute of Technology, Chennai-600036, India). Bioremediation of chromium contaminated soil: optimization of operating parameters under laboratory conditions. Journal of Hazardous Materials, Vol. 118(1-3)(2005):113-120.

Bacterial strains were isolated and enriched from the contaminated site of Tamil Nadu Chromates and Chemicals Limited (TCCL) premises, Ranipet, Tamil Nadu, India. The strain which was isolated from the highly contaminated location had shown high Cr(VI) reduction potential. Cr(VI) reduction was evaluated both in aerobic and anaerobic conditions. Though the aerobic system performed better than the anaerobic one, further study were carried out in the anaerobic condition due to its economic viability. At higher initial concentration, Cr(VI) reduction was not complete even after 108 h, however, specific Cr(VI) reduction, unit weight of Cr reduced/unit weight of biomass was greater at higher concentration. It was found that a bacterial concentration of 15 ± 1.0 mg/g of soil (wet weight) 50 mg of molasses/g of soil as carbon source were required for the maximum Cr(VI) reduction. The bioreactor operated at these conditions could reduce entire Cr(VI) (5.6 mg Cr(VI)/g of soil) in 20 days. The Cr(III) thus formed was found to be strongly attached to the soil matrix and the mobility of Cr(III) was negligible as evident from the low concentration of Cr(III) in the leachate. This study showed that bioremediation is a viable, environmental friendly technology for cleaning-up the chromium contaminated site at TCCL, Ranipet, Tamil Nadu, India, and optimal operating conditions under laboratory conditions were evaluated.

A.J. Savage and S.F. Tyrrel. (Institute of Water and Environment, Cranfield University, Silsoe, Bedfordshire MK45 4DT, UK). Compost liquor bioremediation using waste materials as biofiltration media. Bioresource Technology, Vol. 96(5)(2005): 557-564.

Compost liquor results from the percolation of precipitation through composting waste; the release of liquids from high moisture content feedstocks; and as a result of runoff from hard surfaces and machinery. This research aimed to establish the potential for waste materials to act as media for low-cost compost liquor biofilters. Six types of potential biofilter media were packed into experimental biofilters (1 m long × 0.11 m diameter) and irrigated with compost liquor (organic loading rate of 0.6 kg/m^3/d) for three months. The pH, BOD_5, NH_3/NH_4, and phytotoxicity of the effluent was monitored regularly. Natural, organic materials (oversize, compost and wood mulch) performed best, when compared to synthetic materials such as polystyrene packaging or inert materials such as broken brick. On average, the best media achieved 78% removal of both BOD_5 and ammoniacal nitrogen during the study period. Although significant improvements in liquor quality were achieved, the effluent remained heavily polluted.

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A novel method has been developed for the treatment of green table olive processing wastewater, which combines biological treatment using a selected strain of *Aspergillus niger* and electrochemical treatment in the presence of H_2O_2. Results are reported for the different stages of the scale-up procedure, from laboratory shake-flask cultures to a pilot plant of 4 m^3/day capacity.

In the biological treatment step COD removal efficiency varied between 66–86% while the concentration of selected phenols was reduced by 65%. The efficiency of the electrochemical step depended on pH and the concentration of H_2O_2 used. In laboratory experiments using a 500 ml electrolysis cell, 96% removal efficiency was achieved for both COD and measured phenols with 2.5% H_2O_2. In the pilot plant 75% COD removal efficiency was achieved with 1.6% H_2O_2. Coagulation with $Ca(OH)_2$ finally gave an effluent COD of 360 mg/l and an overall removal efficiency of 98% for the combined treatment.

Monika Walter[a], Kirsty S.H. Boyd-Wilson[a], Don McNaughton[b] and Grant Northcott[b]. ([a]HortResearch, Environment and Risk Management, Gerald Street, PO Box 51, Lincoln, New Zealand, [b]HortResearch, Biological Chemistry, Private Bag 3123, Hamilton, New Zealand). Laboratory trials on the bioremediation of aged pentachlorophenol residues. International Biodeterioration & Biodegradation, Volume 55 (2) (2005): 121-130

The variable nature of field-contaminated soil requires reliable assessments or treatability studies to optimise the bioremediation process in the field. In a series of laboratory-based studies, experiments were developed and conducted to determine fungal isolate variations, optimum fungal inoculum concentration, optimum treatable contaminant concentration and predict pentachlorophenol (PCP) degradation over time. Generally, biodegradation of PCP in old (>30 years) field-contaminated soil (i.e. aged residues) was similar between New Zealand native isolates compared to the American isolates of *Phanerochaete chrysosporium* or *P. sordida*. A concentration of up to 2786 mg freshly added PCP kg^{-1}-soil was readily biodegraded if augmented with live or dead white-rot isolates. However, no biodegradation or soil colonisation was observed at these high PCP concentrations when aged residues were used. Increasing the amount of fungal inoculum (>30%; v/v) for soil augmentation with white-rot fungi did not improve colonisation of field-contaminated PCP soil. Generally, soil colonisation by white-rot fungi did not correlate with PCP decline. However, soil colonisation and PCP biodegradation were isolate dependent. When aged residues were used, the variation between repeated residue analyses was high and similar to the variance among isolates and among isolates within sampling dates. Therefore stratified sampling protocols were developed for PCP residue analysis to be able to determine differences between fungal treatments. The results of the described experiments were then used to standardise treatability studies.

Susan Eapen and S.F. D'Souza. (Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Mumbai-40085, India). Prospects of genetic engineering of plants for phytoremediation of toxic metals. Biotechnology Advances, Volume 23(2) (2005): 97-114.

Bioremediation is gaining a lot of importance in recent times as an alternate technology for removal of elemental pollutants in soil and water, which require effective methods of decontamination. Phytoremediation—the use of green plants to remove, contain or render harmless environmental pollutants—may offer an effective, environmentally nondestructive and cheap remediation method. The use of genetic engineering to modify plants for metal uptake, transport and sequestration may open up new avenues for enhancing efficiency of phytoremediation. Metal chelator, metal transporter, metallothionein (MT), and phytochelatin (PC) genes have been transferred to plants for improved metal uptake and sequestration. Transgenic plants, which detoxify/accumulate cadmium, lead, mercury, arsenic and selenium have been developed. A better understanding of the mechanisms of rhizosphere interaction,

uptake, transport and sequestration of metals in hyperaccumulator plants will lead to designing novel transgenic plants with improved remediation traits. As more genes related to metal metabolism are discovered, facilitated by the genome sequencing projects, new vistas will be opened up for development of efficient transgenic plants for phytoremediation.

Alena Luptakova and Maria Kusnierova. (Department of Mineral Biotechnologies, Institute of Geotechnics of Slovak Academy of Sciences, Watsonova 45, 043 53 Kosice, Slovak Republic). Bioremediation of acid mine drainage contaminated by SRB. Hydrometallurgy, Kammel's Quo Vadis Hydrometallurgy IV - International Conference May 25-28 2004, Herlany, Kosice – Slovakia. Volume 77(1-2) (2005): 97-102.

The aim of this work is to study the possibility of using sulphate-reducing bacteria for the heavy metals removing from acid mine drainage (AMD), which is considered to be the major environmental problem associated with mining activities. Tests were conducted to determine if the bacterial produced hydrogen sulphide could be used for the elimination of soluble heavy metals from AMD in the form of sparingly soluble sulphides. We investigated the kinetics of the copper precipitation in the form of sulphides from the model solution containing Cu^{2+} by sulphate-reducing bacteria on the ground of two different approaches. In the first approach one reactor was used, which provides the simultaneous running of basic processes in study method, i.e. the hydrogen sulphide bacterial production and the copper precipitation by the bacterial produced hydrogen sulphide. The second approach allowed the successive running of aforementioned processes and used two interconnected reactors. The hydrogen sulphide bacterial production was realised in the first reactor and the copper precipitation by the bacterial produced hydrogen sulphide was realised consequence in the second reactor. Under these conditions this method involves three stages such as: the hydrogen sulphide production by sulphate-reducing bacteria, the cooper precipitation by the bacterial produced hydrogen sulphide and the cooper sulphides filtration from the liquid phase. The advantage of the second approach is the faster running of the Cu^{2+} elimination, as well as the possibility of the selective metal precipitation in the form of sulphides.

Wayne Coates. (Office of Arid Lands Studies, The University of Arizona, 250 E. Valencia Road, Tucson, Arizona 85706, USA). Tree species selection for a mine tailings bioremediation project in Peru. Biomass and Bioenergy, Volume 28(4) (2005): 418-423.

Tailings water from a copper mine in southern Peru was being discharged to the sea, carrying a significant amount of solids. To investigate the potential for environmental impact mitigation, it was hypothesized that crops could be grown using the water, with the only restriction being that they are non-edible, since the water could contain relatively high levels of minerals which might be absorbed by plants. Trees were identified as the most appropriate crop since they could be used for fuel or construction, and would have a local market in an area almost devoid of natural tree growth. A project was initiated to determine what species/varieties of trees might best be grown in the area, to establish a test plot, and then assess growth. After 16 months, *Tamarix aphylla* and *Acacia saligna* had the largest base diameter and height, of the 25 species/varieties planted. Four species exceeded 3 m in height, with base diameters exceeding 5.5 cm, and ranging up to 10.5 cm. Comparison of tree measurement techniques showed height and base diameter to have the highest correlation of all techniques used. Given the ease of measuring base diameter, this appears to be the optimal method to use for assessment of growth. Extending the trial and conducting a destructive harvest would have determined which species/varieties produced the

greatest amount of biomass and best lumber; however, funds were not available to obtain these data.

Sang-Jin Kim, Dong Hyuk Choi, Doo Suep Sim and Young-Sook Oh[1]. (Microbiology Lab., Korea Ocean Research and Development Institute, P.O. Box 29, Ansan 425-600, Republic of Korea). Evaluation of bioremediation effectiveness on crude oil-contaminated sand. Chemosphere, Volume 59(6) (2005): 845-852.

A treatability study was conducted using sea sand spiked with 3% or 6% (w/w) of Arabian light crude oil to determine the most effective bioremediation strategies for different levels of contamination. The sea sand used in the study was composed of gravel (0.1%), sand (89.0%), and silt and clay (10.9%). The water content of the sea sand was adjusted to 12.6% (w/w) for the study. Different combinations of the following treatments were applied to the sand in biometer flasks: the concentration of oil (3% or 6%), the concentration of a mixture of three oil-degrading microorganisms (*Corynebacterium* sp. IC-10, *Sphingomonas* sp. KH3-2 and *Yarrowia* sp. 180, 1×10^6 or 1×10^8 cells g^{-1} sand), the concentration of the surfactant Tween 80 (1 or 10 times the critical micelle concentration), and the addition of SRIF in a C:N:P ratio of 100:10:3. Three biometer flasks per combination of experimental conditions were incubated, and the performance of each treatment was examined by monitoring CO_2 evolution, microbial activity, and oil degradation rate. The results suggest that the addition of inorganic nutrients accelerated the rate of CO_2 evolution by a factor of 10. The application of oil-degrading microorganisms in a concentration greater than that of the indigenous population clearly increased biodegradation efficiency. The application of surfactant slightly enhanced the oil degradation rate in the contaminated sand treated with the higher concentration of oil-degrading microorganisms. The initial CO_2 evolution rate was shown to efficiently evaluate the treatability test by providing significant data within a short period, which is critical for the rapid determination of the appropriate bioremediation approach. The measurements of microbial activity and crude oil degradation also confirmed the validity of the CO_2 evolution rate as an appropriate criterion.

J.A. Marin, T. Hernandez and C. Garcia. (Department of Soil and Water Conservation and Waste Management, Centro de Edafología y Biología Aplicada del Segura (CEBAS-CSIC), P.O. Box 164, 30100 Murcia, Spain). Bioremediation of oil refinery sludge by landfarming in semiarid conditions: Influence on soil microbial activity. Environmental Research, Volume 98(2) (2005): 185-195.

Bioremediation of a refinery sludge containing hydrocarbons in a semi-arid climate using landfarming techniques is described. The objective of this study was to assess the ability of this technique to reduce the total hydrocarbon content added to the soil with the refinery sludge in semiarid climate (low rain and high temperature). In addition, we have evaluted the effect of this techique on the microbial activity of the soil involved. For this, biological parameters (carbon fractions, microbial bilmass carbon, basal respiration and ATP) and biochemical parameters(different enzymatic activities) were determined. The results showed that 80% of the hydrocarbons were eiminated in eleven months, half of this reduction taking place during the first three months. The labile carbon fractions, MBC, basal respiration and ATP of the soils submitted to landfarming showed higher values than the control soil during the first months of the process, although these values fell down by the end of the experimental period as the hydrocarbons were degraded by mineralisation. All the enzymatic activities studied: oxydoreductases such as dehydrogenase activity, and hydrolases of C(β-glucosidase activity) and N Cycle (urease and protease) showed higher values in the soils amended with the refinery sludge than in the control. As in the case of the previous parameters, these value fell down as the

bioremediation of the hydrocarbons progressed, many of them reaching levels similar to those of the control soil after eleven months.

Fatima M. Bento[a], Flávio A.O. Camargo[a], Benedict C. Okeke[b] and William T. Frankenberger[b]. ([a]Department of Soil Science, Federal University of Rio Grande do Sul, Porto Alegre RS 91540-000, Brazil, [b]Department of Environmental Sciences-084, University of California, 2217 Geology Building, Riverside, CA 92521-0424, USA) Comparative bioremediation of soils contaminated with diesel oil by natural attenuation, biostimulation and bioaugmentation. Bioresource Technology, Volume 96(9) (2005): 1049-1055.

Bioremediation of diesel oil in soil can occur by natural attenuation, or treated by biostimulation or bioaugmentation. In this study we evaluated all three technologies on the degradation of total petroleum hydrocarbons (TPH) in soil. In addition, the number of diesel-degrading microorganisms present and microbial activity as indexed by the dehydrogenase assay were monitored. Soils contaminated with diesel oil in the field were collected from Long Beach, California, USA and Hong Kong, China. After 12 weeks of incubation, all three treatments showed differing effects on the degradation of light (C_{12}–C_{23}) and heavy (C_{23}–C_{40}) fractions of TPH in the soil samples. Bioaugmentation of the Long Beach soil showed the greatest degradation in the light (72.7%) and heavy (75.2%) fractions of TPH. Natural attenuation was more effective than biostimulation (addition of nutrients), most notably in the Hong Kong soil. The greatest microbial activity (dehydrogenase activity) was observed with bioaugmentation of the Long Beach soil (3.3-fold) and upon natural attenuation of the Hong Kong sample (4.0-fold). The number of diesel-degrading microorganisms and heterotrophic population was not influenced by the bioremediation treatments. Soil properties and the indigenous soil microbial population affect the degree of biodegradation; hence detailed site specific characterization studies are needed prior to deciding on the proper bioremediation method.

Dibyendu Sarkar, Michael Ferguson, Rupali Datta and Stuart Birnbaum. (Department of Earth and Environmental Science, University of Texas San Antonio, 6900 North Loop, 1604 West, San Antonio, TX 78249-0663, USA). Bioremediation of petroleum hydrocarbons in contaminated soils: comparison of biosolids addition, carbon supplementation, and monitored natural attenuation. Environmental Pollution, Volume 136(1) (2005): 187-195.

Two methods of biostimulation were compared in a laboratory incubation study with monitored natural attenuation (MNA) for total petroleum hydrocarbon (TPH) degradation in diesel-contaminated Tarpley clay soil with low carbon content. One method utilized rapid-release inorganic fertilizers rich in N and P, and the other used sterilized, slow-release biosolids, which added C in addition to N and P. After 8 weeks of incubation, both biostimulation methods degraded approximately 96% of TPH compared to MNA, which degraded 93.8%. However, in the first week of incubation, biosolids-amended soils showed a linear two orders of magnitude increase in microbial population compared to MNA, whereas, in the fertilizer-amended soils, only a one order of magnitude increase was noted. In the following weeks, microbial population in the fertilizer-amended soils dropped appreciably, suggesting a toxic effect owing to fertilizer-induced acidity and/or NH_3 overdosing. Results suggest that biosolids addition is a more effective soil amendment method for biostimulation than the commonly practiced inorganic fertilizer application, because of the abilities of biosolids to supplement carbon. No statistically significant difference was observed between the biostimulation methods and MNA, suggesting

that MNA can be a viable remediation strategy in certain soils with high native microbial population.

Addition of biosolids is a potentially effective method of biostimulation for degradation of petroleum hydrocarbons in soils.

G.S. Bañuelos[a], and Z.-Q. Lin[b]. ([a]USDA-Agricultural Research Service-Water Management Research Laboratory, 9611 S. Riverbend Avenue, Parlier, CA 93648, USA, [b]Southern Illinois University, Environmental Sciences Program and Department of Biological Sciences, Edwardsville, IL 62026-1651, USA, Fax: +1 559 596 2851.). Phytoremediation management of selenium-laden drainage sediments in the San Luis Drain: a greenhouse feasibility study. Ecotoxicology and Environmental Safety , Vol. 62(3) (2005): 309-316.

An estimated 100,000 m^3 selenium (Se)-laden drainage sediment resides in the San Luis Drain (SLD) of Central California. This greenhouse study was undertaken to evaluate the feasibility of growing salt- and boron-tolerant plant species in sediment for reduction of Se content by plant extraction. Drainage sediment was collected from the SLD and mixed with control soil (i.e., uncontaminated soil) to the following ratios (sediment:control soil) by volume: 0:3 (i.e., control soil only), 1:2 (i.e., 1/3 sediment and 2/3 control soil), 2:1 (i.e., 2/3 sediment and 1/3 control soil), and 3:0 (i.e., sediment only). Salt-tolerant plant species consisted of canola (*Brassica napus* var. Hyola 420), tall fescue (*Festuca arundinacea* var. Au Triumph), salado grass (*Sporobulus airoides*), and cordgrass (*Spartina patens* var. Flageo). Increased ratios of sediment:soil resulted in decreased dry matter production for all tested plant species; especially at ratios of sediment:soil greater than 1:2. Plant Se concentrations (mg kg^{-1} DM) ranged as follows for plant species at all ratios of sediment:soil: canola (51–72), tall fescue (16–36), and cordgrass and salado grass (9–14). Total Se concentrations in the soil were at least 20% lower at postharvest compared to preplant concentrations for all plant species at each ratio of sediment:soil. In contrast, water-extractable Se concentrations in the soil were at least three times higher at postharvest than at preplant for all plant species, irrespective of the ratio of sediment:soil. Leaching of Se occurred in irrigated bare pots from each respective ratio of sediment:soil over a duration of 60 days. Based upon the downward movement of Se in bare pots of sediment:soil, it may be more prudent to leave the drainage sediment in the SLD, incorporate clean soil, and then grow low maintenance salt-tolerant plants (e.g., cordgrass, salado grass) in the concrete-lined canal. By this means, possible contamination of groundwater with soluble Se will be eliminated, while phytoremediation slowly reduces Se content in the drainage sediment.

Fabio N. Moreno[a] , Chris W.N. Anderson[a], Robert B. Stewart[a], and Brett H. Robinson[b]. ([a]Institute of Natural Resources, Soil and Earth Sciences, Massey University, Private Bag 11222, Palmerston North, New Zealand, [b]HortResearch, Palmerston North, New Zealand, Corresponding author. Tel.: +55 11 3277 54651; fax: +55 11 3277 5461). Mercury volatilisation and phytoextraction from base-metal mine tailings. Environmental Pollution, Volume 136(2) (2005): 341-352.

Experiments were carried out in plant growth chambers and in the field to investigate plant-mercury accumulation and volatilisation in the presence of thiosulphate (S_2O_3)-containing solutions. *Brassica juncea* (Indian mustard) plants grown in Hg-contaminated Tui mine tailings (New Zealand) were enclosed in gastight volatilisation chambers to investigate the effect of ammonium thiosulphate ($[NH_4]_2S_2O_3$) on the plant-Hg volatilisation process. Application of $(NH_4)_2S_2O_3$ to substrates increased up to 6 times the Hg concentration in shoots and roots of *B.*

juncea relative to controls. Volatilisation rates were significantly higher in plants irrigated only with water (control) when compared to plants treated with $(NH_4)_2S_2O_3$. Volatilisation from barren pots (without plants) indicated that Hg in tailings is subject to biological and photochemical reactions. Addition of sodium thiosulphate ($Na_2S_2O_3$) at 5 g/kg of substrate to *B. juncea* plants grown at the Tui mine site confirmed the plant growth chambers studies showing the effectiveness of thio-solutions at enhancing shoot Hg concentrations. Mercury extraction from the field plots yielded a maximum value of 25 g/ha. Mass balance studies revealed that volatilisation is a dominant pathway for Hg removal from the Tui mine site. A preliminary assessment of the risks of volatilisation indicated that enhanced Hg emissions by plants would not harm the local population and the regional environment.

N.S.Isinguzo[1] and O.S.Bello[2]. ([1]Head HSE, Offshore Operations, Shell Nigeria Exploration and Production Company (SNEPCo) NAL Towers, 21/22 Marina, Lagos Nigeria.[2]Department of Soil Science, Ambrose Alli University, Ekpoma, Nigeria, E-mail: salibello2002@yahoo.com). Polluted soil rehabilitation using genetically engineered mix microbial inoculum. Journal of Food, Agriculture & Environment, Vol. 2(2)(2005): 299-301.

Every natural system is self purifying. This is made possible by the diverse micro=and macroflora and –fauna in soils. Bacteria and fungi constitute the greatest population in soils implying that in the case of pollution, microbes are the major agents of purification.

A study was carried out in situ with Nigerian crude oil (Bonny light) in polluted teak soil using axenic cultures of bacteria and fungi, mix culture of bacteria and fungi, a mix culture of bacteria and fungi and a mixed culture of genetically engineered bacteria (Bacillus sp.) and a fungus (Aspergillus niger). The ability to degrade crude oil was measured directly (spectrophotometrically) by oil disappearance and indirectly by the amount of CO_2 produced in a controlled environment.

Results showed that mixed cultures of the isolated bacteria and fungi degraded the crude oil in the teak soil better than axenic cultures by about 85% over a month period. This is a reduction of the pollution to less than 15%, while the genetically engineered mix culture (mutant Bacillus sp. and Asp. niger) degraded crude oil in a similar soil and condition by 99.3% over the same period, thus reducing pollution to less than 1% and can be applied in bioremediation.

Louis A.Licht[a,*], J.G.Isebrands[b]. ([a]Ecolotree, Inc., 3017 Valley View Lane, NE North Liberty, Iowa 52317, USA, [b]Environmental Forestry Consultants, P.O. Box 54, New London, Wisconsin 54961, USA). Linking phytoremediated pollutant removal to biomass economic opportunities. Biomass and Bioenergy 28 (2005): 203-218.

Phytoremediation (phyto) strategies employ trees, shrubs, and/or grasses for treating contaminated air, soil, or water. These strategies include buffers, vegetation filters, in situ phytoremediation plantings, and percolation controlling vegetative caps.

The design parameter that separates phytoremediation from landscaping is purposefully placing and growing a rootzone reactor volume with predictable pollutant removal performance. This phyto reactor integrates with other engineered systems to cover landfills, treat petrochemical spills in soils, intercept a soluble subsurface plume, and capture non-point surface sediment entrained in urban or field runoff.

