ENVIS RESOURCE PARTNER

on

ENVIRONMENTAL BIOTECHNOLOGY

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C O N T E N T S

BACKGROUND

Environmental Information System (ENVIS) is established in the year 1984 as a network of Information Centres. It is planned by the Ministry of Environment and Forest. Aim of this centre is to provide descriptive and environmental subject related numerical data.

This ENVIS Centre is established in the focal theme area - Environmental Biotechnology at the Department of Environmental Science, University of Kalyani, Nadia-741235, West Bengal in the year 2002.

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

This is the 33rd publication of Abstract Volume of this ENVIS Centre. This contains the abstracts of research papers collected from the various areas of Environmental Biotechnology from different journals published in last six months upto December 2018. In this issue, various topics like Bioenergy, Bioengineering, Bio-degradation, Bio-remediation, Bio-transformation etc. have been covered. We are grateful to the various libraries and their staff for their cooperation extended to us during the collection of the articles.

Abstract Format

The format of the abstract is as follows:

Abstract: The abstracts are arranged in different subheads.

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

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

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

GENERAL INFORMATION

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

Abstract are broadly classified and arranged under the following 15 heads:

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

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

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

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

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

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

Biofertilizer: To reduce the impact of excess chemical fertilizers in the field of agriculture the biofertilizer is being considered as a potential tool; biologically fixed nitrogen

is such a source which can supply an adequate amount of Nitrogen to plants and other nutrients to some extent. Many free living and symbiotic bacteria, which fix atmospheric Nitrogen are used as biofertiliser material as a substitute for Nitrogen fertilizer. In general two types of biofertiliser are used

1. Bacterial Biofertilizer
2. Algal Biofertilizer

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

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

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

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

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

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

Bioengineering: It is a developing speciality featuring a multidisciplinary approach to the solution of problems in medicine and biology, based on the application of advances in science, engineering and technology. It generally engineers the biological processes through biotechnological or genetic engineering interventions. It may also be a broad-based engineering discipline that involves product design, sustainability and analysis of biological systems.

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

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

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

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

Nano Biotechnology: Bionanotechnology, nanobiotechnology, and nanobiology are terms that refer to the intersection of nanotechnology and biology. Given that the subject is one that has only emerged very recently, bionanotechnology and nanobiotechnology serve as blanket terms for various related technologies.

This discipline helps to indicate the merger of biological research with various fields of nanotechnology. Concepts that are enhanced through nanobiology include: nanodevices, nanoparticles, and nanoscale phenomena that occurs within the disciple of nanotechnology. This technical approach to biology allows scientists to imagine and create systems that can be used for biological research

Biomimicry: Biomimicry is an applied science that derives inspiration for solutions to human problems through the study of natural designs, systems and processes. Biomimicry on the other hand, which is not a science, is a more subtle way which we can benefit from nature. It is the modern, often high tech, equivalent of the historical practices of emulating nature. . The science of biomimicry is a newly developing field but the application of biomimicry has been around since the beginning of man. The biomimetic technologies (flight controls, bio-robotics, ventilation systems, etc.) and potential technologies (fin geometry, nacre materials, etc.) improve performance. The use of biomimicry is an approach to sustainable engineering, specifically the environmental components.

ABBREVIATIONS USED IN ADDRESSES AND CITED JOURNALS

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

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

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

Bioaccumulation

LizhaoChen[ab1], WeiZhang[a1], ZhiqiangGuo[c], LiZhang[a] ([a]Key Laboratory of Tropical Marine Bio-resources and Ecology, Guangdong Provincial Key Laboratory of Applied Marine Biology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, 510301, China [b]University of Chinese Academy of Sciences, Beijing, 100049, China[c]State Key Laboratory of Marine Resource Utilization in South China Sea, College of Oceanology, Hainan University, Haikou, 570228, China) **Effects of acclimation on arsenic bioaccumulation and biotransformation in freshwater medaka *Oryzias mekongensis* after chronic arsenic exposure. Environmental Pollution, Volume 238(2018) : 17-25**

Fish can acclimate to chronic arsenic (As) exposure, but the mechanisms of acclimation remain unclear to date. Therefore, this study conducted 28-d chronic inorganic As [As(III) and As(V)] exposures in freshwater medaka (*Oryzias mekongensis*), examined the As bioaccumulation and biotransformation during exposure, and the As acute toxicity and toxicokinetics after exposure. After chronic As(V) exposure, the 96-h lethal concentration (96-h LC_{50}) of As(V) increased 1.3-fold (from 223 to 286 μmol/L), indicating that the fish became more tolerant to As(V). The As bioaccumulation in As(V)-exposed fish increased gradually during the initial 21-d exposure period and then decreased at 28 d, indicating that acclimation occurred to regulate the total As levels. Toxicokinetics measurement suggested that As(V) uptake (uptake rate constant, k_u) was significantly decreased and As(III) elimination (efflux rate constant, k_{e1}) was significantly increased, both of which could reduce As bioaccumulation. Furthermore, the organic As species became more predominant (50.1–69.3%) in exposed fish, while the inorganic As species were predominant (53.6–56.4%) in the control fish, suggesting that the capability of As biotransformation increased to acclimate inorganic As during chronic exposure. In summary, this study elucidated the acclimation strategies (reduced bioaccumulation and increased biotransformation) of *O. mekongensis* to counter the ambient As contamination.

Keywords: Arsenic; Acclimation; Bioaccumulation; Biotransformation; Freshwater fish

ZeyingHe[a] YuehuaWang[a] YanweiZhang[a] HaiyanCheng[b] XiaoweiLiu[a] ([a]Key Laboratory for Environmental Factors Control of Agro-product Quality Safety, Ministry of Agriculture, Agro-Environmental Protection Institute, Ministry of Agriculture, Tianjin, 300191, PR China[b] SCIEX, Analytical Instrument Trading Co., Ltd, Beijing, 100015, PR China) **Stereoselective bioaccumulation of chiral PCB 91 in earthworm and its metabolomic and lipidomic responses. Environmental Pollution. Volume 238 (2018) : 421-430**

Stereoselective bioaccumulation, elimination, metabolomic and lipidomic responses of earthworm *Eisenia fetida* exposed to chiral polychlorinated biphenyl (PCB) 91 in an earthworm-soil system were investigated. Preferential bioaccumulation of (−)-PCB 91 and elimination of (+)-PCB 91 were observed following 50 and 500

μg/kg$_{dwt}$ exposures. Enantiomer fraction (EF) values decreased over time during the uptake and elimination periods. Metabolomics and lipidomics techniques based on ultra-performance liquid chromatography/quadrupole time-of-flight mass spectrometry (UPLC-QTOF-MS) revealed significant changes in 108 metabolites after earthworms exposure to (+)-, (−)-, and (±)-PCB 91, compared to control groups. Forty two of these metabolites were identified as amino acids, nucleosides, fatty acids, dicarboxylic acids, vitamins or others. Lysophospholipids including six lysophosphatidylcholines (LPC), six lysophosphatidylethanolamine (LPE), eight lysophosphatidylinositol (LPI) and five lysophosphatidylserine (LPS) were also differentially expressed between exposure and control groups. Alterations in the levels of metabolites and lipids indicated stereoselective effects of chiral PCB91 on earthworm amino acid, energy, and nucleotide metabolism, neurodevelopment and gene expression. Overall, the effects of (+)-PCB 91 were more pronounced than that of (−)- and (±)-PCB 91.

Keywords: PCB 91; Stereoselectivity; Metabolomics; Lipidomics; Bioaccumulation

KongcaoXiao[ab1] MinSong[c1] JingLiu[abd] HaoChen[ab] DejunLi[ab] KelinWang[ab] ([a]Key Laboratory for Agro-ecological Processes in Subtropical Region, Institute of Subtropical Agriculture, Chinese Academy of Sciences, Changsha 410125, China[b] Huanjiang Observation and Research Station for Karst Ecosystem, Chinese Academy of Sciences, Huanjiang 547100, China[c] College of Agronomy, Hunan Agricultural University, Changsha 410125, China[d] University of Chinese Academy of Sciences, Beijing 100049, China) **Differences in the bioaccumulation of selenium by two earthworm species (*Pheretima guillemi* and *Eisenia fetida*). Chemosphere. Volume 202 (2018) : 560-566**

Information on the bioaccumulation of selenium (Se) in soil invertebrates (e.g. earthworms) is rather scarce. In the present study, bioaccumulation of Se in two eco-physiologically different earthworms, namely anecic *Pheretima guillemi* and epigeic *Eisenia fetida*, was determined after 28 days exposure to a successive doses of Se-spiked soil, specifically 0.5, 5, 50, and 200 μg Se g^{-1} soil. The results showed that Se concentration in earthworms elevated with increasing exposure levels, and maximums were up to 54.6 and 83.0 μg g^{-1} dry weight in *Pheretima guillemi* and *Eisenia fetida*, respectively, after 4 weeks exposure to 200 μg Se g^{-1} soil. Exposure to Se caused significant inhibition on earthworm growth, with the fresh weight loss ranging from 8.9% to 80.5%. Bioaccumulation factors (BAFs), empirically-derived and non-steady state, ranged from 0.12 to 4.17 and generally declined at higher exposure levels. Moreover, BAFs of *Pheretima guillemi* were higher than those of *Eisenia fetida* in low-dose Se-spiked soils, but the opposite was true in high-dose soils, indicating there is a species-specific response to exposure of Se between different earthworms. Further research is thus needed to reveal the accumulation pattern of Se in a wider range of earthworm species other than *Eisenia fetida*, which allows a better risk assessment of excessive Se to soil invertebrates and higher order organisms.