There are many potential economic opportunities for biomass associated with phytoremediation, including bioenergy and traditional industrial products such as solid wood products and reconstituted products (i.e., paper, chip board, laminated beams, extruded trim).

More intangibly, phyto creates environmental benefits such as soil erosion control, carbon sequestration, and wildlife habitat. Phyto also creates socio-economic benefits by diversify regional manufacturing into new products that employs local labor, thus building value-added industry. Alternative crops develop a greater diversity of products from the farmland, making the regional economy less exposed to global commodity crop price fluctuations.

Thus, a strategic phyto treatment of non-point agricultural runoff would help diversify land use from annually tilled crops (corn, soybeans, wheat) into perennial, untilled tree crops. A landscape rebuilt using phyto would create diversity represented in business potential, healthier air and water, wildlife habitat, and aesthetics.

Moreover, phyto provides local and current pollutant treatment. Such timely treatment of pollutants that would otherwide move to our downstream or downwind neighbors is key to the environmental justice concept.

We present four case study summaries to illustrate installed commercial applications of phytoremediation.

K.C.Banger[1], and K.K.Kapoor. (Department of Microbiology, CCS Haryana Agricultural University, Hisar – 125 004, India, E-mail: kkkapoor@hau.ernet.in, [1]Present address: Chairman, Haryana Public Service Commission, Caandigarh, India). International Journal of Ecology and Environmental Sciences 31(1)(2005): 3944.

Heavy metals such as Cu, nI. Cd, Zn, Cr and Pb are the most important inorganic pollutants that enter the soil, air and water through mining, atmospheric deposition, industrial activities, sewage sludge and sewage waters. Heavy metals are not naturally removed or degraded and therefore progressively accumulate in soil or water sediments. Some algae, bacteria and aquatic plants can adsorb metals from aquatic environments and can be helpful in clean up of heavy metal polluted water bodies and industrial effluents. Microorganisms that can accumulate metals in their cells can be used for bioremediation of industrial effluents containing heavy metals. There is a great potential role of higher terrestrial plants in remediation of heavy metal polluted soils. The metal accumulating plants have developed detoxification mechanism involving chelation and sequestration by small metal binding proteins and peptides. The best-known metal sequestering molecules are the enzymatically produced small peptides called phytochelatins derived from glutathione. Some of the transgenic plants have been developed which are more effieneit for the metal accumulation.

V.K.Verma, R.K.Gupta and J.P.N. Rai*. (Department of Environmental Science . G.B. Pant University of Agriculture and Technology, Pantnagar – 263 145). Biosorption of Pb and Zn from pulp and paper industry effluent by water hyacinth (*Eichhornia crassipes*). Journal of Scientifica & Industrial Research Vol. 64, (2005): 778-781.

Lead and zinc uptake by water hyacinth *(Eichhornia crassipes)* was studied in the laboratory conditions to investigate a low cost natural aquatic treatment system for pollutant removal from pulp and paper industry effluent. Bioaccumulation of Pb and Zn by water hyacinth was found concentration and duration dependent. The plant possessed ability to neutralize the effluent. It could effectively absorb Pb (0.28-1.39 mg/l, 17.6-80.3%) and Zn (0.26-1.30 mg/l, 16.6-73.4%) after 20 days of treatment. Metal removal efficiency was found to be maximum (80.3% for Pb;

73.4% for Zn) at 20% effluent concentration, thus highlighting that phytoremediation could be used along with and/or in some cases as a substitute of expensive cleanup technologies in industrial sector.

Biotransformation

Ismail Kiran[1] , Tamer Akar[1], Asli Gorgulu[1] and Cavit Kazaz[2] (Department of Chemistry, Osmangazi University, 26480 Eskinşehir, Turkey, Department of Chemistry, Ataturk University, 25240 Erzurum, Turkey, Email: **ikiran@ogu.edu.tr). Biotransformation of racemic diisophorone by *Cephalosporium aphidicola* and *Neurospora crassa*. Biotechnology Letters, Volume 27, Number 14, (2005), 1007 – 1010.**

Racemic diisophorone (500 mg) was converted by Cephalosporium aphidicola and Neurospora crassa over 10 days at 25 °C to 8β-hydroxydiisophorone in yields of 10% (52 mg) and 20% (103 mg), respectively. The structure was established by IR, specific rotation, mass spectral, 1D and 2D-NMR studies.

Yunling Bai, Shang-Tian Yang. (*Correspondence to Shang-Tian Yang, Department of Chemical and Biomolecular Engineering, The Ohio State University, 140 West 19th Avenue, Columbus, Ohio 43210, Tel: 614-292-6611; fax: 614-292-3769, Department of Chemical and Biomolecular Engineering, The Ohio State University, 140 West 19th Avenue, Columbus, Shang-Tian Yang (yang.15@osu.edu). Biotransformation of R-2-hydroxy-4-phenylbutyric acid by D-lactate dehydrogenase and Candida boidinii cells containing formate dehydrogenase coimmobilized in a fibrous bed bioreactor. Biotechnology and Bioengineering, Volume 92, Issue 2,(2005), 137 – 146.

R-2-hydroxy-4-phenylbutyric acid (R-HPBA) is an important intermediate in the manufacture of angiotensin converting enzyme inhibitors. In this work, a recombinant D-lactate dehydrogenase (LDH) was used to transform 2-oxo-4-phenylbutyric acid (OPBA) to R-HPBA, with concomitant oxidation of β-nicotinamide adenine dinucleotide (NADH) to NAD^+. The cofactor NADH was regenerated by formate dehydrogenase (FDH) present in whole cells of *Candida boidinii*, which were pre-treated with toluene to make them permeable. The whole cells used in the process were more stable and easier to prepare as compared with the isolated FDH from the cells. Kinetic study showed that the reaction rate was dependent on the concentration of cofactor, NAD^+, and that both R-HPBA and OPBA inhibited the reaction. A novel method for co-immobilization of whole cells and LDH enzyme on cotton cloth was developed using polyethyleneimine (PEI), which induced the formation of PEI-enzyme-cell aggregates and their adsorption onto cotton cloth, leading to multilayer co-immobilization of cells and enzyme with high loading (0.5 g cell and 8 mg LDH per gram of cotton cloth) and activity yield (> 95%). A fibrous bed bioreactor with co-immobilized cells and enzyme on the cotton cloth was then evaluated for R-HPBA production in fed-batch and repeated batch modes, which gave relatively stable reactor productivity of 9 g/L · h and product yield of 0.95 mol/mol OPBA when the concentrations of OPBA and R-HPBA were less than 10 g/L. © 2005 Wiley Periodicals, Inc.

Mirosaw Anio[1] and Ewa Huszcza[1] (Department of Chemistry, Agricultural University, ul. Norwida 25, Wroc!aw, 50-375, Poland. aniol@ozi.ar.wroc.pl). Biotransformation of 6,7-epoxygeraniol by fungi. Applied Microbiology and Biotechnology, Volume 68, Number 3, (2005): 311-315.

The biotransformation of 6,7-epoxygeraniol by resting cells of selected fungi was investigated. The main product obtained from the transformation in *Rhodotorula glutinis* and *R. marina* cultures was 6,7-epoxynerol (5–48% of chloroform extracts), whereas *Saccharomyces cerevisiae*, *Candida parapsilosis* and *C. kefyr* reduced this substrate to 6,7-epoxycitronellol (30–33% of chloroform extracts). Cultures of *Yarrowia lipolytica*, *Botrytis cinerea* and *S. cerevisiae* promoted the cyclisation of 6,7-epoxygeraniol to 2-methyl-2-(2-hydroxyethyl)-5-(2-hydroxyprop-2-yl) tetrahydrofuran (11–99% of chloroform extracts). The biotransformation of 6,7-epoxynerol was also investigated. However, none of the tested micro-organisms converted this compound.

C.N.Khobragade[1*], Prita S.Borkar and V.T.Kamble[2]. ([1]School of Life Sciences, Biotechnology Laboratory, Swami Ramanand Teerth Marathwada University, nanded, Maharashtra 431 606 India, [2]School of Chemical Sciences, Organic Chemistry laboratory, Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra 431 606 India). In vitro anti-microbial effect of some biotransformed aldehydes into cyanohydrins. Indian Journal of Microbiology Vol. 45, No. 1 (2005)P 63-65.

Six new cyanohydrin derivatives were synthesized from different aldehydes by the process of biotransformation using Daucus carota roots and evaluated for antimicrobial activity. Except cyanohydrin derivative of heptanal, all the cyanohydrin derivatives showed antimicrobial activity against the five pathogenic organisms studied.

Biomarker

Yeung PK. (Dalhousie University, Pharmacokinetics and Metabolism Laboratory, School of Pharmacy, Burbridge Building, Halifax, NS, Canada. pollen.yeung@dal.ca). Biomarker World Congress 2005. IDrugs., 8(8)(2005):625-8.

This report covers some of the many excellent talks, and a selected number of posters, that were presented at this conference. It includes several emerging issues in biomarker development and the question of how biomarker science can drive targeted drug discovery and development and form a scientific basis for personalized medicine. Although relatively small, the meeting provided a good opportunity for business networking, particularly for those involved in the development and regulation of medical diagnostics and biopharmaceuticals.

Hoorn EJ, Pisitkun T, Zietse R, Gross P, Frokiaer J, Wang NS, Gonzales PA, Star RA, Knepper MA. (Laboratory of Kidney and Electrolyte Metabolism, National Heart, Lung and Blood Institute, National Institutes of Health, Bethesda, Maryland 20892-1603, USA). Prospects for urinary proteomics: exosomes as a source of urinary biomarkers. Nephrology (Carlton)., 10(3) (2005):283-90.

Recent progress in biotechnology offers the promise of better medical care at lower costs. Among the techniques that show the greatest promise is mass spectrometry of proteins, which can identify proteins present in body fluids and tissue specimens at a large scale. Because urine can be collected in large amounts in a non-invasive fashion, the potential exists to use mass spectrometry to discover urinary biomarkers that are early predictors of renal disease, or useful in making therapeutic choices. Recently, the authors demonstrated that both membrane proteins and cytosolic proteins from renal epithelia are highly enriched in low-density urinary structures identified as exosomes. Exosomes were found to contain many disease-associated proteins including aquaporin-2, polycystin-1, podocin, non-muscle myosin II, angiotensin-converting enzyme, Na+ K+ 2Cl- cotransporter (NKCC2), thiazide-sensitive Na-Cl cotransporter (NCC), and epithelial sodium channel (ENaC). Potentially, other disease biomarkers could be discovered by mass spectrometry-based proteomic studies in well-defined patient populations. Herein is described the advantages of using urinary exosomes as a starting material for biomarker discovery. In addition, the purpose of this review is to present an overall strategy for biomarker discovery in urine using exosomes and for developing cost-effective clinical assays for these biomarkers, which can potentially be used for early detection of disease, as a means of differential diagnosis, or as a means of guiding therapy. Finally, potential barriers that need to be overcome before urinary proteomics can be applied clinically, are emphasized.

Walker M, Vystavelova A, Pedler S, Eglinton J, Jiranek V. (School of Agriculture and Wine, The University of Adelaide, PMB 1 Glen Osmond, Adelaide, SA 5064, Australia. michelle.walker@adelaide.edu.au). PCR-based gene disruption and recombinatory marker excision to produce modified industrial Saccharomyces cerevisiae without added sequences. J Microbiol Methods., 63(2)(2005):193-204.

The dominant selectable Kanr marker, which confers geneticin resistance in yeast, is extensively used for PCR based disruption of genes in functional analysis studies in laboratory strains of Saccharomyces cerevisiae. We have developed a gene disruption cassette, which incorporates the Kanr marker, and direct repeat sequences designed from the target gene to enable the deletion of the gene without the introduction of added DNA sequences. We report on the disruption of the HO gene as a test case, using the hodr-Kanr-hodr cassette. The cassette was shown to integrate at the HO locus and the Kanr marker excised by recombination between the two direct repeat sequences. The disruption/excision event resulted in the removal of one direct repeat and the coding sequence of the gene, and hence in this case loss of HO function, with the introduction of no foreign or additional sequences, including the Kanr marker. Having been derived from the target site, the remaining direct repeat sequence is native sequence in its native location. This design template has the potential to be adapted to other genes, and as such will be of advantage in instances such as the optimization of strains by recombinant DNA technology where the retention of minimal or no foreign sequences is desired.

Gornati R, Papis E, Rimoldi S, Chini V, Terova G, Prati M, Saroglia M, Bernardini G. (Dipartimento di Biotecnologie e Scienze Molecolari, Universita dell'Insubria, 3 Via Dunant, I-21100 Varese, Italy. rosalba.gornati@uninsubria.it). Molecular markers for animal biotechnology: sea bass (Dicentrarchus labrax, L.) HMG-CoA reductase mRNA. Gene., 344 (2005):299-305.

Modern technologies may improve fish production and quality and, at the same time, reduce environmental impact with benefits on the public perception of the industry. To be economically profitable, these modern technologies request an increase of rearing density that, however, could

affect fish welfare. With the aim to search for molecular biomarkers to describe fish welfare, we have recently compared gene expression of sea bass farmed at different population densities by differential display obtaining six bands differentially expressed. In this paper, we have cloned the mRNA corresponding to one of those differentially expressed bands obtaining a 3860-bp sequence with an ORF of 2664 bp. Its virtual translation originated a 887-aa polypeptide that, by comparison with the other sequences available in the public data bases, resulted to be the 3-hydroxil-3-methyl-glutaryl coenzyme A reductase (HMGCR). In sea bass, as for the other species, the N- and C-terminus portions are the most conserved and are linked by an hydrophilic region that appears to be quite variable. Due to its role in the synthesis of cholesterol, HMGCR mRNA could be a good biomarker for detecting fish welfare. For this reason, we also followed, by real-time PCR, its expression after crowding stress comparing it with mRNA levels of HSP 70 and 90: HMGCR mRNA resulted highly expressed in the fishes farmed at 100 kg/m(3).

Rabelo Buzalaf MA, Caroselli EE, de Carvalho JG, de Oliveira RC, da Silva Cardoso VE, Whitford GM. (Departamento de Ciencias Biologicas, Faculdade de Odontologia de Bauru, Universidade de Sao Paulo, Alameda Octavio Pinheiro Brisolla 9-75, 17012-901, Bauru, SP, Brazil). Bone surface and whole bone as biomarkers for acute fluoride exposure. J Anal Toxicol 29(8)(2005): 810-3.

This study compares fluoride concentrations ([F]) in surface and whole bone for up to 27 days following an acute oral dose of F. Four groups of rats received single oral F dose (50 mg/kg body weight), and the control group received deionized water (n = 10/group). Groups were euthanized at 1, 3, 9, or 27 days after F administration. Plasma and femurs were collected. F on the femur surface was removed from a circular area (4.52 mm(2)) by immersion in 0.5M HCl for 15 s. The solution was buffered with total ionic strength adjustment buffer and analyzed with an electrode. The subjacent bone was sectioned and ashed at 600 degrees C. Ash and plasma were analyzed for F with the electrode following hexamethyldisiloxane-facilitated diffusion. Data were analyzed by Kruskall-Wallis and Dunn's test and by linear regression ($p < 0.05$). Peak plasma and bone surface [F] occurred on day 1 (0.26 +/- 0.14 microg/mL and 1801 +/- 888 microg/g, respectively). Bone surface [F] at 3, 9, and 27 were not statistically different from control. A significant increase in whole bone [F] was observed 3 days after F administration and the [F] remained relatively constant thereafter. The mean (+/- SD) surface/whole bone [F] ratios for the control and F groups were 2.45 +/- 0.98, 3.92 +/- 1.32, 1.61 +/- 0.82, 1.73 +/- 0.39, and 1.09 +/- 0.28, respectively. Plasma and bone surface [F]s were positively correlated ($r = 0.74$). Thus, bone surface was found to be a suitable biomarker for acute, sublethal F exposure 1 day after F administration. Whole bone [F] were significantly increased at 3, 9, and 27 days after F administration.

Vuolteenaho O, Ala-Kopsala M, Ruskoaho H. (Department of Physiology, Medical Faculty, Biocenter Oulu, FIN-90014 University of Oulu, Finland). BNP as a biomarker in heart disease. Adv Clin Chem 40(2005): 1-36.

Heart ventricles produce B-type natriuretic peptide (BNP) in response to increased mechanical load and wall stretch. BNP protects the heart from adverse consequences of overload by increasing natriuresis and diuresis, relaxing vascular smooth muscle, inhibiting the renin-angiotensin-aldosterone system, and by counteracting cardiac hypertrophy and fibrosis. BNP is synthesized by human cardiac myocytes as a 108-amino acid prohormone (proBNP), which is cleaved to the 32-residue BNP and the 76-residue N-terminal fragment of proBNP (NT-proBNP). Both can be used as sensitive biomarkers of cardiac dysfunction and well-

characterized commercial assays have recently become available. In acute coronary syndromes increased concentrations are strong predictors of recurring myocardial infarction, heart failure, and death. In acute dyspnea, high BNP and NT-proBNP point to a cardiac rather than a pulmonary origin of the symptoms. BNP and NT-proBNP help in the assessment of the severity of ventricular dysfunction and heart failure and as a prognostic predictor, regardless of the primary cause of the condition. They can be used to guide the therapy of heart failure and left ventricular dysfunction. BNP and NT-proBNP work better when they are used for specific clinical purposes, rather than for screening in the general population. Their main strength is the excellent negative predictive value with regard to left ventricular dysfunction and heart failure. BNP and NT-proBNP are nonspecific biomarkers of cardiac dysfunction. Specific diagnostic tools, such as echocardiography, are required to define the actual abnormality.

Li Y, Dong X, Yin Y, Su Y, Xu Q, Zhang Y, Pang X, Zhang Y, Chen W. (Immunology Department, Peking University Health Science Center, Beijing, China). BJ-TSA-9, a Novel Human Tumor-Specific Gene, Has Potential as a Biomarker of Lung Cancer. Neoplasia., 7(12)(2005): 1073-80.

Using bioinformatics, we have identified a novel tumor-specific gene BJ-TSA-9, which has been validated by Northern blot analysis and reverse transcription-polymerase chain reaction (RT-PCR). BJ-TSA-9 mRNA was expressed in 52.5% (21 of 40) of human lung cancer tissues and was especially higher in lung adenocarcinoma (68.8%). To explore the potential application of BJ-TSA-9 for the detection of circulating cancer cells in lung cancer patients, nested RT-PCR was performed. The overall positive detection rate was 34.3% (24 of 70) in peripheral blood mononuclear cells (PBMCs) of patients with various types of lung cancers and was 53.6% (15 of 28) in PBMCs of lung adenocarcinoma patients. In combination with the detection of two known marker genes SCC and LUNX, the detection rate was increased to 81.4%. A follow-up study was performed in 37 patients after surgical removal of tumor mass. Among nine patients with persistent detection of two to three tumor marker transcripts in PBMCs, six patients had recurrence/metastasis. In contrast, 28 patients with transient detection of one tumor marker or without detection of any tumor marker were all in remission. Thus, BJ-TSA-9 may serve as a marker for lung cancer diagnosis and as a marker, in combination with two other tumor markers, for the prediction of the recurrence and prognosis of lung cancer patients.

Baak JP, Kruse AJ. (Department of Pathology, Stavanger University Hospital, Norway). Use of biomarkers in the evaluation of CIN grade and progression of early CIN. Methods Mol Med., 119(2005): 85-99.

The treatment of cervical intraepithelial neoplasia (CIN) depends on the evaluation of CIN grade. The grading of CIN is however problematic, as intra- and interobserver reproducibility of CIN-grade evaluation among pathologists is not perfect. There are also difficulties in reliably distinguishing CIN from nonneoplastic lesions, and over- or undertreatment can be the result. These points suggest a need for adjuvant methods that can distinguish CIN from nonneoplastic lesions, and can distinguish different CIN grades and predict the risk of progression of early CIN1 and -2 lesions. This chapter describes the use of biomarker-related methods for the diagnosis and prognostic evaluation of patients with CIN1 and CIN2. As CIN involves the progressive dysfunction of proliferation and differentiation activities in cervical epithelial cells, we have concentrated in this chapter on demonstrating the utility of proliferation- and differentiation-related biomarkers.

Moore MN, Icarus Allen J, McVeigh A. (Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth PL1 3DH, United Kingdom). Environmental prognostics: An integrated model supporting lysosomal stress responses as predictive biomarkers of animal health status. Mar Environ Res., 2005 Dec 9; [Epub ahead of print]

The potential prognostic use of lysosomal reactions to environmental pollutants is explored in relation to predicting animal health in marine mussels, based on diagnostic biomarker data. Cellular lysosomes are already known to accumulate many metals and organic xenobiotics and the lysosomal accumulation of the carcinogenic polycyclic aromatic hydrocarbon 3-methylcholanthrene (3-MC) is demonstrated here in the hepatopancreatic digestive cells and ovarian oocytes of the blue mussel. Lysosomal membrane integrity or stability appears to be a generic indicator of cellular well-being in eukaryotes; and in bivalve molluscs it is correlated with total oxygen and nitrogen radical scavenging capacity (TOSC), protein synthesis, scope for growth and larval viability; and inversely correlated with DNA damage (micronuclei), as well as lysosomal swelling (volume density), lipidosis and lipofuscinosis, which are all characteristic of failed or incomplete autophagy. Integration of multiple biomarker data is achieved using multivariate statistics and then mapped onto "health status space" by using lysosomal membrane stability as a measure of cellular well-being. This is viewed as a crucial step towards the derivation of explanatory frameworks for prediction of pollutant impact on animal health; and has facilitated the development of a conceptual mechanistic model linking lysosomal damage and autophagic dysfunction with injury to cells, tissues and the whole animal. This model has also complemented the creation and use of a cell-based bioenergetic computational model of molluscan hepatopancreatic cells that simulates lysosomal and cellular reactions to pollutants. More speculatively, the use of coupled empirical measurements of biomarker reactions and modelling is proposed as a practical approach to the development of an operational toolbox for predicting the health of the environment.

Chan LL, Sit WH, Lam PK, Hsieh DP, Hodgkiss IJ, Wan JM, Ho AY, Choi NM, Wang DZ, Dudgeon D. (TEDA School of Biological Sciences and Biotechnology, Nankai University, Tianjin, PR China). Identification and characterization of a "biomarker of toxicity" from the proteome of the paralytic shellfish toxin-producing dinoflagellate Alexandrium tamarense (Dinophyceae). Proteomics., 2005 Dec 8; [Epub ahead of print]

The objective of this study was to identify and characterize a "biomarker of toxicity" from the proteome of Alexandrium tamarense, a paralytic shellfish toxin (PST)-producing dinoflagellate. A combination of 2-DE and MS approaches was employed to identify proteins of interest in the vegetative cells of several strains of A. tamarense with different toxin compositions and from different geographical locations. The electrophoretic analysis of the total water-soluble proteins from these toxic strains by 2-DE showed that several abundant proteins, namely AT-T1, AT-T2 and AT-T3, differing slightly in apparent M(r) and pIs, were consistently present in all toxic strains of A. tamarense. Further analysis by MALDI-TOF MS and N-terminal amino acid sequencing revealed that they are isoforms of the same protein. Even more intriguing is that these proteins in A. tamarense have similar amino acid sequences and are closely related to a "biomarker of toxicity" previously reported in A. minutum. Unambiguous and highly species-specific identification was later achieved by comparing the PMFs of proteins in these two species. An initial attempt to characterize these proteins by generation of murine polyclonal antibodies against the AT-T1 protein was successful. Western blot analysis using the murine AT-T1-polycolonal antibodies identified all the toxic strains of A. tamarense and A. minutum, but not the nontoxic strain of A. tamarense. These results indicate that these protein characteristics

for toxic strains are species-specific and that they are stable properties of the tested algae which are clearly distinguishable irrespective of geographical location and toxin composition. To our knowledge, this is the first study to demonstrate the use of polyclonal antibodies against marker proteins purified from 2-DE gels to distinguish different strains and species of the PST-producing dinoflagellate Alexandrium. It provides the basis for the production of monoclonal antibody probes against the "biomarkers of toxicity" for those dinoflagellates whose genome is incompletely characterized. Potentially, immunoassays could be developed to detect the presence of toxic algae in routine monitoring programs as well as to predict bloom development and movement.