Keywords: Bioaccumulation; Selenium; Earthworm; *Pheretima guillemi; Eisenia fetida*

QianWang[ab] Barry C.Kelly[a] ([a]Department of Civil and Environmental Engineering, National University of Singapore, Singapore[b] College of Marine Ecology and Environment, Shanghai Ocean University, China) Assessing bioaccumulation behaviour of hydrophobic organic contaminants in a tropical urban catchment. Journal of Hazardous Materials, Volume 358 (2018): 366-375

The bioaccumulation behaviour of halogenated flame retardant (HFRs), synthetic musks (SMs), organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) in plankton, invertebrates and fish was assessed in an urban catchment in Singapore which is a tropical island country highly populated. The studied contaminants ranged widely in physical-chemical properties, with K_{OW}values ranging between approximately 10^3–10^{11}. BDE-47 and dechlorane plus (DPs) were the predominant HFRs, while galaxolide (HHCB) and tonalide (AHTN) were the predominant synthetic musk compounds in biota from the studied freshwater system. Concentrations of organochlorine contaminants such as chlordanes, DDE, DDD, PCB 138 and PCB 153 were generally higher than those of the HFRs and SMs. On a wet weight basis, bioaccumulation factors (BAFs) of the current use HFRs were in some cases higher than the bioaccumulation criteria value of 5000 L/kg wet weight. Conversely, BAFs of SMs were found to be less than the 5000 L/kg guideline. Lipid adjusted BAFs (L/kg lipid) of the studied contaminants varied among the different aquatic species, which is likely due to organism trophic level and metabolic transformation capacity differences. BAFs were highly correlated with the chemical K_{OW} values. For fish, log BAFs of the studied contaminants increased with increasing log K_{OW}, between a log K_{OW} range of approximately 3–7, after which BAFs subsequently decreased. A similar relationship was observed for BAFs in the studied invertebrates. For plankton, a simple linear regression was observed between log BAF and log K_{OW} over the target analyte K_{OW} range (log K_{OW}'s between 3–11). Predicted BAF values derived from a mechanistic bioaccumulation model for hydrophobic organic contaminants were generally consistent with the observed BAFs. However, in some cases the model substantially overestimated bioaccumulation potential based on the chemical's hydrophobicity, which may be due to a high degree of biotransformation of those compounds. The study provides important information regarding bioaccumulation potential of several emerging organic contaminants of concern.

Keywords: HFRs; PPCPs; Legacy POPs; Bioaccumulation; Tropical urban catchment

Francesca Grisoni[a] Viviana Consonni[a] Marco Vighi[b] (University of Milano-Bicocca, Dept. of Earth and Environmental Sciences, Milano, Italy IMDEA Water Institute, Alcalà de Henares, Madrid, Spain) Detecting the bioaccumulation patterns of chemicals through data-driven approaches. Chemosphere, Volume 208 (2018): 273-284

This work investigates the bioaccumulation patterns of 168 organic chemicals in fish, by comparing their bioconcentration factor (BCF), biomagnification factor (BMF) and octanol-water partitioning coefficient (K_{OW}). It aims to gain insights on the relationships between dietary

and non-dietary bioaccumulation in aquatic environment, on the effectiveness of K_{OW} and BCF to detect compounds that bioaccumulate through diet, as well as to detect the presence of structure-related bioaccumulation patterns. A linear relationship between logBMF and $\log K_{OW}$ was observed ($\log BMF = 1.14 \cdot \log BCF - 6.20$) up to $\log K_{OW} \approx 4$, as well as between logBMF and logBCF ($\log BMF = 0.96 \cdot \log BCF - 4.06$) up to a $\log BCF \approx 5$. 10% of compounds do not satisfy the linear BCF-BMF relationship. The deviations from such linear relationships were further investigated with the aid of a self-organizing map and canonical correlation analysis, which allowed us to shed light on some structure-related patterns. Finally, the usage of K_{OW}- and BCF-based thresholds to detect compounds that accumulate through diet led to many false positives (47%–91% for K_{OW}), and a moderate number of false negatives (up to 5% for BCF). These results corroborate the need of using the experimental BMF for hazard assessment practices, as well as of developing computational tools for BMF prediction.

Keywords: Bioaccumulation; Bioconcentration; Machine-learning; Self-organizing map; Canonical correlation analysis

Samuel P.Haddad[a], AndreasLuek[b], W. CasanScott[a], Gavin N.Saari[a], S. RebekahBurket[a] Lauren A.Kristofco[a], JoneCorrales[a], JosephB.Rasmussen[b], C.KevinChambliss[ae] MichaelLuers[c] ClintRogers[d] Bryan W.Brooks[a] ([a]Department of Environmental Science, Center for Reservoir and Aquatic Systems Research, Baylor University, Waco, TX 76798 USA[b] Department of Biological Sciences, University of Lethbridge, Lethbridge, AB T1K 3M4 Canada[c] Snyderville Basin Water Reclamation District, Park City, UT, USA[d] Carollo Engineers, Salt Lake City, UT, USA[e] Department of Chemistry and Biochemistry, Baylor University, Waco, TX 76798 USA) **Spatio-temporal bioaccumulation and trophic transfer of ionizable pharmaceuticals in a semi-arid urban river influenced by snowmelt. Journal of Hazardous Materials. Volume 359(2018) : 231-240**

Bioaccumulation of pharmaceuticals in aquatic organisms is increasingly reported in the peer-reviewed literature. However, seasonal instream dynamics including occurrence and bioaccumulation across trophic positions are rarely studied, particularly in semiarid streams with flows influenced by seasonal snowmelt and municipal effluent discharges. Thus, we selected East Canyon Creek in Park City, Utah, USA to examine spatio-temporal bioaccumulation of select ionizable pharmaceuticals across trophic positions using trophic magnification factors calculated at incremental distances (0.15, 1.4, 13 miles) downstream from a municipal effluent discharge during spring (May), Summer (August), and fall (October). Nine target analytes were detected in all species during all sampling events. Trophic dilution was consistently observed for amitriptyline, caffeine, diphenhydramine, diltiazem, fluoxetine, and sertraline, regardless of seasonal instream flows or distance from effluent discharge. Calculated TMFs ranged from 0.01–0.71 with negative slopes observed for all regressions of chemical residue in tissue and trophic position. We further presents the first empirical investigation of normalizing pharmaceutical concentrations to lipid, phospholipid or protein fractions using pair matched fish samples. Empirical results identify that normalization of ionizable pharmaceutical residues in aquatic tissues to neutral lipids, polar lipids, or the total protein fraction is inappropriate, though

bioaccumulation studies examining influences of internal partitioning (e.g., plasma proteins) are needed.

Keywords: Bioaccumulation; Ionizable contaminants; Trophic magnification factor; Urbanization; nowmelt

LinCheng[a], Jun LiangZhou[b] JinpingCheng[b] ([a]Institute for Agri-food Standards and Testing Technology, Shanghai Academy of Agricultural Science, Shanghai, 201106, China[b] State Key Laboratory of Estuarine and Coastal Research, East China Normal University, 3663 North Zhongshan Road, Shanghai, 200062, China) **Bioaccumulation, tissue distribution and joint toxicity of erythromycin and cadmium in Chinese mitten crab (*Eriocheir sinensis*). Chemosphere. Volume 210 (2018) : 267-278**

The bioaccumulation of erythromycin (ETM) and cadmium (Cd) in Chinese mitten crab (*Eriocheir sinensis*) and subsequent toxicity on pathological changes and enzymatic activities were investigated during 21-day exposure to ETM, Cd, and Cd^+ ETM mixture. The bioaccumulation of Cd and ETM residues in crab tissues decreased as gill > hepatopancreas > muscle > ovary, with higher Cd bioaccumulation than ETM. The highest Cd bioaccumulation in crab reached 1.15 mg/g dry weight in gill and 461.29 μg/g in hepatopancreas, on the 14th day of Cd treatment. Cd exposure promoted the bioaccumulation of ETM in four tissues. ETM exposure caused tubular vacuolization in epithelial and edema and degeneration of hepatic ducts in hepatopancreas, and disconnected gill epithelial layer and indistinctly cellular structure in gill. During Cd exposure, mitochondria acted as a main biomarker to identify the damage, including reduced and swollen mitochondria, and broken mitochondrial structure. Moreover, Chinese mitten crab showed defence capability against ETM and Cd exposure by physiological adjustment of metabolic enzymes glutathione S-transferase activity.

Keywords: Erythromycin; Cadmium; Bioaccumulation; Joint toxicity; Pathological observation; Metabolic enzymes

Isabella C.Bordon[a], Andrews KrupinskiEmerenciano[b], Julia Reali CostaMelo[b], José Roberto Machado Cunha daSilva[b], Deborah Inês TeixeiraFavaro[c], Paloma KachelGusso-Choueri[a]Bruno Galvão deCampos[a]Denis Moledo de SouzaAbessa[a] ([a]UNESP - Univ Estadual Paulista, Campus do Litoral Paulista, Núcleo de Estudos em Poluição e Ecotoxicologia Aquática (NEPEA), Praça Infante Dom Henrique s/n°, Parque Bitaru, CEP 11330-900, São Vicente, SP, Brazil[b] USP - Univ. de São Paulo, Instituto de Ciências Biomédicas (ICB)- Departamento de Biologia Celular e do Desenvolvimento, Avenida Professor Lineu Prestes, 1524 - Cidade Universitária, CEP 05508-900, São Paulo, SP, Brazil[c] IPEN - Instituto de Pesquisas Energéticas e Nucleares, Centro do Reator de Pesquisa (CRPq), Avenida. Professor Lineu Prestes 2242 - Cidade Universitária, CEP: 05508-000, São Paulo, SP, Brazil) **Implications on the Pb bioaccumulation and**

metallothionein levels due to dietary and waterborne exposures: The *Callinectes danae* case. Ecotoxicology and Environmental Safety. Volume 162(2018) ; 415-422