Biofertilizer

S.C.Gupta. (All India Coordinated Research Project on Chickpea, RAK College of Agriculture, Sehore – 466 001 (India). Response of pigeonpea to potassium and biofertilizers inoculation. Indian J. Applied & Pure Bio.Vol. 20(1)(2005): 87-90.

Field experiment conduted ont eh response of pigeonpea to potassium and biofertilizers application indicates significant increase in the nodule number and nodule dry weight to the tune of 2.5 to 4.0 folds and 2.0 to 3.6 folds respectively in the treatments receiving Rhizobium inoculation as against control i.e. 20 kg N +50 kg P_2O_5/ha (6 nodules/plant and 14 mg nodule dry weifht /plant) with maximum increase in 20 kg N + 50 mg P_2O_5 + 20 kg K_2O/ha + Rhizobium + PSB inoculation (24 nodules/plant and 51 mg nodule dry weight/plant). Further Rhizobium and PSB alone and dual inoculation with Rhizobium +PSB at 20 kg N + 50 mg P_2O_5/ha nutrient level could increase the grain yield of pigeonpea by 16.8, 11.1 and 25.3% respectively over control i.e. 20 kg N + 50 kg P_2O_5/ha alone (14.10 q/ha). Highest yield increase of 36% and net profit of Rs. 6011/ha over control was recorded under the treatment 20 kg N + 50 kg P_2O_5 + 20 kg K_2O/ha +Rhizobium + PSB inoculation which indicates the necessity of use of potassium and dual inoculation of Rhizobium + PSB in pigeonpea cultivation in Madhya Pradesh.

Abha Mishr[1] and U.Pandey[2]. ([1]School of Biochemical Engineering Institute of Technology Banaras Hindu University, Varanasi (India), [2]Department of Botany Guru Nanak Girl's P.G. College Sector – 4, Hiran Magri, Udaipur, Rajasthan (India). Feefects of agriculturally important imcroorganisms on groth of medicinal Mentha Piperita L. Indian J. Applied & Pure Bio. Vol. 20(1)(2005): 19-22.

In view of the fast utilization of agrochemicals with their escalating cost, application of agriculturally ijportant microorganisms was compared with the well documented FYM and urea on Mentha Piperita L. it was found that microbial inoculants alone were comparable to the consortium of conventional manure. Chlorophyll content, total leaf area, leaf production rate, specific leaf area, leaf area duration and leaf weight ratio were considerably increased in the presence of biofertilizers. Leaves are the wellknown source of volatile oil in pharmaceutical industries.

Sunita Gaind and Lata*. (Division of Microbiology, Indian Agricultural Research Institute, new Delhi 110 012, India). Maturity evaluation of composts for safe use in agriculture. Indian Journal of Microbiology Vol. 45, No. 1 (2005: 51-55.

Five composts prepared from wheat straw enriched with different organic amendments were characterized to evaluate their suitability as fertilizers. The parameters determined were pH, total organic carbon, nitrogen, phosphorus, potassium, humus, heavy metals and enzymatic activities. The physiological effect to these composts was also studied on seed germination. After three months of decomposition, vermicompost had the lowest C: N of 11.6 with highest N, P and humus content and germination index of 90%. It was followed by microbially enriched compost (C:N 16.6). on the basis of self-heating test, vermicompost was assessed as the most stable compost, free from toxic compounds. Contrarily, three moths of decomposition period was not enough for wheat straw compost to be fully mature as adjudged from germination index and some other closely related parameters.

Biocomposting

Nakasaki K, Nag K, Karita S. (Department of Materials Science and Chemical Engineering, Shizuoka University, Hamamatsu, Japan. tcknaka@ipc.shizuoka.ac.jp). Microbial succession associated with organic matter decomposition during thermophilic composting of organic waste. Waste Manag Res., 23(1()2005):48-56.

Using dog food as a model of the organic waste, thermophilic composting was carried out for 14 days at a fixed temperature of 60 degrees C. The relationship between organic matter decomposition measured by CO2 evolution during the bio-stabilization process and microbial succession expressed as the changes over time in the restriction fragment length polymorphism (RFLP) patterns of 16S rDNA sequences, of micro-organisms associated with the composting material was also examined. The CO2 evolution rate peaked on day 3 and gradually decreased until it became extremely small after day 9 of composting, indicating that vigorous organic matter decomposition ceased around this time. On the other hand, the RFLP pattern changed drastically from day 0 to day 4 or 5, then remained stable until day 7 or 8, reaching its final configuration, with little variations, after day 9 of composting. RFLP analysis therefore indicates that microbial succession continued into the later stage of composting. Nevertheless, by day 9, the rate of organic matter decomposition was so low that its influence on microbial populations could be hardly recognized by conventional methods of dilution plating. Moreover, the compost produced by day 9 showed no inhibitory effect on the growth of Komatsuna (Brassica campestris L. var. rapiferafroug), indicating that the maturity of compost is sufficient for plant growth when the rate of organic matter decomposition has become extremely low and the RFLP patterns become stable.

Pasda N, Limtong P, Oliver R, Montange D, Panichsakpatana S. (Department of Soil Science, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand 10900). Influence of bulking agents and microbial activator on thermophilic aerobic transformation of sewage sludge. Environ Technol.,26(10)(2005):1127-35.

Bangkok, while improving the wastewater treatment in order to alleviate the river pollution, faces important amounts of sewage sludge. The sewage sludge contains organic matter, nitrogen and phosphorus available for plant growth. However, it may contain pathogenic microorganisms. To be used for agricultural purposes, these pathogens should be destroyed, which can be achieved with the thermophilic phase of composting. As the sewage sludge is dense and unable

to compost alone (low C/N ratio), it should be mixed with an organic by-product. Two by-products available in large quantities in Thailand (wood chips and rice husk) have been tested for mixture with sewage sludge. As these products are not easy to decompose (presence of silica in rice husk and lignin/tannins in wood chips), the addition of a microbial activator for composting has been tested in controlled conditions (small quantities of organic mixtures, 55 degrees C, moisture maintained at 60-70% of water holding capacity). The monitoring of the decomposition has been made by measuring the carbon dioxide respiration, pH, organic matter and nitrogen contents and the evolution of enzymatic activities. When mixed with sewage sludge, wood chips and rice husk do not show significant differences concerning decomposition after 63 days. The use of an activator within the experimental conditions does not improve the decomposition of organic matter contained in the mixture of sewage sludge and rice husk or wood chips.

Tiquia SM. (115F Science Building, Department of Natural Sciences, The University of Michigan, Dearborn, MI 48128, USA) Microbial community dynamics in manure composts based on 16S and 18S rDNA T-RFLP profiles. Environ Technol.,26(10)(2005):1101-13.

Compost processing is assumed to be related to the microbial communities present. However, methods that will evaluate these relationships are not well understood. In this study, terminal restriction fragment length polymorphism (T-RFLP) analysis was used to evaluate the diversity of PCR-amplified bacterial 16S and fungal 18S rDNA communities from manure composts at different stages of composting (initial [day 0], thermophilic [day 24], and mature [day 104]). Results showed that the bacterial and fungal community profiles changed over the composting process, with bacterial communities showing a higher diversity compared with the fungal communities. During the thermophilic stage (day 24), the diversity of the bacterial communities increased, while the fungal communities decreased. As the compost reached maturity (day 104), a reverse pattern was observed between the diversity of bacterial and fungal communities. That is, the 18S rDNA T-RFLP-based diversity indices increased, while the 16S rDNA T-RFLP-based diversity decreased. Differences in temperature profiles at different stages of composting impacted the chemical properties and the diversity of the microbial communities. The day 104 compost (mature) had lower water, organic matter and C contents and higher C and OM loss compared with the day 0 (initial) and day 24 (thermophilic) composts, which affected the diversity of the microbial communities. The results presented here demonstrated that distinctive community patterns from manure composts could be rapidly generated using T-RFLP analysis. The succession of peaks in combination of increasing and decreasing peak heights at different stage of composting indicates the high potential of T-RFLP technique to monitor the dynamics of microbial communities, and their variation qualitatively and quantitatively.

Sasaki H, Yano H, Sasaki T, Nakai Y. (Graduate School of Agricultural Science, Tohoku University, Naruko, Miyagi, Japan). A survey of ammonia-assimilating micro-organisms in cattle manure composting. J Appl Microbiol., 99(6)(2005):1356-63.

AIMS: To evaluate the ammonia-assimilating abilities of micro-organisms isolated from cattle manure composting processes and to determine the distribution of cultivable species of ammonia-assimilating micro-organisms in microbial communities during the composting processes. METHODS AND RESULTS: Compost samples were collected from four stages of treatment. Trypto soya agar was used for the isolation of ammonia-assimilating aerobes. Many of the isolates showed high ammonia-assimilating ability in a medium containing basal components and a compost extract. Partial 16S ribosomal DNA sequencing showed that the cultivable species of highly efficient ammonia-assimilating isolates changed during the composting process. The

community structure of micro-organisms and actinomycetes was analysed by polymerase chain reaction-denaturing gradient gel electrophoresis (PCR-DGGE). Two species of actinomycetes identified by PCR-DGGE coincided with those found among the cultured isolates. CONCLUSIONS: Ammonia-assimilating micro-organisms obtained by the cultivation method were not predominant in the microbial community during the composting process: however certain cultured actinomycetes were members of predominant species in the actinomycetes community. SIGNIFICANCE AND IMPACT OF THE STUDY: Ammonia assimilation by micro-organisms is one of the important mechanisms for ammonia retention in the composting process. Cultivable actinomycetes are a means for preventing ammonia emission from the composting process.

Tateda M, Le DT, Ike M, Fujita M. (Department of Environmental Systems Engineering, College of Technology, Toyama Prefectural University, 5180 Kurokawa, Kosugi, Imizu, Toyama 939-0398, Japan. tateda@pu-toyama.ac.jp). Optimal turning method of composting regarding hygienic safety. J Environ Sci (China), 17(2)(2005): 194-9.

The new turning method was proposed and verified its effectiveness to pathogens by laboratory scale experiments. Considering the results obtained from the previous studies, it could be said that turning of a composting pile was essential in terms of hygienic aspects but the number of turning should be minimized. Effectiveness of inactivation was estimated for each composting run. From this estimation, turning by layers, which is different from conventional turning that mixes compost pile entirely, was proposed and investigated its performance by experiments. Composting operations with static pile method, complete mix (conventional) turning method, and proposed turning (layer turning) method were done and their effectiveness on inactivation of indicator microorganism was evaluated and compared. As results, the conventional turning method was not a proper method in terms of pathogen inactivation, whereas, the proposed turning method showed an excellent performance and should be employed in a composting operation.

Steger K, Eklind Y, Olsson J, Sundh I. (Department of Microbiology, Swedish University of Agricultural Sciences, Uppsala, Sweden, kristin.steger@mikrob.slu.se). Microbial community growth and utilization of carbon constituents during thermophilic composting at different oxygen levels. Microb Ecol., 50(2)(2005): 163-71.

Composting is characterized by dramatic changes in microbial community structure, to a high extent driven by changes in temperature and in the composition of the organic substrate. This study focuses on the interrelationships between decomposition of major classes in the organic material and dynamics in microbial populations during thermophilic composting of source-separated organic household waste. Experiments were performed in a 200-L laboratory reactor at 16, 2.5, and 1% O(2) in the compost atmosphere. Major classes of carbon constituents were analyzed by chemical methods, and the microbial biomass and community structure determined by fatty acid analyses with phospholipid fatty acids (PLFA) and total ester-linked fatty acids (EL) methods. At all three O(2) levels, the process was characterized by a rapid increase in microbial activity and biomass in the early thermophilic phase, although this period was delayed at the lower O(2) concentrations. Starch and fat were the main substrates utilized at all three O(2) levels during this period. The depletion of the starch fraction coincided with the beginning of a microbial biomass decrease, suggesting thatstarch is an important carbon substrate for the growth of thermophilic microorganisms during composting. Growth yields in the microbial community based on consumption of major carbon constituent classes in the high-activity period fell

between 22 and 28%. Multivariate statistical analysis of changes in fatty acid composition revealed small, but statistically significant differences in the microbial community succession. At 16% O(2), 10Me fatty acids from Actinomycetes and cyclopropyl fatty acids (from Gram-negative bacteria) became more important with time, whereas 18:1omega7t was characteristic at 2.5 and 1% O(2), indicating a more stressed bacterial community at the lower O(2) concentrations.Although adequate composting was achieved at O(2) levels as low as 2.5 and 1%, it is not recommended to compost at such low levels in large-scale systems, because the heterogeneous gas transport through the material in these systems might lead to anaerobic conditions and inefficient composting.

Goyal S, Dhull SK, Kapoor KK. (Department of Microbiology, CCS Haryana Agricultural University, Hisar 125 004, India. snehgoyal@hau.ernet.in). Chemical and biological changes during composting of different organic wastes and assessment of compost maturity. Bioresour Technol., 96(14)(2005): 1584-91.

Changes in organic C, total N, C:N ratio, activities of cellulase, xylanase and protease, and microbial population were determined during composting of different organic wastes such as mixture of sugarcane trash and cattle dung, press mud, poultry waste and water hyacinth biomass. There were losses of N in poultry waste and water hyacinth with the effect an initial increase in C:N ratio was observed which decreased later on due to decomposition. The activities of cellulase, xylanase and protease were maximum between 30 and 60 days of composting in various wastes. Similar trend was observed with respect to mesophilic bacterial and fungal population. Various quality parameters like C:N ratio, water soluble C (WSC), CO(2) evolution and level of humic substances were compared after 90 day composting. There was statistically significant correlation between C:N ratio and CO(2) evolution, WSC and humic substances. Significant correlation between CO(2) evolved and level of humic substances was also observed. The study shows that no single parameter can be taken as an index of compost maturity. However, C:N ratio and CO(2) evolved from finished compost can be taken as the most reliable indices of compost maturity.

Xi B, Zhang G, Liu H. (Chinese Research Academy of Environmental Science, Beijing, 100012, PR China. xibeidou@263.net). Process kinetics of inoculation composting of municipal solid waste. J Hazard Mater., 124(1-3)(2005):165-72.

A method was used to improve the composting efficiency by seeding with Inoculum A (a blend of Bacillus azotofixams, Bacillus megaterium and Bacillus mucilaginosus), Inoculum B (a blend of effective cellulolytic strains, i.e. Trichoderma koningii, Streptomyces cellulosae, and White-rot fungi), and Inoculum C (a mixture of Inoculum A and Inoculum B). There were four runs: the control run (not inoculated), Run A, Run B and Run C. During the runs, parameters such as temperature, O2, CO2 and H2S emissions, and microbial concentration were investigated to study the efficiencies of inoculation composting. The maximum oxygen uptake rates in the control run, Run A, Run B and Run C were calculated as 0.22, 0.32; 0.28 and 0.34 mol/hkg while the corresponding total O2 quantities accumulated were 511.18, 684.57, 659.74 and 778.47 g/hkg, respectively. In addition, odorous gases were highly reduced by inoculation. In order to understand the mechanisms of inoculation composting process, two stages kinetics equations were developed from the viewpoint of microbial kinetics. These equations showed that, in the first stage, microbial concentration was the main limiting factor of the degradation rate. The degradation rates in control, Run A, Run B and Run C were 10.5, 13.61, 13.08, and 15.671 g/kgh, respectively. In the second stage, the degradation rate was mainly affected by

substrate concentration. Although the degradation rates were at almost the same level for both with and without inoculation, inoculation could reduce the half velocity coefficient K(m) and in turn stabilize the composting products efficiently. Therefore, inoculation could improve the efficiency of the composting process.

Biopesticide

Swarnali Bhattacharya and Aniruddha Pramanik. (Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bental – 736 165, India). Studies on Different aspects of efficacy of some commercial microbial pesticides against diacrisia oblique on jute. Indian J. Agric. Res., 39(1) (2005): 47-51.

The laboratory investigation was carried out on 2nd instar larvae of Diacrisia oblique with two commercial microbial pesticides viz., Btk 55000 SU/mg and avermeectin 1.8% w/v separately and in combination with different synthetic insecticides. Among the microbials avermectin @0.0018% and Btk @0.2% provided 100 and 80% mortality after 48 h of treatment respectively. However, at 96 h after treatment Btk @0.2% gave the highest mortality of 93.33% being significantly superior to all other treatments except endosulfan @ 0.052%, monocrotophos 0.04%, acetamiprid 0.002%, dichlorvos @ 0.057% and avermectin 0.0018%. thus, botht eh microbial pesticides Btk and avermectin are effective in control of the pest. The best result in the joint effect with different insecticides revealed that Btk (0.1%) with endosulfan (0.026%) mixture, Btk (0.1%) and acetamiprid (0.001%) mixture provided 100% initial larval mortality. Whereas avermectin in combination with the synthetic insecticides provided initial 100% larval mortality in all the treatments except cartap hydrochloride combination.

Nathan SS, Kalaivani K, Murugan K. (Department of Environmental Engineering, Chonbuk National University, Jeonju City, Chonbuk 561 756, South Korea; Department of Zoology, Bharathiar University, Coimbatore, Tamil Nadu 641 046, India). Effect of biopesticides on the lactate dehydrogenase (LDH) of the rice leaffolder, Cnaphalocrocis medinalis (Guenee) (Insecta: Lepidoptera: Pyralidae). Ecotoxicol Environ Saf. (2005) Jul 18; [Epub ahead of print]

The effects of bacterial toxins (Bacillus thuringiensis) and botanical insecticides (Azadirachta indica and Vitex negundo) on lactate dehydrogenase (LDH) activity in Cnaphalocrocis medinalis (Guenee) (the rice leaffolder) were evaluated. Bacterial toxins and botanical insecticides affected the LDH activity individually and in combination. When they were combined, the effect was more severe at low concentration. There was a decrease in enzyme activity over controls at all concentrations tested. The combined effect of the three biopesticides resulted in a considerable decrease in enzyme activity, indicating strong enzyme inhibition. Clear dose-response relationships were established with respect to enzyme activity.

Szewczyk B, Hoyos-Carvajal L, Paluszek M, Skrzecz I, Lobo de Souza M. (Department of Molecular Virology, Intercollegiate Faculty of Biotechnology of the University of Gdansk and Medical University of Gdansk, Kladki 24, 80-822 GDANSK, Poland). Baculoviruses - re-emerging biopesticides. Biotechnol Adv. (2005) Oct 25; [Epub ahead of print]

Biological control of agricultural pests has gained importance in recent years due to increased pressure to reduce the use of agrochemicals and their residues in the environment and food. Viruses of a few families are known to infect insects but only those belonging to the highly specialized family Baculoviridae have been used as biopesticides. They are safe to people and wildlife, their specificity is very narrow. Their application as bioinsecticides was limited until recently because of their slow killing action and technical difficulties for in vitro commercial production. Two approaches for the wider application of baculoviruses as biopesticides will be implemented in future. In countries where use of genetically modified organisms is restricted, the improvements will be mainly at the level of diagnostics, in vitro production and changes in biopesticide formulations. In the second approach, the killing activity of baculoviruses may be augmented by genetic modifications of the baculovirus genome with genes of another natural pathogen. It is expected that the baculoviruses improved by genetic modifications will be gradually introduced in countries which have fewer concerns towards genetically modified organisms.

Scott IM, Gagnon N, Lesage L, Philogene BJ, Arnason JT. (Department of Biology, University of Ottawa, Ottawa, ON, K1N 6N5, Canada). Efficacy of botanical insecticides from Piper species (Piperaceae) extracts for control of Ruropean chafer (Coleoptera: Scarabaeidae). J Econ Entomol. 98(3)(2005): 845-55.

Biopesticides, including botanicals, can offer a safe and effective alternative to conventional insecticides for controlling major insect pests within an integrated pest management program. The current study highlights the practical application of a botanical insecticide for controlling a major insect pest of turfgrass: European chafer, Rhizotrogus majalis (Razoumowsky). Greenhouse and field trials were conducted to test the efficacy of a botanical formulation based on black pepper, Piper nigrum L. (Piperaceae), seed extracts to R. majalis larvae. The 7-d P. nigrum extract LC50 for R. majalis third instars was 2.5%. Successful treatment in the field was accomplished with the application of a 2% P. nigrum formulation to turfgrass infested with R. majalis second and third instars, whereas 4% extract was required in a second field trial with older third instars. The 2% pepper extract activity was comparable with the conventional insecticide diazinon in the first field trial. However, the 4% pepper extracts significantly affected the earthworm populations in treated plots compared with diazinon in the second field trail. The analysis of soil residues for piperamides in the P. nigrum extract determined a half-life of 1 - 2.6 d in the first and second field trials, respectively. This confirmed the expectation that under field conditions the residual activity would be less than conventional insecticides, thereby reducing the environmental risk associated with pesticide use. We recommend the pepper formulation for spot treatment applications when population densities reveal an epicenter of infestation rather than broadcasting over large areas, thus helping to minimize cost and negative affects on nontarget invertebrates.

Brar SK, Verma M, Tyagi RD, Valero JR, Surampalli RY. (INRS-Eau, Terre et Environnement (INRS-ETE), 2800 Rue Einstein, CP 7500, Sainte-Foy, Quebec, Canada G1V 4C7). Sludge based Bacillus thuringiensis biopesticides: viscosity impacts. Water Res. 39(13)(2005): 3001-11.

Viscosity studies were performed on raw, pre-treated (sterilised and thermal alkaline hydrolysed or both types of treatment) and Bacillus thuringiensis (Bt) fermented sludges at different solids concentration (10-40 g/L) for production of biopesticides. Correlations were established among rheological parameter (viscosity), solids (total and dissolved) concentration and entomotoxicity

(Tx) of Bt fermented sludges. Exponential and power laws were preferentially followed by hydrolysed fermented compared to raw fermented sludge. Soluble chemical oxygen demand variation corroborated with increase in dissolved solids concentration on pre-treatments, contributing to changes in viscosity. Moreover, Tx was higher for hydrolysed fermented sludge in comparison to raw fermented sludge owing to increased availability of nutrients and lower viscosity that improved oxygen transfer. The shake flask results were reproducible in fermenter. This study will have major impact on selecting fermentation, harvesting and formulation techniques of Bt fermented sludges for biopesticide production.