This study aimed to assess the bioaccumulation of Pb and induction of metallothionein-like proteins (MT) in *Callinectes danae* through single and combined dietary and waterborne exposures. Male *C. danae* individuals were collected in the south area of the Cananéia-Iguape-Peruíbe Protected Area (APA-CIP), in São Paulo State, Brazil. After an acclimatization period, exposure assays were performed during 7 and 14 days, at two Pb concentrations (0.5 e 2.0 μg/g) in 4 treatments: 1) control; 2) contaminated water only; 3) contaminated food only; 4) contaminated water and food. The results indicate that *C. danae* is highly tolerant to Pb exposure at the evaluated concentrations. In gills, Pb bioaccumulation is more dependent of water efflux and time of exposure (higher Pb values). However, pathways act simultaneously in the induction of MT expression in this tissue. The decreases in Pb accumulation in the combined treatments and MT increases after 14 days in gills suggests that these proteins play a detoxification function in the presence of Pb. In hepatopancreas, depending on the predominance of a certain pathway or combined pathways, accumulation occured at different times. For muscle tissue, bioaccumulation was observed due to contaminated water exposure, but not dietary exposure, probably because Pb concentrations were low.

Keywords: Metals; Bioaccumulation; Biomarkers; Blue crabs; Metallothionein-like; proteins; Artificial food

WenShi[a] XiaomanFang[b], XingfeiWu[a], GaoxiangZhang[a], WeiyanQue[a], FeiliLi[a] ([a] College of Environment, Zhejiang University of Technology, Hangzhou, 310032, China[b]State Key Laboratory Breeding Base for Zhejiang Sustainable Pest and Disease Control, Institute of Quality and Standard for Agro-products, Zhejiang Academy of Agricultural Sciences, Hangzhou, 310021, China) **Alteration of bioaccumulation mechanisms of Cu by microalgae in the presence of natural fulvic acids. Chemosphere. Volume 211 (2018): 717-725**

The impact of natural fulvic acids (FAs) on the toxicity and bioaccumulation of Cu by *Chlorella* pyrenoidosa was studied. FAs extracted from Taihu Lake were separated into three fractions using dialysis bags: F1 (<500 Da), F2 (500–1000 Da) and F3 (>1000 Da). The results showed that the F3 fraction with a larger molecular weight contained less acidic groups and unsaturated aliphatic structures than F1 and F2, and it showed stronger alleviation of the toxicity of Cu to algae. In the presence of F1∼F3, the bioaccumulation curve of Cu in algae intersected with the straight line in the binary system of Cu-algae at approximately 5.3×10^{-3} — 6.0×10^{-3} mM of Cu equilibrium concentration, showing an inhibition of bioaccumulation of Cu in lower concentrations but an enhancement in higher Cu concentrations. The ratio of $\{Cu\}_{ads}/\{Cu\}_{int}$ was used to clarify the transformation mechanism on adsorption; the transition interval occurred at a ratio of 3.5–4.4. This ratio indicated a shift from a mechanism of slow trending to equilibrium to a mechanism with rapid increase, which may be due to the bridging action of Cu to form a ternary complex of FA-Cu-algae and the occurrence of multilayer adsorption. The promotion order of F1> F3> F2 was consistent with percentages of

the carboxyl group in total acidic functional groups in the FAs. This research is helpful for improving the accuracy of present models for the prediction of heavy metal risks in aqueous environments.

Keywords: Fulvic acid; *Chlorella pyrenoidosa;* Bioavailability; Bioadsorption

Elvio D.Amato[abc] Chamani P.M.Marasinghe Wadige[d]Anne M.Taylor[d]William A.Maher[d]Stuart L.Simpson[b]Dianne F.Jolley[c] ([a]Systemic, Physiological and Ecotoxicological Research (SPHERE), Department of Biology, University of Antwerp, Groenenborgerlaan 171, 2020, Antwerp, Belgium [b]Centre for Environmental Contaminants Research, CSIRO Land and Water, Lucas Heights, NSW, 2234, Australia [c]School of Chemistry, University of Wollongong, NSW, 2522, Australia [d]Ecochemistry Laboratory, Institute for Applied Ecology, University of Canberra, Canberra, ACT, 2601, Australia). **Field and laboratory evaluation of DGT for predicting metal bioaccumulation and toxicity in the freshwater bivalve *Hyridella australis* exposed to contaminated sediments. Environmental Pollution. Volume 243, Part B(2018): 862-871**

The diffusive gradients in thin films (DGT) technique has shown to be a useful tool for predicting metal bioavailability and toxicity in sediments, however, links between DGT measurements and biological responses have often relied on laboratory-based exposures and further field evaluations are required. In this study, DGT probes were deployed in metal-contaminated (Cd, Pb, Zn) sediments to evaluate relationships between bioaccumulation by the freshwater bivalve *Hyridella australis* and DGT-metal fluxes under both laboratory and field conditions. The DGT-metal flux measured across the sediment/water interface(±1 cm) was useful for predicting significant cadmium and zinc bioaccumulation, irrespective of the type of sediment and exposure. A greater DGT-Zn flux measured in the field was consistent with significantly higher zinc bioaccumulation, highlighting the importance of performing metal bioavailability assessments *in situ*. In addition, DGT fluxes were useful for predicting the potential risk of sub-lethal toxicity (i.e., lipid peroxidation and lysosomal membrane damage). Due to its ability to account for multiple metal exposures, DGT better predicted bioaccumulation and toxicity than particulate metal concentrations in sediments. These results provide further evidence supporting the applicability of the DGT technique as a monitoring tool for sediment quality assessment.

Bioremediation

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Environmental Engineering, Institut Teknologi Bandung, Bandung, 40132, Indonesia [e] Department of Environmental Engineering, Faculty of Engineering, Universitas Batanghari, Jambi, 36122, Indonesia) An overview of electrokinetic soil flushing and its effect on bioremediation of hydrocarbon contaminated soil. Journal of Environmental Management. Volume 218 (2018) : 309-321

Combination of electrokinetic soil flushing and bioremediation (EKSF-Bio) technology has attracted many researchers attention in the last few decades. Electrokinetic is used to increase biodegradation rate of microorganisms in soil pores. Therefore, it is necessary to use solubilizing agents such as surfactantsthat can improve biodegradation process. This paper describes the basic understanding and recent development associated with electrokinetic soil flushing, bioremediation, and its combination as innovative hybrid solution for treating hydrocarbon contaminated soil. Surfactant has been widely used in many studies and practical applications in remediation of hydrocarbon contaminant, but specific review about those combination technology cannot be found. Surfactants and other flushing/solubilizing agents have significant effects to increase hydrocarbon remediation efficiency. Thus, this paper is expected to provide clear information about fundamental interaction between electrokinetic, flushing agents and bioremediation, principal factors, and an inspiration for ongoing and future research benefit.

Keywords: Electrokinetic soil flushing; Bioremediation; Surfactant; Flushing agents

EKSF-Bio Chih-HaoChang[a], Hsin-YiYang[a], Sheng-KungChen[a], Jui-MinHung[b], Chih-JenLu[a]Min-HsinLiu[c] (Department of Environmental Engineering, National Chung Hsing University, Taichung, Taiwan, ROC[b]Jetpro Technology Co., Ltd., Kaohsiung, Taiwan, ROC [c]Department of Environmental Engineering and Management, Chaoyang University of Technology, Taichung, Taiwan, ROC) Electrokinetic-enhanced bioremediation of tetrachloroethylene. International Biodeterioration & Biodegradation Volume 132 (2018) : 251-258

This study investigated the feasibility of using electrolysis of water to produce hydrogen and oxygen that were used as the electron donor and the electron acceptor for the anaerobic reductive dechlorination and the aerobic cometabolism of chlorinated ethylene contaminants, respectively. By employing the anaerobic and aerobic conditions in different sections of a column test, intermediates formed in the anaerobic dechlorination of PCE in the up-gradient section were further biodegraded through aerobic cometabolism in the down-gradient section, which used methane as the primary substrate. The results indicated that, the effluent PCE concentration was 0.88 $\mu mol\ l^{-1}$ when the influent PCE concentration was 60 $\mu mol\ l^{-1}$, up to 98.5% PCE was degraded in 160 days with an additional current density up to 0.099 $mA\ cm^{-2}$. The First-order rea ction rate was increased by 1.9–17.3 times with biostimulation by electrolysis method, showing that the benefits of an integrated electrochemistry and biotransformation system to complete mineralization of tetrachloroethylene. In addition, the specific microbial populations of *Dehalococcoides sp.* and methane-oxidizing bacteria were analyzed using the

ethidium monoazide-PCR procedure, indicating the presence of viable bacteria in the integrated system.

Keywords: Tetrachloroethylene; Electrolysis method; Biostimulation; Anaerobic/aerobic system

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This data article details *Pseudomonas aeruginosa* effects on the bioremediation of soil that had been polluted by different concentrations, 5% w/w and 8% w/w, of raw (for simulating oil spills from well-heads) and treated (for simulating oil spills from flow lines/storage tanks) crude oil. UV/VIS spectrophotometry instrumentation was used for obtaining absorbance measurements from the Nigerian Escravos Light blend (sourced from Chevron® Nigeria) of crude oil polluting soil samples, which, thus, also simulates light and heavy onshore oil spillage scenarios, in a 30-day measurement design. Data on bioremediation effects of *Pseudomonas aeruginosa* added to the crude oil polluted soil samples, and which were monitored at intervals via the absorbance measurement techniques, are presented in tables with ensuing analyses for describing and validating the data presented in graphs. Information from the presented data in this article is useful to researchers, the oil industries, oil prospecting communities, governments and stakeholders involved in finding solution approach to the challenges of onshore oil spills. This information can also be used for furthering research on bioremediation kinetics such as biostimulant analyses, polluting hydrocarbon content/degradation detailing, by *Pseudomonas aeruginosa* strain of microorganism, on petroleum pollutant removal from soil that had been polluted by crude oil spillage.