Nathan SS, Chung PG, Murugan K. (Department of Environmental Engineering, Chonbuk National University, Jeonju City, Chonbuk 561 756, South Korea; Department of Zoology, Bharathiar University, Coimbatore, Tamil nadu, 641046, India). Combined effect of biopesticides on the digestive enzymatic profiles of Cnaphalocrocis medinalis (Guenee) (the rice leaffolder) (Insecta: Lepidoptera: Pyralidae). Ecotoxicol Environ Saf. (2005) Jun 6; [Epub ahead of print]

Plant extracts, especially botanical insecticides, are currently studied more and more because of the possibility of their use in plant protection. Many of the natural plant compounds and organic compounds used in the control of insect pests are known to affect digestive enzymes. When fed a diet of rice leaves treated with botanical insecticides and bacterial toxins in bioassays, activities of the digestive enzymes protease, amylase, and lipase in the rice leaffolder larvae are affected. Digestive enzyme activities were affected by botanical insecticides and bacterial toxins individually and in combination. When combined, the effect was more severe at low concentration. There were statistically significant differences (P0.05) in enzyme activities in combined and individual treatments. The combination of Btk and botanical insecticides caused a two-fold decrease in enzyme activity even at reduced concentration. Clear dose-response relationships were established with respect to enzyme activity. A synergistic effect of botanical insecticides and bacterial toxins was found when combined in low doses. These effects are most pronounced in early instars.

Biodegradation

Oguz Bayraktar[1]. (Department of Chemical Engineering, Bioreaction Engineering Laboratory, Izmir Institute of Technology, Gülbahçe Köyü, 35437 Urla-Izmir, Turkey, oguzbayraktar@iyte.edu.tr). Bioleaching of nickel from equilibrium fluid catalytic cracking catalysts. World Journal of Microbiology and Biotechnology, Volume 21(5) (2005), 661 – 665.

This study investigates the possibility of reusing metal-contaminated equilibrium fluid catalytic cracking (FCC) catalyst after bioleaching. Leaching with *Aspergillus niger* culture was found to be more effective in the mobilization of nickel from the catalyst particles compared to chemical leaching with citric acid. Bioleaching achieved 32% nickel removal whereas chemical leaching achieved only 21% nickel removal from catalyst particles. The enhanced nickel removal from the catalysts in the presence of *A. niger* culture was attributed to the biosorption ability of the fungal mycelium and to the higher local concentration of citric acid on the catalyst surface. It was found that 9% of solubilized nickel in the liquid medium was biosorbed to fungal biomass. After nickel leaching with *A. niger* culture, the hydrogen-to-methane molar ratio and coke yield,

which are the measures of dehydrogenation reactions catalysed by nickel during cracking reactions, decreased significantly.

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Recombinant forms of three cyanide-degrading nitrilases, CynD from *Bacillus pumilus* C1, CynD from *Pseudomonas stutzeri*, and CHT from *Gloeocercospora sorghi*, were prepared after their genes were cloned with C-terminal hexahistidine purification tags and expressed in *Escherichia coli*, and the enzymes purified using nickel-chelate affinity chromatography. The enzymes were compared with respect to their pH stability, thermostability, metal tolerance, and kinetic constants. The two bacterial genes, both cyanide dihydratases, were similar with respect to pH range, retaining greater than 50% activity between pH 5.2 and pH 8 and kinetic properties, having similar K_m (6–7 mM) and V_{max} (0.1 mmol min^{-1} mg^{-1}). They also exhibited similar metal tolerances. However, the fungal CHT enzyme had notably higher K_m (90 mM) and V_{max} (4 mmol min^{-1} mg^{-1}) values. Its pH range was slightly more alkaline (retaining nearly full activity above 8.5), but exhibited a lower thermal tolerance. CHT was less sensitive to Hg^{2+} and more sensitive to Pb^{2+} than the CynD enzymes. These data describe, in part, the current limits that exist for using nitrilases as agents in the bioremediation of cyanide-containing waste effluent, and may help serve to determine where and under what conditions these nitrilases may be applied.

Tahar Mechichi[a], Bharat K.C. Patel[b] and Sami Sayadi[a]. ([a]Laboratoire des Bioprocédés, Centre de Biotechnologie de Sfax BP "K", 3038 Sfax, Tunisia, [b]Microbial Discovery Research Unit, Faculty of Science, Griffith University, School of Biomolecular and Biomedical Sciences, Brisbane, QLD 4111, Australia). Anaerobic degradation of methoxylated aromatic compounds by *Clostridium methoxybenzovorans* and a nitrate-reducing bacterium *Thauera* sp. strain Cin3,4 International Biodeterioration & Biodegradation, (2005) Article in Press, Corrected Proof.

The coupling of growth of the *o*-demethylating bacterium, *Clostridium methoxybenzovorans* SR3, with a nitrate-reducing bacterium able to degrade aromatic compounds, *Thauera* sp. Cin3,4, allowed complete mineralization of poorly oxidizable methoxylated aromatic compounds such as vanillate, isovanillate, vanilline, anisate, ferulate and veratrate. *C. methoxybenzovorans* *o*-demethylated these aromatic compounds to their corresponding hydroxylated derivatives and fermented the side chains to acetate and butyrate. The hydroxylated compounds and the fermentation end-products in the *C. methoxybenzovorans* spent growth medium were then completely metabolized to CO_2 on inoculation with the *Thauera* strain. Kinetic studies with veratrate indicated that *C. methoxybenzovorans* initially *o*-demethylated the substrate to vanillate and then further to protocatechuate together with the production of acetate and butyrate from the demethylated side chains. Protocatechuate, acetate and butyrate were then utilized as a carbon source by the *Thauera* strain aerobically or anaerobically in the presence of nitrate. The results

therefore suggest that mono- or dimethoxylated aromatic compounds can be completely mineralized by coupling the growth of a fermentative bacterium with a nitrate-reducing bacterium, and a metabolic pathway for this is proposed.

K.V. Harish Prashanth[a], Kshama Lakshman[b], T.R. Shamala[b] and R.N. Tharanathan[a]. ([a]Department of Biochemistry and Nutrition, Central Food Technological Research Institute, Mysore-570020, India, [b]Department of Food Microbiology, Central Food Technological Research Institute, Mysore-570020, India, Received 13 September 2004; revised 31 January 2005; accepted 19 June 2005. Available online 25 August 2005). Biodegradation of chitosan-graft-polymethylmethacrylate films. International Biodeterioration & Biodegradation, Vol. 56(2)(2005): 115-120.

Methylmethacrylate was graft copolymerized onto chitosan, the *N*-deacetylated derivative of chitin, by persulfate-induced free radical initiation to get chitosan-graft-polymethylmethacrylate (C-g-PMMA), which could be thermo-pressed into thin films. Screening of known microorganisms for in vivo degradation of C-g-PMMA copolymer showed maximum activity (11.3 μg glucosamine released min^{-1} ml^{-1} at 37 °C) for *Bacillus subtilis. Aspergillus flavus* which colonized on C-g-PMMA films was isolated and purified. The fungus degraded the graft film by 40–45% over 5–25 days of aerobic cultivation. Infrared spectral data of the treated film showed absorption above 3000 cm^{-1} due to hydrogen bonding of −OH groups, 1650 cm^{-1} due to amide group of chitosan diminished, and 1730 cm^{-1} absorption due to –C═0 group of polymethylmethacrylate became broader as biodegradation increased. SEM of treated film revealed preferential utilization of chitosan moieties. HPLC data showed chitotetraose due to initial (day 5) endo-hydrolase activity, and after 20 days glucosaminidase activity converted this to glucosamine in the culture medium. No monomer (MMA) was released into the medium even after incubation for 25 days. In vitro degradation of C-g-PMMA (27% grafting) with chitosanase, pepsin and lysozyme released chito-oligomers (HPLC), whereas these enzymes showed no activity towards highly grafted copolymer.

Rodrigo J.S. Jacques[a], Eder C. Santos[a], Fátima M. Bento[a], Maria C.R. Peralba[b], Pedro A. Selbach[a], Enilson L.S. Sá[a] and Flávio A.O. Camargo[a]. ([a]Department of Soil Science, Faculty of Agronomy, Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil 7712 Bento Gonçalves Ave 91540-000, Brazil, [b]Department of Organic Chemistry, Institute of Chemistry, Federal University of Rio Grande do Sul. Porto Alegre, RS, Brazil 9500 Bento Gonçalves Ave 91540-000, Brazil , Received 1 April 2005; revised 1 June 2005; accepted 20 June 2005. Available online 2 September 2005. Anthracene biodegradation by *Pseudomonas* sp. isolated from a petrochemical sludge landfarming site. International Biodeterioration & Biodegradation, Vol. 56(3)(2005): 143-150.

Anthracene is a polycyclic aromatic hydrocarbon (PAH) that presents a high pollution potential and health risk and has been used as a model for degradation studies on PAHs because of its relative toxicity. This study aimed to evaluate anthracene degradation by *Pseudomonas* sp. isolated from a 14-year-old petrochemical sludge landfarming site. Three isolates were selected from 26 by the best growth in anthracene and two of them were identified by 16S rRNA gene sequencing as *Ps. aeruginosa* and *Ps. citronellolis.* They showed better growth at pH 7.0 and 30 °C in medium containing up to 2 g anthracene L^{-1}. They were also able to grow in medium containing phenanthrene, pyrene, gasoline and diesel oil. Analysis of anthracene degradation estimated by gas chromatography showed that *Ps. aeruginosa* isolate 312A had the highest rate of degradation (3.90 mg L^{-1} day^{-1}), degrading 71% of the anthracene added to the medium

(250 mg L^{-1}) after 48 days. *Ps. citronellolis* 222A showed an intermediate level of degradation (51%), but *Ps. aeruginosa* 332C degraded only 24.4%. Isolate 312A was also responsible for the highest phenanthrene and pyrene degradation after 48 days. In order to establish the mechanisms involved in the PAH degradation, surfactant production by the isolates was assessed by an emulsification index and reduction of the surface tension in the mineral medium free of cells. Emulsification was not detected, indicating that the isolates did not produce high molecular weight surfactant, although reduction in surface tension indicated production of low molecular weight surfactant compounds. The medium containing *Ps. citronellolis* 222A showed the highest reduction in surface tension, which could increase anthracene bioavailability for biodegradation. To our knowledge, this is the first report concerning increase of anthracene degradation by surfactants produced by *Ps. citronellolis*. However, the highest degradation rate shown by *Ps. aeruginosa* 312A was not related to surfactant production, indicating that some other mechanism could be involved in anthracene degradation. The *Pseudomonas* isolates may be useful for the study of PAH degradation and for bioremediation purposes.

Lin Wang[1], Deborah A. Samac[2,3], Nir Shapir[3,4,5], Lawrence P. Wackett[1,3,4], Carroll P. Vance[3,6], Neil E. Olszewski[3,7] and Michael J. Sadowsky[1,3,5,]* Biodegradation of atrazine in transgenic plants expressing a modified bacterial atrazine chlorohydrolase (*atzA*) gene. Plant Biotechnology Journal, Vol. 3 (5) (2005): 475 p

Atrazine is one of the most widely used herbicides in the USA. Atrazine chlorohydrolase (AtzA), the first enzyme in a six-step pathway leading to the mineralization of atrazine in Gram-negative soil bacteria, catalyses the hydrolytic dechlorination and detoxification of atrazine to hydroxyatrazine. In this study, we investigated the potential use of transgenic plants expressing *atzA* to take up, dechlorinate and detoxify atrazine. Alfalfa, *Arabidopsis thaliana* and tobacco were transformed with a modified bacterial *atzA* gene, p-*atzA*, under the control of the cassava vein mosaic virus promoter. All transgenic plant species actively expressed p-*atzA* and grew over a wide range of atrazine concentrations. Thin layer chromatography analyses indicated that *in planta* expression of p-*atzA* resulted in the production of hydroxyatrazine. Hydroponically grown transgenic tobacco and alfalfa dechlorinated atrazine to hydroxyatrazine in leaves, stems and roots. Moreover, p-*atzA* was found to be useful as a conditional-positive selection system to isolate alfalfa and *Arabidopsis* transformants following *Agrobacterium*-mediated transformation. Our work suggests that the *in planta* expression of p-*atzA* may be useful for the development of plants for the phytoremediation of atrazine-contaminated soils and soil water, and as a marker gene to select for the integration of exogenous DNA into the plant genome.

Diane Fournier,[1] Sandra Trott,[2,] Jalal Hawari,[1*] and Jim Spain[3] (Biotechnology Research Institute, National Research Council of Canada, Montreal, Quebec H4P 2R2, Canada,[1] U.S. Air Force Research Laboratory, Tyndall Air Force Base, Florida 32403,[2] Department of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0512[3], E-mail: jalal.hawari@cnrc-nrc.gc.ca). Metabolism of the Aliphatic Nitramine 4-Nitro-2,4-Diazabutanal by *Methylobacterium* sp. Strain JS178. Applied and Environmental Microbiology, Vol. 71, (8)(2005): 4199-4202.

The aliphatic nitramine 4-nitro-2,4-diazabutanal (NDAB; $C_2H_5N_3O_3$) is a ring cleavage metabolite that accumulates during the aerobic degradation of the energetic compound hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) by various *Rhodococcus* spp. NDAB is also produced during the alkaline hydrolysis of either RDX or octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and during the photolysis of RDX. Traces of NDAB were observed in a soil

sampled from an ammunition-manufacturing facility contaminated with both HMX and RDX, suggesting natural attenuation. In this study, we report the isolation of a soil bacterium that is able to degrade NDAB under aerobic conditions. The isolate is a pink-pigmented facultative methylotroph affiliated with the genus *Methylobacterium*. The strain, named *Methylobacterium* sp. strain JS178, degrades NDAB as a sole nitrogen source, with concomitant growth and formation of 1 molar equivalent of nitrous oxide (N_2O). Comparison of the growth yield of strain JS178 grown on NDAB, nitrite (NO_2^-), or ammonium (NH_4^+) as a nitrogen source revealed that 1 N equivalent is assimilated from each mole of NDAB, which completes the nitrogen mass balance. In radiotracer experiments, strain JS178 mineralized 1 C of the [^{14}C]NDAB produced in situ from [^{14}C]RDX by *Rhodococcus* sp. strain DN22. Studies on the regulation of NDAB degradation indicated that allantoin, an intermediate in the purine catabolic pathway and a central molecule in the storage and transport of nitrogen in plants, up-regulated the enzyme(s) involved in the degradation of the nitramine. The results reveal the potential for the sequential participation of rhodococci and methylobacteria to effect the complete degradation of RDX.

Inés García-Peña,[1] Sergio Hernández,[1] Richard Auria,[2] and Sergio Revah[1*] (Department of Chemical Engineering, Universidad Autónoma Metropolitana-Iztapalapa, P.O. Box 55-534, 09340 Mexico City, Mexico,[1] Institut de Recherche pour le Développement, Laboratoire IRD de Microbiologie, Université de Provence, CESB/ESIL, Case 925, 163 Avenue de Luminy, 13288 Marseille Cedex 9, France[2]). Correlation of Biological Activity and Reactor Performance in Biofiltration of Toluene with the Fungus Paecilomyces variotii CBS115145. Applied and Environmental Microbiology, Vol. 71, (8) (2005): 4280-4285.

A biofiltration system inoculated with the mold *Paecilomyces variotii* CBS115145 showed a toluene elimination capacity (EC) of around 250 g/m^3 of biofilter/h, which was higher than the values usually reported for bacteria. *P. variotii* assimilated *m*- and *p*-cresols but not the *o* isomer. Initial toluene hydroxylation occurred both on the methyl group and through the *p*-cresol pathway. These results were corroborated by detecting benzyl alcohol, benzaldehyde, and *p*-cresol as volatile intermediates. In liquid cultures with toluene as a substrate, the activity of toluene oxygenase (TO) was 5.6 nmol of O_2/min/mg of biomass, and that of benzyl alcohol dehydrogenase was 16.2 nmol of NADH/min/mg of protein. Toluene biodegradation determined from the TO activity in the biofilter depended on the biomass distribution and the substrate concentration. The specific enzymatic activity decreased from 6.3 to 1.9 nmol of O_2/min/mg of biomass along the reactor. Good agreement was found between the EC calculated from the TO activity and the EC measured on the biofilter. The results were confirmed by short-time biofiltration experiments. Average EC measured in different biofiltration experiments and EC calculated from the TO activity showed a linear relation, suggesting that in the biofilters, EC was limited by biological reaction. As the enzymatic activities of *P. variotii* were similar to those reported for bacteria, the high performance of the fungal biofilters can possibly be explained by the increased transfer of the hydrophobic compounds, including oxygen, from the gas phase to the mycelia, overcoming the transfer problems associated with the flat bacterial biofilms.

Roger Koukiekolo,[1] Hee-Yeon Cho,[1] Akihiko Kosugi,[1,] Masayuki Inui,[2] Hideaki Yukawa,[2] and Roy H. Doi[1*] . (Section of Molecular and Cellular Biology, University of California, Davis, California 95616,[1] Research Institute of Innovative Technology for the Earth, Kyoto 619-0292, Japan[2]). Degradation of Corn Fiber by *Clostridium cellulovorans* Cellulases and Hemicellulases and Contribution of Scaffolding Protein CbpA. Applied and Environmental Microbiology, Vol. 71(7) (2005): 3504-3511.

Clostridium cellulovorans, an anaerobic bacterium, degrades native substrates efficiently by producing an extracellular enzyme complex called the cellulosome. All cellulosomal enzyme subunits contain dockerin domains that can bind to hydrophobic domains termed cohesins which are repeated nine times in CbpA, the nonenzymatic scaffolding protein of *C. cellulovorans* cellulosomes. In this study, the synergistic interactions of cellulases (endoglucanase E, EngE; endoglucanase L, EngL) and hemicellulases (arabinofuranosidase A, ArfA; xylanase A, XynA) were determined on the degradation of corn fiber, a natural substrate containing mainly xylan, arabinan, and cellulose. The degradation by XynA and ArfA of cellulose/arabinoxylan was greater than that of corn fiber and resulted in 2.6-fold and 1.4-fold increases in synergy, respectively. Synergistic effects were observed in increments in both simultaneous and sequential reactions with ArfA and XynA. These synergistic enzymes appear to represent potential rate-limiting enzymes for efficient hemicellulose degradation. When mini-cellulosomes were constructed from the cellulosomal enzymes (XynA and EngL) and mini-CbpA with cohesins 1 and 2 (mini-CbpA1&2) and mini-CbpA with cohesins 5 and 6 (mini-CbpA5&6), higher activity was observed than that for the corresponding enzymes alone. Based on the degradation of different types of celluloses and hemicelluloses, the interaction between cellulosomal enzymes (XynA and EngL) and mini-CbpA displayed a diversity that suggests that dockerin-cohesin interaction from *C. cellulovorans* may be more selective than random.

Martin Obst,[1] Andreas Krug,[1] Heinrich Luftmann,[2] and Alexander Steinbüchel[1*] (Institut für Molekulare Mikrobiologie und Biotechnologie, Westfälische Wilhelms-Universität Münster, Corrensstrasse 3, 48149 Münster, Germany,[1] Institut für Organische Chemie, Corrensstrasse 40, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany[2]). Degradation of Cyanophycin by *Sedimentibacter hongkongensis* Strain KI and *Citrobacter amalonaticus* Strain G Isolated from an Anaerobic Bacterial Consortium. Applied and Environmental Microbiology, Vol. 71(7)(2005): 3642-3652.

Using a combination of various enrichment techniques, the strictly anaerobic, gram-positive, endospore-forming bacterium *Sedimentibacter hongkongensis* strain KI as revealed by 16S rRNA analysis and the gram-negative enterobacterium *Citrobacter amalonaticus* strain G as revealed by physiological tests were isolated from an anaerobic cyanophycin (CGP)-degrading bacterial consortium. *S. hongkongensis* strain KI is the first anaerobic bacterium with the ability to hydrolyze CGP to ß-Asp-Arg and ß-Asp-Lys dipeptides, as revealed by electrospray ionization-mass spectrometry and reversed-phase high-performance liquid chromatography analysis. However, these primary accumulated hydrolysis products were only partially used by *S. hongkongensis* strain KI, and significant growth on CGP did not occur. On the other hand, *C. amalonaticus* strain G did not degrade CGP but grew on the ß-linked iso-dipeptides formed in vitro by enzymatic CGP degradation or in vivo by metabolic activity of *S. hongkongensis* strain KI. Dipeptide utilization occurred at the highest rate if both strains were used in cocultivation experiments with CGP, indicating that cooperation between different bacteria occurs in anaerobic natural environments for complete CGP turnover. The amino acids obtained from the cleavage of dipeptides were fermented to ethanol, acetic acid, and succinic acid, as revealed by gas chromatographic analysis and by spectrophotometric enzyme assays.

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School of Marine and Atmospheric Sciences, University of Miami, 4600 Rickenbacker Cswy., Miami, Florida 33149,[3] Earth System Science, University of California at Irvine, Irvine, California 92697[4]). Description of Toluene Inhibition of Methyl Bromide Biodegradation in Seawater and Isolation of a Marine Toluene Oxidizer That Degrades Methyl Bromide. Applied and Environmental Microbiology, Vol. 71,(7)(2005): 3495-3503.

Methyl bromide (CH_3Br) and methyl chloride (CH_3Cl) are important precursors for destruction of stratospheric ozone, and oceanic uptake is an important component of the biogeochemical cycle of these methyl halides. In an effort to identify and characterize the organisms mediating halocarbon biodegradation, we surveyed the effect of potential cometabolic substrates on CH_3Br biodegradation using a $^{13}CH_3Br$ incubation technique. Toluene (160 to 200 nM) clearly inhibited CH_3Br and CH_3Cl degradation in seawater samples from the North Atlantic, North Pacific, and Southern Oceans. Furthermore, a marine bacterium able to co-oxidize CH_3Br while growing on toluene was isolated from subtropical Western Atlantic seawater. The bacterium, Oxy6, was also able to oxidize *o*-xylene and the xylene monooxygenase (XMO) pathway intermediate 3-methylcatechol. Patterns of substrate oxidation, lack of acetylene inhibition, and the inability of the toluene 4-monooxygenase (T4MO)-containing bacterium *Pseudomonas mendocina* KR1 to degrade CH_3Br ruled out participation of the T4MO pathway in Oxy6. Oxy6 also oxidized a variety of toluene (TOL) pathway intermediates such as benzyl alcohol, benzylaldehyde, benzoate, and catechol, but the inability of *Pseudomonas putida* mt-2 to degrade CH_3Br suggested that the TOL pathway might not be responsible for CH_3Br biodegradation. Molecular phylogenetic analysis identified Oxy6 to be a member of the family *Sphingomonadaceae* related to species within the *Porphyrobacter* genus. Although some *Sphingomonadaceae* can degrade a variety of xenobiotic compounds, this appears to be the first report of CH_3Br degradation for this class of organism. The widespread inhibitory effect of toluene on natural seawater samples and the metabolic capabilities of Oxy6 indicate a possible link between aromatic hydrocarbon utilization and the biogeochemical cycle of methyl halides.