Keywords: Bioremediation; Onshore oil pollution simulating system; *Pseudomonas eruginosa;* UV/VIS Spectrophotometry; Absorbance;Crude oil polluted soil

JyotiKaushalSeema, MehandiaGursharanSingh, ArunRainaShailendra, KumarArya (University Institute of Engineering and Technology, Panjab University, Chandigarh, India) **Catalase enzyme: Application in bioremediation and food industry. Biocatalysis and Agricultural Biotechnology. Volume 16 (2018) : 192-199**

The enzyme catalase is known to catalyse the breakdown of hydrogen peroxideinto oxygen and water. Hydrogen peroxide metabolism is mainly regulated by this enzyme. Catalase is a common enzyme found in nearly all living organisms. It has one of the highest turnovers of all enzymes as it has the capacity to decompose more than one million molecules of hydrogen peroxide, per molecule of enzyme. Catalase has been used as an important enzyme in many biotechnological areas including bioremediation. This paper gives a review of its use and application in the field of bioremediation as an indicator of hydrocarbon degradation in soil (an important aspect in bioremediation of crude oil pollution), as a provider of oxygen in aerobic bioremediation process and in the removal of H_2O_2 from bleaching industry effluent and also its potential use in the food industry.

Keywords: Catalase; Hydrogen peroxide; Bioremediation; Food

YichaoWu,XinxinJing, ChunhuiGao, QiaoyunHuang, PengCai (State Key Laboratory of Agricultural Microbiology, College of Resources of Environment, Huazhong Agricultural University, Wuhan, China) Recent advances in microbial electrochemical system for soil bioremediation. Chemosphere. Volume 211(2018) : 156-163

Soil contamination poses a serious threat to ecosystem and human well-being. Compared to conventional physical and chemical treatment, the microbial electrochemical system (MES) offers a sustainable and environment-friendly solution for soil bioremediation. In principle, soil microbe degrades organic substrate and releases electron in anode region. The electron flows through electric circuit to the cathode and finally is accepted by oxygen or oxidized metals. With various inherent advantages, MES has been applied in petroleum hydrocarbon, chlorinated organics and heavy metals bioremediation in soils. This paper aims to review the recent advances of MES in soil bioremediation, including main mechanisms of contaminant removal with MES, configurations of soil MES and current development in bioremediation of soil contaminated by organic and inorganic pollutants. Moreover, challenges and future prospects of soil MES are discussed.

Keywords: Microbial electrochemical system; Soil; Bioremediation

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Microbial consortia isolated from aged phorate contaminated soil were used to degrade phorate. The consortia of three microorganisms (*Brevibacterium frigoritolerans*, *Bacillus* aerophilus and *Pseudomonas* fulva) could degrade phorate, and the highest phorate removal (between 97.65 and 98.31%) was found in soils inoculated with mixed cultures of all the three bacterial species.

However, the mixed activity of any of two of these bacteria was lower than mixed consortia of all the three bacterial species. The highest degradation by individual mixed consortia of (*B. frigoritolerans+B.aerophilus, B. aerophilus+P. fulva* and *B. frigoritolerans+P. fulva*) appeared in soil between (92.28–94.09%, 95.45–97.15% and 94.08–97.42%, respectively). Therefore, inoculation of highly potential microbial consortia isolated from in situ contaminated soil could result in most effective bioremediation consortia for significantly relieving soils from phorate residues. This much high phorate remediation from phorate contaminated soils have never been reported earlier by mixed culture of native soil bacterial isolates.

Keywords: Phorate; Metabolite; Consortia; Soil; Bioremediation

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Bioremediation of chromium contaminated water by diatoms with concomitant lipid accumulation for biofuel production. Journal of Environmental Management. Volume 227 (2018) : 313-320

Hexavalent chromium compounds such as chromate and dichromate, commonly designated as Cr (VI) compounds, are widely used heavy metals in different industries and are considered highly toxic to most life forms. Unfortunately, they have become a major pollutant of groundwater and rivers around dichromate using industries. Bioremediation is widely used to decrease the amount of dichromate in wastewater but requires large amounts of precious fresh water. Here we tested two marine micro-algal species, *Phaeodactylum tricornutum* strain CCY0033 and *Navicula pelliculosa* strain CCMP543, for their ability of dichromate bioremediation and concomitantly producing lipids that can serve as biofuel. Dichromate tolerance of the strains was investigated under different growth conditions in order to obtain high biomass yields, high lipid accumulation and high dichromate removal from the medium. Both algal strains grew well and produced high biomass in media containing up to 1 mg of dichromate per liter. Variations in growth conditions revealed that dichromate removal from the medium correlated positively with biomass yield. Dichromate removal using living cells was in the same order of magnitude as with autoclaved dead cells or when using extracted extracellular polymeric substances (EPS). This suggests biosorption of dichromate to cell-associated polymeric substances as the major mechanism of the bioremediation process. For both strains, optimal dichromate removal and lipid production were achieved at a light intensity of 55 $\mu mol\ m^{-2}s^{-1}$ and at a sodium nitrate concentration of 3 mM. The optimal temperature for dichromate removal and lipid production was 23 °C for *P. tricornutum* and 27 °C for *N.*

pelliculosa. Compared to *P. tricornutum*strain CCY0033, *N. pelliculosa* strain CCMP543 produced an overall higher lipid yield under these conditions.