Karolina Nordin,[1,2] Maria Unell,[3] and Janet K. Jansson[2,3*] .(Department of Biochemistry and Biophysics, Stockholm University, 106 91 Stockholm, Sweden,[1] Section for Natural Sciences, Södertörn University College, 141 89 Huddinge, Sweden,[2] Department of Microbiology, Swedish University of Agricultural Sciences, Box 7025, 750 07 Uppsala, Sweden[3]). Novel 4-Chlorophenol Degradation Gene Cluster and Degradation Route via Hydroxyquinol in *Arthrobacter chlorophenolicus* A6. Applied and Environmental Microbiology, Vol. 71(11) (2005): 6538-6544.

Arthrobacter chlorophenolicus A6, a previously described 4-chlorophenol-degrading strain, was found to degrade 4-chlorophenol via hydroxyquinol, which is a novel route for aerobic microbial degradation of this compound. In addition, 10 open reading frames exhibiting sequence similarity to genes encoding enzymes involved in chlorophenol degradation were cloned and designated part of a chlorophenol degradation gene cluster (*cph* genes). Several of the open reading frames appeared to encode enzymes with similar functions; these open reading frames included two genes, *cphA-I* and *cphA-II*, which were shown to encode functional hydroxyquinol 1,2-dioxygenases. Disruption of the *cphA-I* gene yielded a mutant that exhibited negligible growth on 4-chlorophenol, thereby linking the *cph* gene cluster to functional catabolism of 4-chlorophenol in *A. chlorophenolicus* A6. The presence of a resolvase pseudogene in the *cph* gene cluster together with analyses of the G+C content and codon bias of flanking genes suggested that horizontal gene transfer was involved in assembly of the gene cluster during evolution of the ability of the strain to grow on 4-chlorophenol.

Andrea Zille,[1] Barbara Górnacka,[2] Astrid Rehorek,[2] and Artur Cavaco-Paulo[1].* (University of Minho, Department of Textile Engineering, 4800-058 Guimarães, Portugal,[1] University of Applied Sciences Cologne, Institute of Chemical Engineering and Plant Design, Betzdorfer Str. 2, D-50679 Cologne, Germany[2]). Degradation of Azo Dyes by *Trametes villosa* Laccase over Long Periods of Oxidative Conditions. Applied and Environmental Microbiology Vol. 71(11), (2005): 6711-6718.

Trametes villosa laccase was used for direct azo dye degradation, and the reaction products that accumulated after 72 h of incubation were analyzed. Liquid chromatography-mass spectrometry (LC-MS) analysis showed the formation of phenolic compounds during the dye oxidation process as well as a large amount of polymerized products that retain azo group integrity. The amino-phenol reactions were also investigated by ^{13}C-nuclear magnetic resonance and LC-MS analysis, and the polymerization character of laccase was shown. This study highlights the fact that laccases polymerize the reaction products obtained during long-term batch decolorization processes with azo dyes. These polymerized products provide unacceptable color levels in effluents, limiting the application of laccases as bioremediation agents.

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Biodegradation is cost-effective, environmentally friendly treatment for oily contaminated sites by the use of microorganisms. In this study, laboratory experiments were conducted to establish the performance of bacterial isolates in degradation of organic compounds contained in oily sludge from the Jordanian Oil Refinery plant. As a result of the laboratory screening, three natural bacterial consortia capable of degrading total organic carbons (TOC) were prepared from isolates enriched from the oil sludge. Experiments were conducted in Erlenmeyer flasks under aerobic conditions, with TOC removal percentage varied from 0.3 to 28% depending on consortia type and concentration. Consortia 7B and 13B exhibited the highest TOC removal percentage of 28 and 22%, respectively, before nutrient addition. TOC removal rate was enhanced after addition of nutrients to incubated flasks. The highest TOC reduction (43%) was estimated after addition of combination of nitrogen, phosphorus and sulphur to consortia 7B.

A significant variation ($P < 0.005$) was obser0ved between the effect of consortia type and concentration on TOC% reduction. No significant variation was observed between incubation at 10 and 18 days in TOC% reduction. This is the first report concerning biological treatment of TOC by bacteria isolated from the oil refinery plants, where it lays the ground for full integrated studies recommended for the degradation of organic compounds that assist in solving sludge problems.

Mufaddal I. Ezzi and James M. Lynch. (School of Biomedical and Molecular Sciences, University of Surrey, Guildford, Surrey GU2 7XH, UK). Biodegradation of cyanide by *Trichoderma* spp. and *Fusarium* spp. Enzyme and Microbial Technology, Vol.36(7)(2005): 849-854.

The rate of degradation of cyanide by certain strains of the *Trichoderma* spp. was evaluated. For comparison two *Fusarium* spp., which had previously been demonstrated to degrade

metallocyanides were also studied. Studies were carried out to assess the rate of degradation using cyanide as the sole source of carbon or in the presence of glucose. Biodegradation was observed in flask cultures using cyanide as the sole carbon source. Strong evidence of cyanide biodegradation and co-metabolism emerged from studies with flask cultures where glucose was provided as a co-substrate. The rate of degradation of 2000 ppm CN^- was enhanced almost three times in the presence of glucose. A concomitant increase in fungal biomass was also observed in all the strains over the experimental period. Growth yield calculations performed provided values that were comparable to those reported in literature for one-carbon substrates.

Nidhi Sharma* and P C Trivedi. (Department of Botany, University of Rajasthan, Jaipur 302 004, India). Microbial Bioagents: Economic multiplication and management of fungal-nematode comples on cumin. Indian Journal of Biotechnology, Vol. 4, (2005): 422-423.

Mass-scale multiplication was done on cheaper substrates for application of bioagents in the management of plant-parasitic nematodes and fungal pathogens. The bioagents were isolated from the local field soils. Out of the 13 isolated fungi, most of the isolates of *Trichoderma* spp. that were found antagonistic to *Fusarium sysporum* of sp. *cumini* in dual culture technique, were mass multiplied on cheaper agrowastes. Suitability of 6 substrates was screened and tea waste was found to be best followed by wheat bran and sorghum straw. *Trichoderma harzianum* (T5) had the maximum spore load per gram (SLPG) value on tea waste followed by *T. hamatum* (T16) on wheat bran. Three isolates of bacteria viz. *Bacillus subtitlis*, *Pseudomonas fluorescens* and *Rhizobium* spp. were multiplied on nutrient broth, King's B broth and yeast extract mannitol broth, respectively.

Arnaud Boivin[a, b], Samira Amellal[b], Michel Schiavon[b,] and Martinus Th. van Genuchten[a]. ([a]George E. Brown, Jr. Salinity Laboratory, USDA-ARS, 450 West Big Springs Road, Riverside, CA 92507-4617, USA, [b]Laboratoire Sols et Environnement, UMR 1120 INPL/ENSAIA-INRA 2, Avenue de la Forêt de Haye, BP 172, 54505 Vandoeuvre-lès-Nancy cedex, France, Tel.: +1 951 369 4865; fax: +1 951 342 4964). 2,4-Dichlorophenoxyacetic acid (2,4-D) sorption and degradation dynamics in three agricultural soils. Environmental Pollution, Volume 138, Issue 1, (2005): 92-99.

The fate and transport of 2,4-dichlorophenoxyacetic acid (2,4-D) in the subsurface is affected by a complex, time-dependent interplay between sorption and mineralization processes. 2,4-D is biodegradable in soils, while adsorption/desorption is influenced by both soil organic matter content and soil pH. In order to assess the dynamic interactions between sorption and mineralization, 2,4-D mineralization experiments were carried using three different soils (clay, loam and sand) assuming different contact times. Mineralization appeared to be the main process limiting 2,4-D availability, with each soil containing its own 2,4-D decomposers. For the clay and the loamy soils, 45 and 48% of the applied dose were mineralized after 10 days. By comparison, mineralization in the sandy soil proceeded initially much slower because of longer lag times. While 2,4-D residues immediately after application were readily available (>93% was extractable), the herbicide was present in a mostly unavailable state (<2% extractable) in all three soils after incubation for 60 days. We found that the total amount of bound residue decreased between 30 and 60 incubation days. Bioaccumulation may have led to reversible immobilization, with some residues later becoming more readily available again to extraction and/or mineralization.

S.Venkata Mohan, K.Krishna Prasad, N.Chandrasekhara Rao, Y Vijaya Bhaskar, V Lalit

Babu, D Rajagopal and P.N.Sharma. (Bioengineering and Environmental Centre, Indian Institute of Chemical Technology, Hyderabad 500 007). Biological treatment of low-biodegradable composite chemical wastewater using upflow anaerobic sludge blanket (UASB) reactor: Process monitoring. Journal of Scientific & Industrial Research, Vol. 64, (2005): 771-777.

Upflow Anaerobic Sludge Blanket (UASB) reactor was investigated for the treatment of low biodegradable composite chemical wastewater, which was complex in nature and has low biodegradability (BOD/COD) ratio ~0.32), with high concentrations of sulphate and total dissolved inorganic solids (TDIS). After inoculating with slaughterhouse wastewater treating anaerobic sludge, the reactor showed a rapid startup phase. The reactor was operated continuously for 60 days with an actual organic loading rate (OLR_{actual}) of 4.25 kg COD/m^3-d accounting for 37 h of detention time in continuous mode without recirculation at a mesophilic temperature of 29±2°C. At steady state conditions, the reactor resulted in 62% of COD removal efficiency accounting for substrate degradation rate (SDR_{actual}) of 2.6 kg COD/M^3-d. the experimental data demonstrated the applicability of UASB system for treating composite chemical wastewater with low biodegradable nature. Introduction of appropriate inoculum to the reactor during startup showed the effective biological treatment of composite wastewater, which is evident from the substrate and sulfate removal data and non-accumulation of VFA concentration in the reactor along with the generation of biogas.

M.T.Garcia[a,*], E. Campos[a], I. Ribosa[a], A.Latorre[b], J.Sanchez-Leal[a]. ([a]Department of Surfactant Technology, IIQAB – CSIC, Jordi Girona 18-26, 08034 Barcelona, Spain, [b]Department of Environmental Chemistry, IIQAB-CSIOC, Jordi Girona 18-26, 08034 Barcelona, Spain). Anaerobic digestion of linear alkyl benzene sulfonates: Biodegradation kinetics and metabolite analysis. Chemosphere 60(2005): 1636-1643.

In the present work the effect of the alkyl chain length and the position of the sulfophenyl substituent of the linear alkylbenzene sulfinates (LAS) on their anaerobic biodegradability have been investigated. Degradation kinetics of the linear alkyl benzene sulfonates homologues, $2\phi C_{10}$LAS, $2\phi C_{12}$LAS and $2\phi C_{14}$LAS, have been studied. It bhas been also investigated the effect of the isomer type on the degradation rate of the LAS molecule through the comparative study of the $2\phi C_{10}$LAS and $5\phi C_{10}$LAS isomers. Batch anaerobic biodegradation tests were performed using sludge from the anaerobic digester of a wastewater treatment plant as microorganisms source. Ultimate biodegradation was evaluated from the biogas production whereas primary biodegradation was determined by specific analysis of the surfactant. LAS homologues asnd isomers showed a negligible primary biodegradation under anaerobic conditions. Furthermore, analysis of sulophenyl carboxilates (SPC) by LC-MS indicated a low and constant level of these LAS degradation metabilites over the test period. These data are consistent with a minimal transformation of the LAS parent molecule in the anaerobic digesters. On the other hand, the addition of the shortest alkyl chain length homologues, decyl and dodecyl-sulfonate, enhances the biogas production. This LAS homologue seems to increase the availability of organic compounds sorbed on the anaerobic sludge promoting their biodegradation.

B.V.Chang[*], F.Chiang, S.Y.Yuan. (Department of Microbiology, Soochow University, Taipei 111, Taiwan). Biodegradation of nonylphenol in sewage sludge. Chemosphere 60(2005): 1652-1659.

We investigated the effects of various factors on the aerobic degradation of nonylphenol (NP) in sewage sludge. NP (5 mg/kg) degradation rate constants (k_1) calculated were 0.148 and 0.224 day^{-1} for the batch experiment and the bioreactor experiment, respectively, and half-lives ($t_{1/2}$) were 4.7 and 3.1 days, respectively. The optimal pH value for NP degradation in sludge was 7.0 and the degradation rate was enhanced when the temperature was increased and then yeast extract (5 mg/l) and surfactants such as brij 30 or brij 35 (55 or 91 μM) were added. The addition of aluminium sulfate (200 mg/l) and hydrogen peroxide (1 mg/l) inhibited NP degradation within 28 days of incubation. Of the micro-organism strains isolated from the sludge samples, we found that strain CT7 (identified as Bacillus sphaericus) manifested the best degrading ability.

Kim Broholm[a,*], Loselotte Ludvigsen[b], Thorkild Feldthusen Jensen[b] Henrik Ostergaard[c]. ([a]DHI-Institute for Water and Environment, HSW, Agern Alle 5, DK-2970 orsholm, Denmark, [b]Ramboll, Denmark, [c]Frederiksborg County, Denmark). Aerobic biodegradation of vinyl chloride and cis-1,2-dichloroethylene in aquifer sediments. Chemosphere 60(2005): 1555-1564.

Laboratory batch experiments have been performed with sediment and groundwater obtained from two sites in Denmark to study the aerobic biodegradation of vinyl chloride (VC) and cis-1,2-dichloroethylene (c-1,2-DCE) to assess the natural aerobic biodegradation potential at two sites. The experiments revealed that VC was degraded to below the detection limit within 204 and 57 days at the two sites. C-1,2-DCE was also degraded in the experiments but not completely. At the two sites 50% and 35% was removed by the end o the experimental period of 204 and 274 days. The removal of c-1,2-DCE seems to occur concomitantly with VC indicating that the biodegradation of c-1,2-DCE may depend on the biodegradation of VC. However, in bnoth cases natural groundwater was mixed with sediment and consequently there may be other compounds (e.g. ammonium, natural organic compound etc.) that serves as primary substrates for the co-metabolic biodegradation of c-1,2-DCE. At one of the sites methane was supplied to try to enhance the biodegradation of VC and c-1,2-DCE. That was successful since the time for complete biodegradation of VC decreased from 204 days in the absence of methane to 84 days in the presence of methane. For c-1,2-DCE the amount that was biodegraded after 204 days in the increased from 50% to 90% as a result of the addition of methane. It seems like a potential for natural biodegradation exists at least for VC at these two sites and also to some degree for c-1,2-DCE.

R.Pal[a,*], K.Chakrabarti[a], A. Chakraborty[b], A.Chowdhury[a]. ([a]Department of Agricultural Chemistry and Soil Science, Calcutta University, 35 Ballygunge Circular Road, Calcutta 700 019, India, [b] Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal 741 252, India). Pencycuron application to soils: Degradation and effect on microbiological parameters. Chemosphere 60 (2005): 1513-1522.

Clay loam soil from agricultural fields of alluvial (AL) soil (typic udifluvent) and coastal saline (CS) soil (typic enmdoaquept) were investigated for the degradation and effect of pencycuron application at field rate (FR), 2-times FR (2FR) and 10-times FR (10FR) with and without decomposed cow manure (DCM) on soil microbial variables under laboratory conditions. Pencycuron degraded faster in CS soil and in soil amended with DCM. Pencycuron spiking at FR and 2FR resulted in a short-lived (in case of 10 FR slightly longer) and transitory toxic effect on soil microbial biomass-C (MBC), ergosterol content and fluorescein diacetate hydrolysing activity (FDHA). Amendment of DCM did not seem to have any counteractive effect of the

toxicity of pencycuron on the microbial variables. The ecophysiological status of the soil microbial communities as expressed by microbial metabolic quotient (a_{CO2}) and microbial respiration quotient (Q_R) changed, but for a short period, indicating pencycuron induced distuirbance. The duration of this disturbance was slightly longer at 10FR. Pencycuron was more toxic to the metabolically activated soil microbial populations, specifically the fungi. It is concluded that side effects of pencycuron at 10FR on the microbial variables studied were only short-liver and probably of little ecological significance.

Biosensor

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A method is desibed for the removal of mercury from solution by using the off-gas produced from aerobic cultures of *Klebsiella pneumoniae* M426. Cells growing in Hg-supplemented medium produced a black precipitate containing mercury and sulphur. The ratio of Hg:S was determined as ~1:1 by analysis using proton-induced X-ray emission, suggesting precipitation of HgS within the culture. The outlet gases produced by a mercury-unsupplemented aerated culture were bubbled into an external chamber supplemented with up to 10 mg $HgCl_2$/ml. A yellowish-white precipitate formed, corresponding to 99% removal of the mercury from solution within 120 min. Energy dispersive X-ray microanalysis showed that this metal precipitate consisted of mercury, carbon and sulphur. Formation of mercury carbonate was discounted since similar precipitation occurred at pH 2 and no oxygen was detected in the solid, which gave an X-ray powder pattern suggesting an amorphous material, with no evidence of HgS. Precipitation of mercury with a volatile organosulphur compound is suggested. Bio-precipitation of heavy metals by using culture off-gas is a useful approach because it can be used with concentrated or physiologically incompatible solutions. Since the metal precipitate is kept separate from the bacterial biomass, it can be managed independently.

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A biosensor has been designed for measuring plasma fibrinogen concentrations based on an enzyme kinetic model. The values obtained correspond linearly to those of a clinical method but have a higher sensitivity within the normal range of fibrinogen. By using the disposable biosensor technology, this method is easy to follow, quick (within 2 min) and precise (with coefficients of variation to be as low as below 5%) and requires only a small amount of plasma sample (<50 μl). This biosensor technology also holds potential for use in point-of-care diagnostics.

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A capacitive biosensor with polyclonal antibodies raised against human serum albumin (HSA) immobilized on a gold transducer has been developed for continuous measurement of HSA in the μM-range. A mathematical model has been refined to describe integral HSA-binding curves assuming that (i) binding is essentially irreversible under the conditions used, (ii) the signal is scaled as the number of non-occupied binding sites and (iii) the rate of disappearance of available binding sites is scaled as the number of available binding sites and analyte concentration in solution. Deconvolution of the curves using the mathematical model indicates clearly that it is possible to retrieve concentration profiles (isocratic, linearly or exponentially increasing gradients) of the analyte in the continuous sample flow from the normalized integral binding (NIB) curves. The data presented constitutes the theoretical background and the first step towards the development of an analytical system allowing on-line detection of the concentration profile of the analyte from NIB-curves. Since the system can be used for extended time periods between regeneration steps, a low frequency of regeneration steps can be expected.

J. Jegan Roy[a], T. Emilia Abraham[a], K.S. Abhijith[b], P.V. Sujith Kumar[b] and M.S. Thakur[b]. ([a]Bioactive Polymer Engineering Section, Polymer Science Division, Regional Research Laboratory (CSIR), Trivandrum 695019, India, [b]Fermentation Biotechnology and Bioengineering, Central Food Technological Research Institute, Mysore 570013, India, Corresponding author. Tel.: +91 471 2515253; fax: +91 471 2490186). Biosensor for the determination of phenols based on Cross-Linked Enzyme Crystals (CLEC) of laccase. Biosensors and Bioelectronics, Volume 21, Issue 1, (2005): 206-211.

Cross-linked enzyme crystals (CLECs) are a versatile form of biocatalyst that can also be used for biosensor application. Laccase from *Trametes versicolor* (E.C.1.10.3.2) was crystallized, cross-linked and lyophilized with β-cyclodextrin. The CLEC laccase was found to be highly active towards phenols like 2-amino phenol, guaiacol, catechol, pyrogallol, catechin and ABTS (non-phenolic). The CLEC laccase was embedded in 30% polyvinylpropylidone (PVP) gel and mounted into an electrode to make the sensor. The biosensor was used to detect the phenols in 50–1000 μmol concentration level. Phenols with lower molecular weight such as 2-amino phenol, catechol and pyrogallol gave a short response time where as the higher molecular weight substrates like catechin and ABTS had comparatively a long response time. The optimum pH of the analyte was 5.5–6.0 when catechol was used as substrate. The CLEC laccase retained good activity for over 3 months.

Ana M. Azevedo, D. Miguel F. Prazeres, Joaquim M.S. Cabral and Luís P. Fonseca. (Centro de Engenharia Biológica e Química, Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 Lisboa, Portugal, Corresponding author. Tel.: +351 21 8419065; fax: +351 21 8419062.). Ethanol biosensors based on alcohol oxidase. Biosensors and Bioelectronics, Volume 21, Issue 2, (2005): 235-247.

The detection and quantification of ethanol with high sensitivity, selectivity and accuracy is required in many different areas. A variety of methods and strategies have been reported for the determination of this analyte including gas chromatography, liquid chromatography,

refractometry and spectrophotometry, among other. The use of the enzyme alcohol oxidase (AOX) on the analysis of ethanol in complex samples allows a considerable enhancement in specificity. This paper reviews the state of the art on ethanol determination based on AOX sensors, using either electrochemical electrodes or immobilised enzyme reactors.

Almost all AOX-based ethanol sensors developed so far are based on the monitoring of O_2 consumption or H_2O_2 formation. This has been mostly achieved using amperometric electrodes set at appropriate potentials namely, −600 mV for O_2 monitoring or +600 mV for H_2O_2 monitoring. Mediated and non-mediated bienzymatic systems have also been assembled using AOX coupled to horseradish peroxidase (HRP). Different types of electrodes have been proposed for the detection of ethanol, namely, membrane electrode, carbon paste electrodes, screen-printed electrodes and self-assembled monolayers.

Another approach to work with this sensitive enzyme is to use high amounts of AOX in order to create an enzyme reservoir, a strategy which can be implemented using immobilised enzyme reactors. These reactors can be combined with a colorimetric detection in a flow-injection analysis system or with electrochemical transducers.

Md. Aminur Rahman[a], Mi-Sook Won[b] and Yoon-Bo Shim[a]. ([a]Department of Chemistry and Center for Innovative Bio-Physio Sensor Technology, Pusan National University, Busan 609-735, South Korea, [b]Korea Basic Science Institute, Keumjeong-ku, Busan 609-735, South Korea, Corresponding author. Tel.: +82 51 510 2244; fax: +82 51 514 2430). The potential use of hydrazine as an alternative to peroxidase in a biosensor: comparison between hydrazine and HRP-based glucose sensors. Biosensors and Bioelectronics, Volume 21(2)(2005): 257-265

The potential use of hydrazine sulfate was examined for the catalytic reduction of enzymatically generated H_2O_2 in a biosensor system. The performance of the hydrazine-based sensor was compared with an HRP-based glucose sensor as a model of a biosensor. Hydrazine and HRP were covalently immobilized onto a conducting polymer layer with glucose oxidase. The direct electron transfer reactions of the immobilized hydrazine and HRP onto the poly-5,2′:5,2″-terthiophene-3′-carboxylic acid (poly-TTCA) layer were investigated by using cyclic voltammetric method and the electron transfer rate constants were determined. The glucose oxidase- and hydrazine-immobilized sensor efficiently reduced the enzymatically generated H_2O_2 at −0.15 V versus Ag/AgCl. The surface of this GO_x/hydrazine/poly-TTCA-based glucose sensor was characterized by QCM, SEM, and ESCA. Glucose-sensing properties were studied using cyclic voltammetric and chronoamperometric techniques. Various experimental parameters were optimized according to the amount of hydrazine, pH, the temperature, and the applied potential. A linear calibration plot was obtained in the concentration range between 0.1 and 15.0 mM, and the detection limit was determined to be 40.0 ± 7.0 μM. Interferences from other biological compounds were studied. The long-term stability of the GO_x/hydrazine sensor was better than that of the one based on a GO_x/HRP biosensor. The proposed glucose sensor was successfully applied to human whole blood and urine samples for the detection of glucose.

F. Ricci and G. Palleschi. (Dipartimento di Scienze e Tecnologie Chimiche, Università di Roma Tor Vergata, Via della Ricerca Scientifica, 00133 Rome, Italy, Corresponding author. Tel.: +39 06 72594403; fax: +39 06 72594328). Sensor and biosensor preparation, optimisation and applications of Prussian Blue modified electrodes. Biosensors and Bioelectronics, Volume 21(3)(2005): 389-407.

Being one of the most commonly used electrochemical mediators for analytical applications, Prussian Blue has found a wide use in the biosensor field during the last years. Its particular characteristic of catalysing hydrogen peroxide reduction has been applied in the construction of a large number of oxidase enzyme-based biosensors for clinical, environmental and food analysis.

By modifying an electrode surface with Prussian Blue, it is in fact possible to easily detect hydrogen peroxide at an applied potential around 0.0 V versus Ag/AgCl, thus making possible coupling with oxidase enzymes while also avoiding or reducing electrochemical interferences.

Papers dealing with glucose, lactate, cholesterol and galactose biosensors that are based on the use of Prussian Blue have recently appeared in the most important analytical chemistry journals.

Another recent trend is the use of a choline probe based on choline oxidase for pesticide determination to exploit the inhibition of acetylcholinesterase by these compounds.

In addition, the use of Prussian Blue in the development of biosensors for food analysis has captured the interest of many research groups and led to improved methods for the detection of glutamate, galactose, alcohol, fructosyl amine, formate, lysine and oxalate.

This review will focus on the biosensing aspects of Prussian Blue-based sensors giving a general overview of the advantages provided by such mediator as well as its drawbacks. A comprehensive bibliographic reference list is presented together with the most up to date research findings in this field and possible future applications. The commercial potential of sensors based on this mediator will also be discussed.

Brian Lillis[a], Cornelia Jungk[b], Daniela Iacopino[a], Andrew Whelton[a], Eileen Hurley[a], Michelle M. Sheehan[a], Alexandra Splinter[b], Aidan Quinn[a], Gareth Redmond[a], William A. Lane[c], Alan Mathewson[a] and Helen Berney[a] . ([a]NMRC, Lee Maltings, Prospect Row, Cork, Ireland, [b]IMSAS, Otto-Hahn-Allee, Building NW1, D-28359 Bremen, Germany, [c]Analog Devices, Raheen Industrial Estate, Limerick, Ireland, Corresponding author. Tel.: +353 21 4904083; fax: +353 21 4270271). Microporous silicon and biosensor development: structural analysis, electrical characterisation and biocapacity evaluation. Biosensors and Bioelectronics, Volume 21, Issue 2 , (2005): 282-292.

An investigation of the fabrication of microporous silicon (MPS) layers as a material for the development of an electrolyte insulator semiconductor (EIS) capacitance sensor has been performed. The goal was to create a high surface area substrate for the immobilisation of biorecognition elements. Structural analysis of MPS layers as a function of key etch parameters, namely implant type (p or n), implant dose, hydrofluoric acid (HF) etch concentration and current density has been performed using scanning electron microscopy (SEM). It was possible to image porous layers with average pore diameter as low as 4 nm.

n-type silicon samples had larger pore networks than p-type samples and reducing the silicon resistivity led to a reduction in the pores per μm^2. It was found that increasing the HF etch concentration reduced the average pore diameter and increased the pores per μm^2. Increasing the current density at which the etch was performed has the same effect. Understanding the effect of these parameters allows the MPS layer to be tuned to match specifications for optimum biocapacity.

Different MPS layers were electrically characterised using capacitance–voltage and capacitance–frequency sweeps, in order to determine the effect of porosity on increases in surface area. The measured capacitance increased with increasing pores per μm^2. p-type silicon with a boron implant in the back of the wafer, which had been etched in 25% HF in ethanol at a current density of 75 mA/cm^2 yielded the highest capacitance signal per unit area. The effect of porosity and pore size on the biocapacity of the samples was also determined. For avidin immobilisation, with pores sizes above 5 nm, as the porosity increased the biocapacity increased. MPS fabricated in p-type silicon with a front and back implant etched in 25% HF at a current density of 25 mA/cm^2 was used for the capacitance detection of synthetic oligonucleotides.

Celine Chouteau[a, b], Sergei Dzyadevych[c], Claude Durrieu[a] and Jean-Marc Chovelon[b]. ([a]Laboratoire des Sciences de l'Environnement, Ecole Nationale des Travaux Publics de l'Etat, rue Maurice Audin, 69518 Vaulx-en-Velin Cedex, France, [b]Laboratoire d'Application de la Chimie à l'Environnement UMR 5634, Université Claude Bernard Lyon 1, 43 boulevard du 11 Novembre 1918, Villeurbanne Cedex, France, [c]Laboratory of Biomolecular Electronics, National Academy of Sciences of Ukraine, Institute of Molecular Biology and Genetics, 150 Zabolotnogo St., Kiev 03143, Ukraine, Corresponding author. Tel.: +33 4 7243 2638; fax: +33 4 7244 8438). A bi-enzymatic whole cell conductometric biosensor for heavy metal ions and pesticides detection in water samples. Biosensors and Bioelectronics, Volume 21, Issue 2, (2005): 273-281.

A conductometric biosensor using immobilised *Chlorella vulgaris* microalgae as bioreceptors was used as a bi-enzymatic biosensor. Algae were immobilised inside bovine serum albumin membranes reticulated with glutaraldehyde vapours deposited on interdigitated conductometric electrodes. Local conductivity variations caused by algae alkaline phosphatase and acetylcholinesterase activities could be detected. These two enzymes are known to be inhibited by distinct families of toxic compounds: heavy metals for alkaline phosphatase, carbamates and organophosphorous (OP) pesticides for acetylcholinesterase. The bi-enzymatic biosensors were tested to study the influence of heavy metal ions and pesticides on the corresponding enzyme. It has finally appeared that these biosensors are quite sensitive to Cd^{2+} and Zn^{2+} (limits of detection (LOD) = 10 ppb for a 30 min long exposure) while Pb^{2+} gives no significant inhibition as this ion seems to adsorb on albumin preferably. For pesticides, first experiments showed that paraoxon-methyl inhibits *C. vulgaris* AChE contrary to parathion-methyl and carbofuran. Biosensors were then exposed to different mixtures (Cd^{2+}/Zn^{2+}, Cd^{2+}/paraoxon-methyl) but no synergetic or antagonist effect could be observed. A good repeatability could be achieve with biosensors since the relative standard deviation did not exceed 8% while response time was 5–7 min.

A comparison between inhibition levels obtained with biosensors (after a 30 min long exposure) and bioassays (after a 240 min long exposure) has finally shown a similar LOD for both Cd and Zn (LOD = 10 ppb).

Bioengineering

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Lastruccia 3, 50019 Sesto Fiorentino, Italy). Bioengineering of a Cellulosic Fabric for Insecticide Delivery via Grafted Cyclodextrin. Biotechnol Prog., 21(6)(2005):1724-30.

beta-Cyclodextrin (beta-CD) can be easily grafted onto cellulosic textiles through covalent bonds. In such a way beta-CD empty cavities provide an efficient tool for entrapping different kinds of hydrophobic molecules on the surface of the fabric and releasing them slowly in time. The capability of cyclodextrins to include hydrophobic molecules such as fragrances, antimicrobial agents, and other chemicals can be then exploited to produce new grafted textiles with peculiar and useful performances. In this work we report the inclusion of two different products, the pyrethroid insecticide permethrin (PERM) and the insect repellent N,N-diethyl-m-toluamide (DEET), into beta-CD molecules grafted on cotton fabric. UV-vis spectrophotometry and thermal analysis confirmed the presence of the guest molecules on the fabric surface. Bioassays were carried out on two mosquito species of medical importance, Aedes aegypti and Anopheles stephensi; knock down effect and mortality were measured using standard World Health Organization (WHO) cone tests. Repellency and irritancy (blood feeding inhibition) were also measured using cage tests and a baited tunnel device. PERM-treated fabrics kept the insecticidal/irritant efficacy even for a long time after the treatment, whereas DEET activity lasted more shortly.

Pusch O, Boden D, Hannify S, Lee F, Tucker LD, Boyd MR, Wells JM, Ramratnam B. (From the *Center of Anatomy and Cell Biology, Laboratories of Genome Dynamics, Medical University of Vienna, Vienna, Austria; dagger Aaron Diamond AIDS Research Center, New York, NY; double daggerInstitute of Food Research, Norwich, United Kingdom; section sign Laboratory of Retrovirology, Division of Infectious Diseases, Brown Medical School, Providence, RI; parallelSwammerdam Institute for Life Sciences, Amsterdam, The Netherlands; and paragraph sign USA Cancer Research Institute, University of South Alabama College of Medicine, Mobile, AL). Bioengineering Lactic Acid Bacteria to Secrete the HIV-1 Virucide Cyanovirin. J Acquir Immune Defic Syndr., 40(5)(2005): 512-520.

An urgent need exists to prevent the sexual transmission of HIV-1. With prevalence rates exceeding 35% in parts of sub-Saharan Africa, increasing attention has been placed on developing and testing microbicidal agents capable of preventing virus transmission at mucosal sites. HIV-1 microbicides must meet several requirements before their widespread use. The drugs must be able to neutralize a diversity of HIV-1 strains, not induce mucosal inflammation, be associated with minimal side effects, and be effective for a prolonged period after a single application. Recent work has demonstrated the utility of recombinant lactic acid bacteria (LAB) as agents of mucosal drug delivery. Here, we describe the bioengineering of strains of LAB to secrete the prototypic virucidal compound cyanovirin (CV-N) and demonstrate the anti-HIV-1 activity of secreted CV-N. Our results suggest that recombinant LAB may serve as effective microbicidal compounds and deserve in vivo testing in simian immunodeficiency virus models of mucosal virus transmission.

Lang S, Huners M, Verena L. (Technische Universitat Braunschweig, Institut fur Biochemie und Biotechnologie, Spielmannstr. 7, 38106 Braunschweig, Germany. s.lang@tu-bs.de). Bioprocess engineering data on the cultivation of marine prokaryotes and fungi. Adv Biochem Eng Biotechnol., 97(2005):29-62.

The temperature/pressure dependency of marine prokaryotes and fungi, in terms of their growth behaviour as well as their potential to produce new metabolites or enzymes, is evaluated. Advanced shake-flask cultivations and controlled bioreactor cultivations following the batch-type, fed-batch-type and/or continuous-type procedures are summarized. After a summary of the fermentation data available so far, values on maximal biomass, specific growth rates, and (sub)optimal production yields are presented. The application of mesophilic microbes, especially bioactive metabolites, to intensify bioprocess engineering studies, is the goal. Cold-active enzymes and thermostable enzymes are the targets of experiments with psychrophilic and hyperthermophilic enzymes. A special challenge to bioengineers is also provided by barophilic strains originating from depths of, say, nearly 11000 m, or from hydrothermal vents.

Taba M Jr, Jin Q, Sugai JV, Giannobile WV. (Department of Periodontics and Oral Medicine, University of Michigan School of Dentistry, Ann Arbor, 48108, USA). Current concepts in periodontal bioengineering. Orthod Craniofac Res., 8(4)(2005): 292-302.

Repair of tooth supporting alveolar bone defects caused by periodontal and peri-implant tissue destruction is a major goal of reconstructive therapy. Oral and craniofacial tissue engineering has been achieved with limited success by the utilization of a variety of approaches such as cell-occlusive barrier membranes, bone substitutes and autogenous block grafting techniques. Signaling molecules such as growth factors have been used to restore lost tooth support because of damage by periodontal disease or trauma. This paper will review emerging periodontal therapies in the areas of materials science, growth factor biology and cell/gene therapy. Several different polymer delivery systems that aid in the targeting of proteins, genes and cells to periodontal and peri-implant defects will be highlighted. Results from preclinical and clinical trials will be reviewed using the topical application of bone morphogenetic proteins (BMP-2 and BMP-7) and platelet-derived growth factor-BB (PDGF) for periodontal and peri-implant regeneration. The paper concludes with recent research on the use of ex vivo and in vivo gene delivery strategies via gene therapy vectors encoding growth promoting and inhibiting molecules (PDGF, BMP, noggin and others) to regenerate periodontal structures including bone, periodontal ligament and cementum.

Pollen Biotechnology

Yannis Gounaria[1,*]. Stella Galanopoulou[1], Nikos Galanopoulos[1], Alexis ladopoulos[2], Zisis Michailidis[2] and Stelios Theophilou[3]. (University of Thessaly, Dept. of Agriculture, Crop Production and Rural Environment, Fytokou Street, 38446 New Ionia, Magnesia, Greece. [2]Bios Agrosystems SA., Industrial Area of Thessaloniki, PO Box 48, 570022 Sindos, Greece. [3]Institute of Molecular Biology and Biotechnology, Vasilika Vluton, 71110 Heraklion, Crete, Greece. E-mail: igoun@uth.gr, igoun@uth.gr). Pollen-mediated genetic transformation of cotton with the Arabidopsis thaliana hmgr cDNA using the particle gun. Journal of Food, Agriculture & Environment Vol. 3(2)(2005): 157-160.

The particle gun procedure was used to introduce a cDNA copy of the Arabidopsis thaliana 3'-hydroxylmethyl glutaryl coenzyme A reductase (hmgr) gene, combined with the neomycin phosphotransferase (nptII) gene for kanamycin resistence, into mature pollen of cotton (Gossypium hirsutum cv. /Christina). The bombarded pollen was used in pollination experiments. Four thousand seeds from plants pollinated by the bombarded pollen were germinated in the presence of 160 $\mu g\ ml^{-1}$ kanamycin. Sixty five kanamycin resistant seedlings

were further studied as potentially containing the transgene and allowed to mature and produce seeds. DNA from these second-generation seeds was used in polymerase chain reaction (PCR) amplification experiments to detect the presence of the hmgr transgene and the upstream cauliflower mosaic virus (CaMV) 35S promoter. Seeds from twelve of the 65 kanamycin-selected plants were found to contain the 35S promoter of the hmgr gene but only three of the twelve contained almost the full-length hmgr cDNA sequence. The methodology is presented as a versatile and easy way of achieving genetic transformation of cotton cultivars and varieties.

Weber RW. (National Jewish Medical and Research Center, University of Colorado Health Sciences Center, Denver, Colorado, USA. weberr@njc.org). Cross-reactivity of pollen allergens: recommendations for immunotherapy vaccines. Curr Opin Allergy Clin Immunol., 5(6)(2005):563-9.

PURPOSE OF REVIEW: This review will summarize recent research on pollen allergen and epitope cross-reactivity. Knowledge of these relationships aids in the rational formulation of allergen immunotherapy vaccines. RECENT FINDINGS: There has been further clarification of panallergens and their roles as both major and minor allergens. Recent studies have targeted non-specific lipid transfer proteins and calcium-binding proteins (polcalcins), as well as pathogenesis-related protein families and profilins. Polcalcins and non-specific lipid transfer proteins are responsible for pollen-fruit interactions as well as pollen cross-reactivity, in some cases, but not all, accounting for major allergenicity. Delineation of the enzymatic activity of certain allergens explains the ubiquitous nature of these pollen proteins. SUMMARY: Characterization of specific pollen allergens and their protein families has provided insight into the grounds for cross-reactivity. Continuing clarification of these relationships will allow the substitution and consolidation of inhalant extracts as described in the conclusion.

Bist A, Kumar L, Roy I, Ravindran P, Gaurs SN, Singh AB. (Institute of Genomics and Integrative Biology, Delhi University Campus, Delhi, India). Clinico-immunologic evaluation of allergy to Himalayan tree pollen in atopic subjects in India--a new record. Asian Pac J Allergy Immunol., 23(2-3)(2005):69-78.

Exposure to local pollen allergens has a direct bearing on the prevalence of allergic symptoms among the inhabiting atopic population. The populations in the Himalayas and around it are exposed to a variety of pollen grains from trees growing in the region, but the pollen-population interaction has not been clinically investigated. Himalayan tree pollen from five different taxa, i.e. Alnus nitida (AN), Betula utilis (BU), Cedrus deodara (CD), Mallotus phillipensis (MP) and Quercus incana (QI) were evaluated for their allergenicity in the Indian population by in vivo (skin prick test) and in vitro (ELISA) clinico-immunological methods. The presence of specific IgE against these tree pollen in the sera of skin test positive patients was taken as evidence for sensitization to these pollen. The average skin positivity in atopic populations recorded at different allergy centers in India varied from 2.2% against AN, to 4.7% against MP pollen. Significantly raised specific IgE against these pollen were observed in the sera of hypersensitive patients. The sensitization pattern to Himalayan tree pollen in these atopic populations varied. It was concluded that skin prick test positivity and raised IgE antibodies specific to AN, BU, CD, MP and QI established Himalayan tree pollen as important sensitizers in the atopic populations of India. A high incidence of skin sensitivity was observed to pollen antigens of Cedrus deodara, Mallotus phillipensis and Quercus incana in patients of Chandigarh residing in the hills and foothills of the Himalayas while Alnus nitida, Betula utilis and Cedrus deodara were important sensitizers in Delhi patients. The skin sensitization pattern against these pollen was in

accordance with the level of exposure to these pollen of the subjects residing in that part of the country.

Holmes-Davis R, Tanaka CK, Vensel WH, Hurkman WJ, McCormick S. (Plant Gene Expression Center, USDA/ARS and UC Berkeley, Albany, CA, USA). Proteome mapping of mature pollen of Arabidopsis thaliana. Proteomics.,5(18)(2005):4864-84.

The male gametophyte of Arabidopsis is a three-celled pollen grain that is thought to contain almost all the mRNAs needed for germination and rapid pollen tube growth. We generated a reference map of the Arabidopsis mature pollen proteome by using multiple protein extraction techniques followed by 2-DE and ESI-MS/MS. We identified 135 distinct proteins from a total of 179 protein spots. We found that half of the identified proteins are involved in metabolism (20%), energy generation (17%), or cell structure (12%); these percentages are similar to those determined for the pollen transcriptome and this similarity is consistent with the idea that in addition to the mRNAs, the mature pollen grain contains proteins necessary for germination and rapid pollen tube growth. We identified ten proteins of unknown function, three of which are flower- or pollen-specific, and we identified nine proteins whose RNAs were absent from the transcriptome, seven of which are involved in metabolism, energy generation, or cell wall structure. Our work complements and extends recent analyses of the pollen transcriptome.

Noir S, Brautigam A, Colby T, Schmidt J, Panstruga R. (Max-Planck-Institute for Plant Breeding Research, Carl-von-Linne-Weg 10, D-50829 Koln, Germany). A reference map of the Arabidopsis thaliana mature pollen proteome. Biochem Biophys Res Commun., 337(4)(2005):1257-66.

The male gametophyte (or pollen) plays an obligatory role during sexual reproduction of higher plants. The extremely reduced complexity of this organ renders pollen a valuable experimental system for studying fundamental aspects of plant biology such as cell fate determination, cell-cell interactions, cell polarity, and tip-growth. Here, we present the first reference map of the mature pollen proteome of the dicotyledonous model plant species, Arabidopsis thaliana. Based on two-dimensional gel electrophoresis, matrix-assisted laser desorption/ionization time-of-flight, and electrospray quadrupole time-of-flight mass spectrometry, we reproducibly identified 121 different proteins in 145 individual spots. The presence, subcellular localization, and functional classification of the identified proteins are discussed in relation to the pollen transcriptome and the full protein complement encoded by the nuclear Arabidopsis genome.

Sheng XY, Hu ZH. (College of Life Science, Northwest University, Xian 710069). [Effects of MG132 , an inhibitor of proteasome , on the pollen germination and tube growth of Pecea wilsonii]. Shi Yan Sheng Wu Xue Bao., 38(4)(2005):309-16.

The ubiquitin/proteasome system is regarded as a major pathway of proteolysis in eukaryotic cells, in which the proteasome acts as primary protease for its function of degrading substrate proteins to short peptides. In the present paper, cytological, statistical studies and Fourier transform infrared (FTIR) analysis on the effects of MG132, an inhibitor of proteasome, on the pollen germination and tube growth of Pecea wilsonii were carried out in an artificial experimental system. It is showed that MG132 significantly reduced the germination rate and tube growth. Furthermore, MG132 treatment lead to vacuolization occurred both in tube cytoplasm and generative cell. While DMSO and non-proteasome inhibitor E-64 do not have similar effects. FTIR analysis revealed that MG132 treatment markedly reduced the contents of

wall-bound proteins and pectin at the apex of tube. Those findings provided evidence that by inhibiting the activity of proteasme, MG132 strongly affects pollen germination and tube growth of P. wilsonii, and that UPP plays an important role in organization and maintaining polarized growth of pollen tube. Inhibition of UPP will induce apoptosis of pollen tube.

Jorgensen TH, Andersson S. (Department of Ecology, Section of Plant Ecology & Systematics, Lund University, Sweden. Tove.Hedegaard@sysbot.lu.se). Evolution and maintenance of pollen-colour dimorphisms in Nigella degenii: habitat-correlated variation and morph-by-environment interactions. New Phytol., 168(2)(2005):487-98.

Dimorphism in pollen colour is rare among flowering plants, but occurs in two geographically and morphologically distinct subspecies of Nigella degenii (Ranunculaceae). We evaluated the role of genotype-by-environment interactions in the maintenance of two pollen morphs within each of these subspecies. Morph frequencies in a number of populations were related to current habitat conditions, and an extensive common-garden experiment involving both optimal and stressful conditions (drought and nutrient deficiency) was carried out. The putatively derived (dark) pollen morph of N. degenii ssp. barbro has a higher frequency on slopes facing north or east than on slopes facing south or west. Plants of the dark morph also have a higher mortality under drought stress or nutrient deficiency. Data available for N. degenii ssp. jenny provide little evidence for habitat-correlated variation in morph frequency or morph-specific differences in fitness under optimal and stressful growth conditions. Our results suggest that morph-by-environment interactions in mortality could contribute to the maintenance of pollen-colour dimorphisms in N. degenii ssp. barbro.

Biotechnology Policy Issue

Caulfield T, Brownsword R. (Timothy Caulfield is at the Faculty of Law and the Faculty of Medicine and Dentistry at the University of Alberta, Edmonton, Alberta T6G 2H5, Canada). Human dignity: a guide to policy making in the biotechnology era? Nat Rev Genet., 2005 Dec 13; [Epub ahead of print]

This article explores the ways in which human dignity is used in debates about controversial biotechnologies, including biobanks, human gene patents, stem cell research and human cloning. Increasingly, human dignity is used as a form of general condemnation and as blanket justification for regulatory restraint. However, this use of human dignity marks a significant departure from the traditional, human-rights informed view of human dignity that has dominated bioethics debates for decades. In addition, on its own, it stands as dubious justification for policies that are aimed at constraining controversial biotechnologies.

Tencalla F. (Monsanto Europe S.A., Avenue de Tervuren 270-272, B-1150 Brussels, Belgium). Science, politics, and the GM debate in Europe. Regul Toxicol Pharmacol. (2005) Sep 24; [Epub ahead of print].

Europe today stands at a crossroad, facing challenges but also opportunities. In its intent to make Europe a leading technology-based economy by 2010, the European Commission has identified biotechnology and genomics as fields for future growth, crucial for supporting the agricultural

and food processing industry. Since first commercialization in 1996, GM crop areas have grown at double-digit rates, making this one of the most rapidly adopted technologies in agriculture. However, in contrast to other world areas and despite European Commission support, Europe has found itself 'bogged-down' in a polemic between opponents and supporters of plant biotechnology. As a result, planted areas have remained small. This stalemate is due to a lack of political leadership, especially at the Member State level, all the more surprising in light of European early development and competitive advantage with crop biotechnology. This situation proves once again that, for cutting-edge innovations, a solid science base alone is not sufficient. Acceptance or rejection of new technologies depends on interlinked political, economic, and societal factors that create a favorable or unfavorable situation at a given time. This article will look at GM crops in Europe and the role science and politics have played in the introduction of crop biotechnology.

Schmidt J, Vickery CE, Cotugna NA, Snider OS. (Maryland Agricultural Education Foundation, Sudlersville, MD 21668, USA. jenhans@dmv.com). Health professionals hold positive attitudes toward biotechnology and genetically engineered foods. J Environ Health., 67(10)(2005):44-9.

Few biotechnology processes have elicited the degree of controversy that genetic manipulation of food through recombinant DNA technology has. Research has shown that consumers turn to health professionals for answers to questions regarding health and nutrition. This study sought to assess the knowledge, attitudes, and beliefs of physicians (MDs/DOs), nurse practitioners (NPs), and registered dietitians (RDs) toward food biotechnology and genetic engineering (GE). Six hundred three-part, self-administered surveys were sent to health professionals holding active professional licenses. Statistical analysis included analysis of variance with Tukey's HSD and Scheffe's post hoc tests. Attitudes toward GE were positive. MDs held more positive attitudes than NPs or RDs ($p = .000$). MDs and NPs supported the use of GE to improve plant resistance to pests; RDs tended to support nutritional-improvement technology. All groups supported the use of GE to produce human medicines and the current Food and Drug Administration (FDA) labeling policy. No profession was more knowledgeable than another. Biotechnology holds the potential to positively affect human health. All health professionals can facilitate or diminish this process through their understanding of the technology and their ability to communicate effectively about the science and issues associated with biotechnology.

Foley PL, Hill RE Jr. (USDA, Animal and Plant Health Inspection Service, Veterinary Services, Center for Veterinary Biologics, 510 S. 17th Street, Suite 104, Ames, IA 50010, USA). Regulatory considerations for marker vaccines and diagnostic tests in the U.S. Biologicals., 33(4)(2005): 253-6.

Marker vaccines and diagnostic tests can prove to be invaluable in disease eradication and control programs, as was found in the pseudorabies (Aujeszky's Disease) virus eradication program in the U.S. During that campaign, numerous gene-deleted vaccines and companion diagnostic test kits were used to differentiate infected animals from vaccinated animals, in a strategy that ultimately led to eradication of the disease in commercial swine herds. The United States Department of Agriculture played a key role in delivery of that success by developing biologics policy, evaluating each product, and ensuring that the conditions of licensure were met. What was most critical in the overall eradication effort, however, was the detailed and dedicated interaction among key players: the biologics regulators, manufacturers, Federal, State, and local regulatory partners, veterinary researchers, industry associations, and animal owners. A good

disease control program has to include all of these. The regulatory requirements for licensure of marker vaccines and diagnostic test kits are not different from that for other products. There are several mechanisms for vaccine approval, some more rapid than others, but only a few that could apply to these products. Generally, the platforms that might support marker vaccines and companion diagnostic kits are those based on genetic engineering or protein manipulation. If the product is derived from the application of biotechnology, then additional regulatory considerations are applicable. Most important of these are the considerations found in the National Environmental Policy Act (NEPA), wherein deliberate release of any organism containing recombinant DNA into the environment is subject to review and approval by appropriate federal agencies. Environmental release and NEPA compliance are discussed.

Fisher M, Small B, Roth H, Mallon M, Jerebine B. What do individuals in different science groups within a life sciences organization think about genetic modification? Public Underst Sci., 14(3)(2005): 317-26.

An assessment was undertaken of the attitudes of individuals within the science community towards a program to produce genetically modified cattle for altered milk composition, expectantly allowing for research into the treatment of multiple sclerosis in humans. The majority of respondents to an electronic survey expressed favorable attitudes to the program, thought it beneficial, respected individual freedom and was fair and just and disagreed that it was harmful. A passion for science and having a suitable lifestyle were the most important motivating factors for individuals. Finally, there were a wide range of responses to a number of cultural beliefs or myths. Science grouping significantly affected the responses. Compared with Systems and Land groups, Plant and Reproduction groups more strongly agreed with the project, thought it less harmful to interest groups, felt that genetic modification of animals was more morally acceptable, and more strongly agreed with the myth statements. These results indicate a diversity of beliefs and attitudes towards genetic modification amongst those within the science community, and highlight the importance of understanding ethics and myths in dealing with them. It is suggested that the diversity of beliefs could be better used to help shape public policy and understanding of biotechnology.

Bickford J, Mather C, Fleising U. Time and the structuring of ritual performance in the xenotransplantation debate. Public Underst Sci., 14(3)(2005): 235-47.

Advancements in biotechnology provoke fundamental questions about the relationship of humans to the natural world. A crisis arises as the knowledge, practice, and policies concerning biotechnology grow further out of step with each other. This paper examines the role of ritual performance as a means of resolving this crisis, uniting the organic with the socio-moral aspects of science, technology and regulatory policy. Ritual performance is evident in the public discussions of the United States' Secretary's Advisory Committee on Xenotransplantation (SACX). In an attempt to understand the cultural responses to new knowledge, this paper examines the transcripts of several SACX meetings for its ritual elements and references to authority. We find that time is used by scientists to structure ritual performance in a way that guides public policy and attitudes toward xenotransplantation.

Verstraete W, Morgan-Sagastume F, Aiyuk S, Waweru M, Rabaey K, Lissens G. (Laboratory for Microbial Ecology and Technology, Ghent University, Coupure Links 653, 9000 Ghent, Belgium). Anaerobic digestion as a core technology in sustainable management of organic matter. Water Sci Technol., 52(1-2)(2005): 59-66.

In the past decades, anaerobic digestion (AD) has steadily gained importance. However, the technology is not regarded as a top priority in science policy and in industrial development at present. In order for AD to further develop, it is crucial that AD profits from the current fuel issues emerging in the international arena. AD can provide low-cost treatment of sewage and solid domestic wastes, which represents a vast application potential that should be promoted in the developing world. Furthermore, the developments in the last decades in the domain of anaerobic microbiology and technology have generated some interesting niches for the application of AD, such as anaerobic nitrogen removal and the treatment of chlorinated organics. Recently, AD has also generated some serendipities, such as the use of AD in processes for sulphur and calcium removal and the coupling of AD with microbial fuel cells. The international developments in terms of bio-refineries and CO2-emission abatement are of crucial importance with respect to the impetus that AD will receive in the coming decade. There should be little doubt that by placing the focus of AD on the production of green energy and clean nutrients, the future of AD will be assured.

Sun A, Perkins T. (Perseus-Soros Biopharmaceutical Fund, 888 7th Avenue, Floor 30, New York, New York 10105, USA. anthony_sun@psbiofund.com). Outlook: directed development: catalysing a global biotech industry. Nat Rev Drug Discov., 4(9)(2005):719-25.

Governments are increasingly relying on directed development tools or proactive public-policy approaches to stimulate scientific and economic development for their biotechnology industries. This article will discuss the four main tools of directed development in biotechnology and the lessons learned from current global efforts utilizing these tools.

The Indian Genome Variation Consortium. The Indian Genome Variation database (IGVdb): a project overview. Hum Genet., 118(1)(2005):1-11.

Indian population, comprising of more than a billion people, consists of 4693 communities with several thousands of endogamous groups, 325 functioning languages and 25 scripts. To address the questions related to ethnic diversity, migrations, founder populations, predisposition to complex disorders or pharmacogenomics, one needs to understand the diversity and relatedness at the genetic level in such a diverse population. In this backdrop, six constituent laboratories of the Council of Scientific and Industrial Research (CSIR), with funding from the Government of India, initiated a network program on predictive medicine using repeats and single nucleotide polymorphisms. The Indian Genome Variation (IGV) consortium aims to provide data on validated SNPs and repeats, both novel and reported, along with gene duplications, in over a thousand genes, in 15,000 individuals drawn from Indian subpopulations. These genes have been selected on the basis of their relevance as functional and positional candidates in many common diseases including genes relevant to pharmacogenomics. This is the first large-scale comprehensive study of the structure of the Indian population with wide-reaching implications. A comprehensive platform for Indian Genome Variation (IGV) data management, analysis and creation of IGVdb portal has also been developed. The samples are being collected following ethical guidelines of Indian Council of Medical Research (ICMR) and Department of Biotechnology (DBT), India. This paper reveals the structure of the IGV project highlighting its various aspects like genesis, objectives, strategies for selection of genes, identification of the Indian subpopulations, collection of samples and discovery and validation of genetic markers, data analysis and monitoring as well as the project's data release policy.

Anwar WA. (Environmental and Occupational Medicine, Director of Ain Shams Center for Genetic Engineering and Biotechnology (ACGEB), Ain Shams University, Cairo, Egypt). Possibilities and pitfalls for modern biotechnology in the development of African genetic toxicology. Toxicol Appl Pharmacol., 207(2 Suppl)(2005):706-11.

Developing countries are currently going through a transitional phase facing the new challenges of globalization and its potential negative impact. Research policy should highlight the need to mobilize resources for human resource development, networking, improved research culture, information sharing, and pragmatic use of research findings. Advancement in molecular genetics whether at the educational or research level should greatly progress in developing countries so as to improve diagnosis, treatment, understanding of disease risk factors, and prevention. Currently, there is a growing interest to genetic toxicology research, the use of different biomarkers, and genetic susceptibility testing, which can contribute effectively in risk assessment. Africa has unique environmental exposures and public health circumstances, which make it ideal for environmental mutagenicity and carcinogenicity research. There are exposures to chemical genotoxicants (e.g., automobile exhaust, pesticides, metals, and cytotoxic drugs) and to lifestyle factors (e.g., consumption of tobacco products) that have been linked to the expression of biological effects and to increased risk for cancer. Infections can be associated with cancer development when the environmental factors interact with the infection and lead to the enhancement of the carcinogenic process. The high prevalence of viral pathogens and the improper use of pesticides may endanger biological functions beyond those for which they originally manufactured. Biomarkers are used to detect the effects of pesticides before adverse clinical health occurs. The scientific community plays a crucial role in understanding the environmental causes of human health problems and through its collaboration with communities, industries, and government agencies can help in resolving health problems.

Mabee WE, Gregg DJ, Saddler JN. (Forest Products Biotechnology, University of British Columbia, 4043-2424 Main Mall, Vancouver, British Columbia, Canada V6T 1Z4. warren.mabee@ubc.ca). Assessing the emerging biorefinery sector in Canada. Appl Biochem Biotechnol. (2005) Spring;121-124:765-78.

The biorefinery is a key concept used in the strategies and visions of many industrial countries. The potential for Canadian biorefineries based on lignocellulosic forest and agricultural residues is examined. The sector is described in terms of research interests, emerging companies, and established corporate interests. It is found that the Canadian biorefining sector currently has an emphasis on specific bioproduct generation, and the process elements required for a true sugar-based process are in the research phase. A Canadian national strategy should focus on increasing forest industry participation, and increasing collaboration with the provinces, particularly in western Canada.

Kitzinger J, Williams C. (Cardiff School of Journalism, Media and Cultural Studies, Cardiff University, King Edward VII Avenue, Cardiff, CF10 3NB Wales, UK. kitzinger@cardiff.ac.uk) Forecasting science futures: legitimising hope and calming fears in the embryo stem cell debate. Soc Sci Med., 61(3)(2005):731-40.

Controversies about biotechnologies often centre not so much on present scientific facts as on speculations about risks and benefits in the future. It is this key futuristic element in these arguments that is the focus of this article. We examine how competing visions of utopia or dystopia are defended through the use of diverse vocabularies, metaphors, associations and

appeals to authority. Our case study explores how these rhetorical processes play out in the debate about embryo stem cell research in UK national press and TV news media. The findings show how predictions from those in favour of embryo stem cell research are supported by both hype and by anti-hype, by inconsistent appeals to the technologies' innovative status and by the selective deconstruction of concepts such as 'potential' and 'hope'. The debate also mobilises binary oppositions around reason versus emotion, science versus religion and fact versus fiction. This article highlights how traditional assertions of expertise are now combined with ideas about compassion and respect for democracy and diversity. It also highlights the fact that although news reporters are often responding to topical events the real focus is often on years, even decades ahead. Close attention to how images of the future are constructed, and the evolution of new strategies for legitimation are, we suggest, important areas of on-going research, particularly in discussions of scientific and medical developments and policy.

Agricultural Biotechnology

Edelmann W, Baier U, Engeli H. (GmbH, Lattichstrasse 8, CH-6340 Baar, Switzerland. arbi@biogas.ch). Environmental aspects of the anaerobic digestion of the organic fraction of municipal solid wastes and of solid agricultural wastes. Water Sci Technol., 52(1-2)(2005):203-8.

In order to obtain more detailed information for better decision making in future biogenic waste treatment, different processes to treat biogenic wastes in plants with a treatment capacity of 10,000 tons of organic household wastes per year as well as agricultural codigestion plants were compared by life cycle assessments (LCA). With the tool EcoIndicator, anaerobic digestion is shown to be advantageous as compared to composting, incineration or a combination of digestion and composting, mainly because of a better energy balance. The management of the liquid manure in agricultural codigestion of organic solid wastes causes increased gaseous emissions, which have negative effects on the LCA, however. It is recommended to cover the slurry pit and to use an improved manure management in order to compensate for the additional gaseous emissions. In the LCAs, the quality of the digester output could only be taken into account to a small extent; the reasons are discussed.

Nogales R, Cifuentes C, Benitez E. (Estacion Experimental del Zaidin, CSIC, Granada, Spain. rnogale@eez.csic.es) Vermicomposting of winery wastes: a laboratory study. J Environ Sci Health B., 40(4)(2005):659-73.

In Mediterranean countries, millions of tons of wastes from viticulture and winery industries are produced every year. This study describes the ability of the earthworm Eisenia andrei to compost different winery wastes (spent grape marc, vinasse biosolids, lees cakes, and vine shoots) into valuable agricultural products. The evolution of earthworm biomass and enzyme activities was tracked for 16 weeks of vermicomposting, on a laboratory scale. Increases in earthworm biomass for all winery wastes proved lower than in manure. Changes in hydrolytic enzymes and overall microbial activities during the vermicomposting process indicated the biodegradation of the winery wastes. Vermicomposting improved the agronomic value of the winery wastes by reducing the C:N ratio, conductivity and phytotoxicity, while increasing the humic materials, nutrient contents, and pH in all cases. Thus, winery wastes show potential as raw substrates in

vermicomposting, although further research is needed to evaluate the feasibility of such wastes in large-scale vermicomposting systems.

Weil JH. (Institut de Biologie Moleculaire des Plantes, Strasbourg, France. Jacques-Henry.Weil@ibmp-ulp.u-strasbg.fr). Are genetically modified plants useful and safe? IUBMB Life., 57(4-5)(2005):311-4.

So far, plants have been genetically modified essentially to achieve resistance to herbicides, or to pathogens (mainly insects, or viruses), but resistance to abiotic stresses (such as cold, heat, drought, or salt) is also being studied. Genetically modified (GM) plants with improved nutritional qualities have more recently been developed, such as plants containing higher proportions of unsaturated fatty acids (omega-3 and omega-6) in their oil (to prevent cardio-vascular diseases), or containing beta-carotene as in the golden rice (to prevent vitamin A deficiency). Possible risks for human health (such as the production of allergenic proteins), or for the environment (such as the appearance of superweeds as a result from gene flow), should be carefully studied, and a science-based assessment of benefits vs. risks should be made on a case by case basis, both for GM plants and for plants obtained by conventional breeding methods.

Park S, Kang TS, Kim CK, Han JS, Kim S, Smith RH, Pike LM, Hirschi KD. (Vegetable and Fruit Improvement Center, Texas A&M University, College Station, Texas 77845, USA). Genetic manipulation for enhancing calcium content in potato tuber. J Agric Food Chem., Jul 13; 53(14)(2005):5598-603.

Increased calcium (Ca) in potatoes may increase the production rate by enhancing tuber quality and storability. Additionally, increased Ca levels in important agricultural crops may help ameliorate the incidence of osteoporosis. However, the capacity to alter Ca levels in potato tubers through genetic manipulations has not been previously addressed. Here we demonstrate that potato tubers expressing the Arabidopsis H+/Ca2+ transporter sCAX1 (N-terminal autoinhibitory domain truncated version of CAtion eXchanger 1) contain up to 3-fold more Ca than wild-type tubers. The increased Ca appears to be distributed throughout the tuber. The sCAX1-expressing potatoes have normally undergone the tuber/plant/tuber cycle for three generations; the trait appeared stable through successive generations. The expression of sCAX1 does not appear to alter potato growth and development. Furthermore, increased Ca levels in sCAX1-expressing tubers do not appear to alter tuber morphology or yield. Given the preponderance of potato consumption worldwide, these transgenic plants may be a means of marginally increasing Ca intake levels in the population. To our knowledge, this study represents the first attempts to use biotechnology to increase the Ca content of potatoes.

Schmidt J, Vickery CE, Cotugna NA, Snider OS. (Maryland Agricultural Education Foundation, Sudlersville, MD 21668, USA. jenhans@dmv.com). Health professionals hold positive attitudes toward biotechnology and genetically engineered foods. J Environ Health. 67(10)(2005): 44-9.

Few biotechnology processes have elicited the degree of controversy that genetic manipulation of food through recombinant DNA technology has. Research has shown that consumers turn to health professionals for answers to questions regarding health and nutrition. This study sought to assess the knowledge, attitudes, and beliefs of physicians (MDs/DOs), nurse practitioners (NPs), and registered dietitians (RDs) toward food biotechnology and genetic engineering (GE). Six hundred three-part, self-administered surveys were sent to health professionals holding active

professional licenses. Statistical analysis included analysis of variance with Tukey's HSD and Scheffe's post hoc tests. Attitudes toward GE were positive. MDs held more positive attitudes than NPs or RDs ($p = .000$). MDs and NPs supported the use of GE to improve plant resistance to pests; RDs tended to support nutritional-improvement technology. All groups supported the use of GE to produce human medicines and the current Food and Drug Administration (FDA) labeling policy. No profession was more knowledgeable than another. Biotechnology holds the potential to positively affect human health. All health professionals can facilitate or diminish this process through their understanding of the technology and their ability to communicate effectively about the science and issues associated with biotechnology.

Lilley AK, Bailey MJ, Cartwright C, Turner SL, Hirsch PR. (Centre for Ecology and Hydrology, Oxford, Mansfield Road, Oxford, UK, OX1 3SR). Life in earth: the impact of GM plants on soil ecology? Trends Biotechnol. (2005) Nov 21; [Epub ahead of print]

The impact of changes incurred by agricultural biotechnology has led to concern regarding soil ecosystems and, rightly or wrongly, this has focused on the introduction of genetically modified (GM) crops. Soils are key resources, with essential roles in supporting ecosystems and maintaining environmental quality and productivity. The complexity of soils presents difficulties to their inclusion in the risk assessment process conducted for all GM plants. However, a combined approach, informed by both soil ecology and soil quality perspectives, that considers the impacts of GM crops in the context of conventional agricultural practices can provide a regulatory framework to ensure the protection of soils without being overly restrictive.

Haruta S, Nakayama T, Nakamura K, Hemmi H, Ishii M, Igarashi Y, Nishino T. (Department of Ecosystem Studies, Graduate School of Agricultural and Life Sciences, The University of Tokyo, 1-8 Yayoi-cho, Inage-ku, Chiba 263-0022, Japan). Microbial diversity in biodegradation and reutilization processes of garbage. J Biosci Bioeng. 99(1)(2005):1-11.

With particular focus on the microbial diversity in garbage treatment, the current status of garbage treatment in Japan and microbial ecological studies on various bioprocesses for garbage treatment are described in detail. The future direction of research in this field is also discussed.

Chung SM, Vaidya M, Tzfira T. (Department of Biochemistry and Cell Biology, State University of New York, Stony Brook, NY 11794, USA). Agrobacterium is not alone: gene transfer to plants by viruses and other bacteria. Trends Plant Sci. (2005) Nov 14; [Epub ahead of print]

Agrobacterium-mediated genetic transformation is the most widely used technology for obtaining the overexpression of recombinant proteins in plants. However, complex patent issues related to the use of Agrobacterium as a tool for plant genetic engineering and the general requirement of establishing transgenic plants can create obstacles in using this technology for speedy research and development and for agricultural improvements in many plant species. Recent studies addressing these issues have shown that virus-based vectors can be efficiently used for high transient expression of foreign proteins in transfected plants and that non-Agrobacterium bacterial species can be used for the production of transgenic plants, laying the foundation for alternative tools for future plant biotechnology.

Bioenergy

Corporan E, Reich R, Monroig O, DeWitt MJ, Larson V, Aulich T, Mann M, Seames W. (Air Force Research Laboratory-Fuels Branch, Wright-Patterson Air Force Base, OH 45433, USA. edwin.corporan@wpafb.af.mil). Impacts of biodiesel on pollutant emissions of a JP-8-fueled turbine engine. J Air Waste Manag Assoc. Vol. 55(7) (2005): 940-9.

The impacts of biodiesel on gaseous and particulate matter (PM) emissions of a JP-8-fueled T63 engine were investigated. Jet fuel was blended with the soybean oil-derived methyl ester biofuel at various concentrations and combusted in the turbine engine. The engine was operated at three power settings, namely ground idle, cruise, and takeoff power, to study the impact of the biodiesel at significantly different pressure and temperature conditions. Particulate emissions were characterized by measuring the particle number density (PND; particulate concentration), the particle size distribution, and the total particulate mass. PM samples were collected for offline analysis to obtain information about the effect of the biodiesel on the polycyclic aromatic hydrocarbon (PAH) content. In addition, temperature-programmed oxidation was performed on the collected soot samples to obtain information about the carbonaceous content (elemental or organic). Major and minor gaseous emissions were quantified using a total hydrocarbon analyzer, an oxygen analyzer, and a Fourier Transform IR analyzer. Test results showed the potential of biodiesel to reduce soot emissions in the jet-fueled turbine engine without negatively impacting the engine performance. These reductions, however, were observed only at the higher power settings with relatively high concentrations of biodiesel. Specifically, reductions of approximately 15% in the PND were observed at cruise and takeoff conditions with 20% biodiesel in the jet fuel. At the idle condition, slight increases in PND were observed; however, evidence shows this increase to be the result of condensed uncombusted biodiesel. Most of the gaseous emissions were unaffected under all of the conditions. The biodiesel was observed to have minimal effect on the formation of polycyclic aromatic hydrocarbons during this study. In addition to the combustion results, discussion of the physical and chemical characteristics of the blended fuels obtained using standard American Society for Testing and Materials (ASTM) fuel specifications methods are presented.

Dewulf J, Van Langenhove H, Van De Velde B. (Research Group Environmental Chemistry and Technology (ENVOC), Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, B-9000 Ghent, Belgium. jo.dewulf@ugent.be). Energy-based efficiency and renewability assessment of biofuel production. Environ Sci Technol. Vol. 39(10)(2005): 3878-82.

This study presents an efficiency and renewability analysis of the production of three biofuels: rapeseed methyl ester (RME), soybean methyl ester (SME) and corn-based ethanol (EtOH). The overall production chains have been taken into account: not only the agricultural crop production and the industrial conversion into biofuel, but also production of the supply of agricultural resources (pesticides, fertilizers, fuel, seeding material) and industrial resources (energy and chemicals) to transform the crops into biofuel. Simultaneously, byproducts of the agricultural and industrial processes have been taken into account when resources have to be allocated to the biofuels. The technical analysis via the second law of thermodynamics revealed that corn-based EtOH results in the highest production rate with an exergetic fuel content of 68.8 GJ ha(-1) yr(-1), whereas the RME and SME results were limited to 47.5 and 16.4 GJ ha(-1) yr(-1). The allocated nonrenewable resource input to deliver these biofuels is significant: 16.5, 15.4, and 5.6

MJ ha(-1) yr(-1). This means that these biofuels, generally considered as renewable resources, embed a nonrenewable fraction of one-quarter for EtOH and even one-third for RME and SME. This type of analysis provides scientifically sound quantitative information that is necessarywith respect to the sustainability analysis of so-called renewable energy.

Liu Y, Wang M, Zhao F, Liu B, Dong S. (State Key Laboratory of Electroanalytical Chemistry, Changchun Institute of Applied Chemistry, Changchun Jilin, 130022, Graduate School of the Chinese Academy of Sciences, Beijing 100039, China). A low-cost biofuel cell with pH-dependent power output based on porous carbon as matrix. Chemistry. Vol. 11(17)(2005):4970-4.

A glucose/O(2) biofuel cell (BFC) possessing a pH-dependent power output was fabricated by taking porous carbon (PC) as the matrix to load glucose oxidase or fungi laccase as the catalysts. The electrolytes in the anode and cathode compartments contain ferrocene monocarboxylic acid and 2,2'-azino-bis-(3-ethylbenzthiazoline-6-sulfonic acid) diammonium salt as the mediators, respectively. The power of the BFC was enhanced significantly by using PC as the matrix, rather than glassy carbon electrode. Additionally, the power output of the BFC decreases as the pH of the solution increases from 4.0 to 7.0, which provides a simple and efficient method to achieve the required power output. More importantly, the BFC can operate at pH 6.0, and even at pH 7.0, which overcomes the requirement for cathode solutions of pH<5.0 when using fungi laccase as a catalyst. Operation of the BFC at neutral pH may provide a means to power medical devices implanted in physiological systems. The facile and low-cost fabrication of this BFC may enable its development for other applications.

Rabaey K, Boon N, Hofte M, Verstraete W. (Laboratory of Microbial Ecology and Technology, Ghent University, Coupure Links 653, B-9000 Ghent, Belgium). Microbial phenazine production enhances electron transfer in biofuel cells. Environ Sci Technol. May 1;39(9)(2005):3401-8.Environ., Comment in: Sci Technol. Vol. 39(9)(2005):191A-192A.

High-rate electron transfer toward an anode in microbial fuel cells (MFCs) has thus far not been described for bacteria-producing soluble redox mediators. To studythe mechanism of electron transfer, we used a MFC isolate, Pseudomonas aeruginosa strain KRP1. Bacterial electron transfer toward the MFC anode was enabled through pyocyanin and phenazine-1-carboxamide. The presence of the anode stimulated pyocyanin production. Mutant strains, deficient in the synthesis of pyocyanin and phenazine-1-carboxamide, were unable to achieve substantial electron transfer and reached only 5% of the wild type's power output. Upon pyocyanin addition, the power output was restored to 50%. Pyocyanin was not only used by P. aeruginosa to improve electron transfer but as well enhanced electron transfer by other bacterial species. The finding that one bacterium can produce electron shuttles, which can be used also by other bacteria, to enhance electron-transfer rate and growth, has not been shown before. These findings have considerable implications with respect to the power output attainable

Ramanavicius A, Kausaite A, Ramanaviciene A. (Department of Analytical and Environmental Chemistry, Vilnius University, Naugarduko 24, 03225 Vilnius 6, Lithuania. arunas@imi.lt). Biofuel cell based on direct bioelectrocatalysis. Biosens Bioelectron. 20(10)(2005):1962-7.

A biofuel cell, consisting of two 3mm diameter carbon rod electrodes and operating at ambient temperature in aqueous solution, pH 6, is described. Biofuel cell based on enzymes able to exchange directly electrons with carbon electrodes was constructed and characterized. Anode of the biofuel cell was based on immobilized Quino-hemoprotein alcohol dehydrogenase from Gluconobacter sp. 33 (QH-ADH), cathode on co-immobilized glucose oxidase from Aspergilus niger (GO(x)) and microperoxidase 8 from the horse heart (MP-8) acting in the consecutive mode. Two enzymes GO(x) and MP-8 applied in the design of biofuel cell cathode were acting in consecutive mode and by hydrogen peroxide oxidized MP-8 was directly accepting electrons from carbon rod electrode. If ethanol was applied as an energy source the maximal open circuit potential of the biofuel cell was -125 mV. If glucose was applied as energy source the open circuit potential of the cell was +145 mV. The maximal open circuit potential (270 mV) was achieved in the presence of extent concentration (over 2 mM) of both substrates (ethanol and glucose). Operational half-life period (tau(1/2)) of the biofuel cell was found to be 2.5 days.

Monique Hoogwijk[a,b,*], Andre Faaij[a], Bas Eickhout[b], Bert de Varies[b], Wim Turkenburg[a]. ([a]Department of Science, Technology and Society, Copernicus Institute, Utrecht University, Heidelberglaan 23584 CS Utrecht, the Netherlands, [b]Netherlands Environmental Assessment Agency (MNP), Bilthoven, The Netherlands). Potential of biomass energy out to 2100, for four IPCC SRES land-use scenarios. Biomass and Bioenergy 29(2005): 225-257.

The availability of the resources is an important factor for high shares of biomass to penetrate the electricity, heat or liquid fuel markets. We have analysed the grographical and technical potential of energy crops for the years 2050-2100 for three land-use categories: abandoned agricultural land, low-productivity land and 'rest land', i.e. remaining noproductive land. We envisaged development paths using four scenarios resulting from different future land-use patterns that were developed by the Inter governmental Panel on Climate Change in its Special Report on Emission Scenarios: A1, S2, B1 and B2. The geographical potential is defined as the product of the available area for energy crops and the corresponding productivity level for energy crops. The grographical potential of abandoned agricultural land is the largest contributor. For the year 2050 the grographical potential of abandoned land ranges from about 130 to 410 Ej yr^{-1}. for the year 2100 it ranges from 240 to 850 EJ yr^{-1}. the potential of low-productive land is negligible compared to the other categories. The rest land area is assumed to be partly available, resulting in ranges of the geographical potential from about 35 to 245 Ej yr^{-1} for the year 2050 and from about 35 to 265 Ej yr^{-1} in 2100. at a regional level, significant potentials are found in the Former USSR, East Asia and South America. The grographical potential can be converted to transportation fuels or electricity resulting in ranges of the technical potential for fuels in the year 2050 and 2100 equal to several times the present oil consumption.

Semida Silveira*. (Sustainable Vision, Global Ventures AB, Patron Haraldsvag 8, 18131 Lidingo, SE-Sweden). Promoting bioenergy through the clean development mechanism. Biomass and Bioernery, 28 (2005): 107-117.

This paper explores the potential of the Clean Development Mechanism (CDM) of the Kyoto Protocol to promote modern bioenergy options in developing countries. The starting point is that developing countries need to be given a major role in the implementation of the Convention on Climate Change because of their increasing energy demands and the pressing need to mitigate climate change. The role of CDM is discussed in the context of sustainable development, formation of carbon markets, and promotion of bioenergy options. Besides contributing to

migigate climate change, CDM can be used to demonstrate and disseminate new technologies, reduce investment risks and enhance the cost efficiency of projects, while also creating jobs and improving environmental conditions. In this context, bioenergy projects are attractive and CDM provides a complementary bridge for international cooperation towards sustainable development. However, since CDM is project-based, a broader policy framework is needed to integrate such projects in regional and global bioenergy systems solutions.

Edgard Gnansounou[1,*] and Arnaud Dauriat[2]. ([1]Laboratory of Energy Systems (LASEN), ICARE-ENAC, Swiss Federal Institute of Technology of Lausanne (EPFL), [2]ENERS Energy Concept). Ethanol fuel from biomass: A review. Journal of Scientific & Industrial Research, Vol. 64, (2005): 809-821.

This paper presents a general review of biomass-to-ethanol, analysis of conversion pathways from technical, economic and environmental points of view, and estimation of production cost in the Indian context. Due to learning curve and other economic reasons, Brazil and the United States are found to be more competitive worldwide and will maintain their comparative advantage in the next decade. However, the fast growth of the world demand of bio-ethanol fuel and give windows for a wide scale production in other regions such as Europe and Asia. As one of the major producers and consumers of sugars and the second populous country, India gives a high priority to food production. However, Indian production of bio-ethanol can be envisaged successfully and preliminary analyses exhibit a promising avenue. In long term, lignocellulose-to-ethanol is the most viable pathway from environmental point of view. However, its production cost must be reduced for giving this process a chance to drive forward the strategy of biomsss-to-ethanol worldwide.

Padma Vasudevan*, Satyawati Sharma and Ashwani Kumar. (Centre for Rural Development & Technology, Indian Institute of Technology, Hauz Khas, New Delhi 110 016). Liquid fuel from biomssss: An overview. Journal of Scientific & Industrial Research, Vol. 64, (2005)P 822-831.

With depleting oil resources and negative environmental impacts associated with the use of petro fuels, there is a renewed interest in biomsss based fuels, which can still form the base for sustainable development in terms of techno-economics, environmental as well as socio-cultural considerations. As it is locally available resource energy equity can also be achieved at global levels and developing countries would stand to gain. However, to exploit the potential of biomass, more work is needed for converting it efficiently into modern energy carriers at competitive prices, supported by relevant policies. Currently, bioethanol and biodiesel have already reached commercial markets, especially as blends with petro fuels. This paper gives an overview on liquid biofuels covering the current and futuristic trends with respect to production and utilization of alcohols, vegetable oil based biodiesel and biocrude, emphasizing on the benefits to rural economy.

Rajeev K Sukumaran, Reeta Rani Singhania and Ashok Pandey*. (Biotechnology Division, Regional Research Laboratory, Industrial Estate PO, Trivandrum 695 019). Microbial cellulases-Production, applications and challenges. Journal of Sentific & industrial Research, Vol. 64, (2005): 832-844.

Microbial cellulases find applications in various industries and constitute a major group of the industrial enzymes. Recently, there is resurgence in utilization of biomass for fuel production

employing cellulases and hence forth in obtaining better yields and novel activities. Improving the economics of such processes will involve cost reduction in cellulase production which may be achieved by better bioprocesses and genetic improvement of cellulase producers to yield more of the enzyme. The review discusses the current knowledge on cellulase production by microorganisms and the genetic controls exercised on it. It discusses the industrial applications of cellulases and the challenges in cellulase research especially in the direction of improving the process economics of enzyme production.

V.Senthikumar and P.Gunasekaran*. (Department of Genetics, Centre for Excellence in Genomic Sciences, School of Biological Sciences, Maduraj Kamaraj University, Madurai 625 021).Bioethanol production from cellulosic substrates: Engineered bacteria and process integration challenges. Journal of Scientific & Industrial Research, Vol. 64 (2005) 845-853.

Cellulosic biomass from agricultural and forestry residues, waste paper ands industrial wastes could be used as an ideal and inexpensive source of sugar for sustainable fermentation into transportation fuel. As such, ethanol producing microorganisms, mainly *Zymomonas mobilis* and *Saccharomyces cerevisiae* are potential candidates for ethanol production. However, the substrates are not cost effective, as the organisms are not able to hydeolyze complex sugars such as lignocellulose. Since last two decades, several microorganisms are manipulated for production of ethanol. Gram-negative bacteria such as *escherichia coli, Klebsiella oxytoca, Z. mobilis*, Gram-positive bacteria such as *Clostridium Cellulolyticum, Lactobacillus casei* and several yeast strains have been engineered for bioethanol production from cellulosic substrates. These engineered organisms are able to produce ethanol from a wide spectrum of sugars. This review is focused on the strategies and development of processes for ethanol production by such organisms from lignocellulosic substrates.

M.A.Hanna[1], Loren Isom[1] and John Campbell[2]. ([1]University of Nebraska, Industrial Agricultural Products Centre, 209 LW Chase hall, Lincoln, NE 68583-0730, [2]Ag Processing Inc. (AGP), 12700 West Dodge Road,, Omaha, NE 68154, USA). Biodiesel: Current perspectives and future. Journal of Scientific & Industrial Research, Vol. 64, (2005): 854-857.

Biodiesel, a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fat (or mixtures thereof), is produced by transesterification with glycerol being produced as a co-product. Worldwide, I billion ton of diesel fuel are consumed annually. The total feedstocks available for biodiesel production are 115 million tons. This represents less than 12% of diesel fuel use. The opportunities for the future for biodiesel include improvements in the conversion technology, which appears promising, and expanding the amount of available feedstock through various plans to increase oil yields or oilseed production.

Ayhan Demirbas*. (Department of Chemical Engineering, Selcuk University, Campus, Konya, Turkey). Biodiesel production from vegetable oils by supercritical methanol. Journal of Scientific & Industrial Research, Vol. 64, (2005): 858-865.

Transesterification of vegetable oils in supercritical metahanol are carried out without using any catalyst. Methyl esters of vegetable oils or biodiesels have several outstanding advantages among other new-renewable and clean engine fuel alternatives and can be used in any diesel engine without modification. The most important variables affecting the methyl ester yield during the

transesterification reaction are molar ratio of alcohol to vegetable oil and reaction temperature. Compared to no. 2Diesel fuel, all vegetable oils are more viscous, while the methyl esters of vegetable oils are slightly more viscous. Biodiesel has become more attractive because of its environmental benefits. The cost of biodiesel, however, is the main obstacle to commercialization. With cooking oils as raw material, viability of a continuous transesterification process and recovery of high quality glycerol as a biodiesel by-product are primary options to be considered to lower the cost of biodiesel. Supercritical methanol has a high potential for both transesterification of triglycerides and methyl esterification of free fatty acids to methyl esters for diesel fuel substitute. In supercritical methanol transesterification method, yield of conversion rises 95% in 10 min. viscosity of vegetable oils (27.2-53.6 mm^2/s) get reduced in vegetable oil methyl esters (3.59-4.63 mm^2/s). the flash point values of vegetable oil methyl esters are highly lower than those of vegetable oils. An increase in density from 860 to 885 kg/m^3 for vegetable oil methyl esters increases the viscosity from 3.59 to 4.63 mm^2/s.

Yi-Hsu Ju* and Shaik Ramjan Vali. (Department of Chemical Engineering. National Taiwan University of Science and Technology, 43, Sec 4, Keelung Rod, Taipei 106-07). Rice bran oil as a potential resource for biodiesel: a review. Journal of Scientific & Industrial Research, Vol. 64, (2005): 866-882.

Biodiesel (BD) is receiving increased attention as an alternative, non-toxic, biodegradable, and renewable diesel fuel. Exploring new energy resources, such as BD fuel, is of growing importance in recent years. The main concern with BD fuel is its high price. One of the future aims in BD research is on the selection of inexpensive feedstock with high value-added byproducts. Rice bran is a by-product of rice milling that contains 15-23% lipids and a significant amount of nutraceutical compounds. Due to the presence of active lipase in the bran and the lack of economical stabilization methods, most bran is used as livestock feed or boiler fuel and most rice bran oil (RBO) produced is not of edible grade. Thus RBO is relatively an production of proteins, carbohydrates, phytochemical, and the isolation and purification of value added nutraceutical generated during BD production from RBNO are attractive options to lower the cost of BD. Production of BD from RBO can be carried out either via *in situ* esterification, lipase-catalyzed esterification, acid-catalyzed or base-catalyzed reactions. A single step reaction for the conversion of RBO with high free fatty acid content into BD, via acid-catalyzed, base-catalyzed or lipase-catalyzed, fails to attain high conversion in reasonably short time. Pretreatment of crude RBO such as dewaxing/degumming is a crucial step because of its efficient methanolysis. The fatty acid composition of dewaxed/degummed RBO is similar to that of other vegetable oils, which are used as BD feedstock. Various byproducts generated from the rice bran during the production of BD and their applications are also addressed.

Naveen Kumar* and P.B.Sharma. (Delhi College of Engineering, Bawana Road, Delhi 110 042). Jatropha curcus – A sustainable source for production of biodiesel. Journal of Scientific & Industrial Research, Vol. 64, (2005): 883-889.

Non-edible oils like Jatropha, Pongamia, Argemone, mahua, Castro, Sal etc., can be used for the production of biodiesel. *Jatropha curcus* has enormous potential for biodiesel production in India. *J. curcus* is a multipurpose plant with many attributes and considerable potential. It is a tropical plant that can be grown in low to high rainfall areas and can be used to reclaim and, as a hedge and/or as a commercial crop. Thus, rowing is could provide employment, improve the environment and enhance the quality of rural life.

Sukumar Puhan[1], N.Vedaraman[1,*], B.V.Rambrahamam[1] and G.nagarajan[2]. ([1]Chemical Engineering Division, Central Leather Research Institute, Chennai, [2]Department of Mechanical Engineering, Anna University, Chennai). Mahua (Madhuca indica) seed oil: A source of renewable energy in India. Journal of Scientific & Industrial Research, Vol. 64, (2005): 890-896.

Mahua oil methyl, ethyl and butyl esters were prepared and studied in a four stroke, direct injection diesel engine for their performance and emissions. The engine test results showed high thermal efficiency in case of methyl ester compared to all other esters and diesel fuel. Different emissions such as carbon monoxide (CO), oxides of nitrogen (NOx), hydrocarbons (HC) is low for alkyl esters compared to diesel. Among alkyl esters except NOx all tail pipe emissions are lower in case of methyl ester compared to other esters. The ethyl ester shows lower NOx emission compared to other esters. Based on this study, mahua oil methyl ester performs well compared to other esters on the basis of performance and emissions.

Carlos R.Soccol[1,*], Luciana P.S.Vandenberghe[1], Bill Costa[2], Adenise Lorenci Woiciechowski[1], Julio Cesar de Carvalho[1], Adriane B.P.Medeiros[1], Antonio Maria Francisco and Luiz Jose Bonomi[3]. ([1]Bioprocess Engineering and Biotechnology Division, Dept. of Chemical Engineering, UFPR, Federal University of Parana, PO Box 190011, CEP 81531-970 Curitiba – PR, - Brazil, [2]Brazilian Reference Centre on Biofuels – CERBIO, Parana Institute of Technology – TECPAR, [3]Instituto de Pesquisas Technologicas do Estado de Sao Paulo – IPT e Director de Combustiveis Automotivos e Biocombustiveis da Associacao Brasileira de Engenharia Automotiva). Brazilian Biofuel program: An overview. Journal of Scientific & Industrial Research, Vol. 64, (2005): 897-904.

Brazilian National Bio-Fuel Program comprises ProAlcool and Biodiesel; the former was initiated in 1975 to substitute gasoline for sugarcane alcohol in automobile use. ProAlcool passed through intensive changes due to fluctuant social-economics situation and public policies, which are fundamental to definitely install the use of biomass and make it competitive to face traditional fossil fuels. The production of flex fuel cars is bringing great promise for ProAlcool, not only for Brazilian market but also for rest of the world. In parallel, program of vegetable oils – OVEG, conceived in 1983, gave significant contribution to the automotive applications of vegetable oils (biodiesel) in vehicles. The fleet tested ran more than one million km at that time. The results demonstrated the technical feasibility of using vegetable oils in diesel engines.

Mats Galbe, Gunnar Liden and Guido Zacchi*. (Chemical Engineering, lund University, PO Box 124, S-221 00 Lund, Sweden). Production of ethanol from biomass – Research in Sweden. Journal of Scientific & Industrial Research, Vol. 64, (2005): 905-919.

Ethanol produced from various lignocellulosic materials such as wood, agricultural and forest residues has the potential to be a valuable substitute for, or complement to, gasoline. This paper reviews the research activities in Sweden on development of the technology for ethanol production from lignocellulosics. The paper focuses on hemicellulose and cellulose hydrolysis and fermentation as well as on process integration and techno-economic evaluation of the overall process.

M.A.Kalam* and H.H.Masjuki. (Department of Mechanical Engineering, University of Malaya, Kuala Lumpur 50603, Malaysia). Recent developments on biodiesel in Malaysia. Journal of Scientific & industrial Research, Vol. 64 (2005): 920-927.

This paper presents recent developments on biodiesel production from palm oil, its properties and engine test results to evaluate its performance on diesel engine. The potential of palm diesel to be commercially used depends on its price comparison with diesel fuel and its status of reservation. Increasing cost and pollution effects of fossil diesel fuel can be resolved through producing vegetable oil based fuels such as palm diesel. This paper discusses Malaysian palm diesel as well as global biodiesel status, standardization of biodiesel and their commercial price consideration and various engine test results on aspects of brake power, combustion, emissions, engine wear and lubrication performance.

Henry R.Bungay*. (H.P.Isermann Department of Chemical and Biological Engineering, Rensselaer Polytechnic Institute Troy, NY 12180-3590, USA). Biomass energy priority for developing nations. Journal of Scientific & Industrial Research, Vol. 64 (2005): 928-930.

All countries have unused biomass resources. Some are wastes with costs for disposal, but others are cultivated and collected. Because arable lands are not abnundant and vary greatly in fertility, access to water, harvesting cost, and transportation costs, the decisions about what biomass to collect and how to use it must be wide. It is naïve to view biomass as the panacea for the coming energy crisis because there is not enough in practical locations and the costs involved in retrieving and refining it will be relatively high. Major thrusts for commercialization of biomass refining are imminent, and fuel ethanol, despite its enormous potential, market may not be the most profitable product. Comparison of some developing countries shows wide differences in their problems and potential solutions.

Stephane His*. (French Institute of Petroleum (IFP), Economic Studies Division, 1&4 Avenue de Bois-Preau, F-92 852 Rueil –Malmaison cedex, France). Biofuels in Europe. Journal of Scientific & Industrial Research, Vol. 64 (2005): 931-935.

Biofuels have been under industrial development for over 20 years. Still handicapped by high costs, their future once again looks promising because they might be able to help reduce oil consumption and greenhouse gas emissions in the transport sector. This is especially true in Europe, where recently approved directives contain ambitious production volume targets encouraging member states to develop biofuels.

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