Biotransformation

AzaKobakhidze[a] VladimirElisashvili[a] Philippe F.-X.Corvini[bc] MonikaČvančarová[b] ([a]Institute of Animal Husbandry and Feed Production, Agricultural University of Georgia, 240 David Agmashenebeli Alley, 0159 Tbilisi, Georgia[b]Institute for Ecopreneurship, School of Life Sciences, University of Applied Sciences and Arts, Northwestern Switzerland, Gründenstrasse 40, Muttenz CH-4132, Switzerland[c]State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University Xianlin Campus, Xianlin Avenue 163, Nanjing 210023, China) **Biotransformation of ritalinic acid by laccase in the presence of mediator TEMPO. *New Biotechnology*. Volume 43(2018) : 44-52**

Methylphenidate is widely used as a medication for the treatment of attention deficit hyperactivity disorder (ADHD) in children. Less than 1% of methylphenidate is excreted unchanged in urine, while 80% of an oral dose is excreted as ritalinic acid (which is reportedly poorly degradable). This study aims to investigate the biotransformation of ritalinic acid by free and immobilized enzymes. The influence of various laccase mediators on biotransformation efficiency has been tested. Formation of the main transformation products has been monitored and their potential structures suggested. The effective transformation of ritalinic acid was observed only in the presence of 2,2,6,6-tetramethylpiperidine 1-oxyl mediator (TEMPO). The most effective enzyme was the laccase of *T. versicolor* 159. The main transformation product was an *N*-methyl derivative of ritalinic acid. Ritalinic acid was also reduced to aldehyde and alcohol, and a broad spectrum of intermediate complexes with oxoammonium ion of TEMPO were detected. This is the first time the biotransformation of ritalinic acid has been investigated in detail.

Keywords: Ritalinic acid; Laccase; Biotransformation; TEMPO; LC–MS

Vinit K.Mittal[a1], Carla A.Ng[b]. ([a]Formerly: Institute for Chemical and Bioengineering, ETH Zurich, 8093, Zurich, Switzerland[b] Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, PA 15261, USA) **Formation of PFAAs in fish through biotransformation: A PBPK approach. Chemosphere. Volume 202 (2018) : 218-227**

A physiologically-based pharmacokinetic (PBPK) model for perfluorinated alkyl acids (PFAAs) in rainbow trout has been updated to include formation of perfluorooctanoic acid (PFOA) from the biotransformation of 8:2 fluorotelomer carboxylic acid (8:2 FTCA). The updated model is dynamic and simulates both uptake and depuration phases. Two empirical studies are used to parameterize and test the model. In the first case, parameters related to fecal elimination and protein binding were optimized. In the second case, parameters were sourced either from literature or from optimized values based on the first study to test model performance.

Optimization of parameters resulted in a decrease in the difference between experimental data and simulation results by 57 and 23 percent for the first and the second case, respectively, compared to the original case. Sensitivity analysis was performed to identify important parameters, and uncertainty in model prediction propagated by these parameters was assessed using Monte Carlo analysis. For each case, 80 and 89 percent, respectively, of median predicted values were within the limits of experimental error when comparing simulated and experimental data. This is the first toxicokinetic model that incorporates biotransformation of PFAA precursors and simultaneously predicts the distribution of the precursor and metabolite in different tissues. The model is mechanistic, and could be applied to simulate a variety of scenarios by using the organism-specific physiological properties compiled here with other chemical-specific parameters (e.g. protein interactions).

Keywords: Bioaccumulation; Biotransformation; FTCA; PFAA; PFAS

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Microorganism biotransformation of sulfamethazine (SMT) in aqueous environments is a major concern, especially considering their exposure to coexisting SMT and heavy metals. *Phanerochaete chrysosporium* (*P. chrysosporium*) is a more concerned Cadmium (Cd) and SMT hyper accumulation specie. This study, referring to metabolic mechanisms and application, was performed to investigate the single and combined effects of Cd-SMT, including toxicity, resistance, as well as the accumulation and biotransformation by *P. chrysosporium*. The results revealed that Cd-SMT co-contamination caused increasing active oxygen accumulation, and the number of antioxidant enzyme and non-enzymatic antioxidants were higher than that under the stress of their individual pollution. It was found that *P. chrysosporium* accumulated high levels of Cd with the increment of 6.98–23.96% induced by Cd-SMT co-contamination compared to under the stress of Cd individual pollution. What's more, the addition of Cd reduced the toxicity of SMT to *P. chrysosporium*. The decrease of malonaldehyde and the increase of protein also proved that *P. chrysosporium* held enormous potential to fit in the co-contaminated environment, and to remediate the co-contaminated water especially in the long-term treatment. These results undoubtedly contribute to the development of fungi-based technologies and the applications of *P. chrysosporium* in realistic environment rather than laboratory simulation environment.

Keywords: Cadmium; Sulfamethazine; Co-contamination; Biotransformation; Resistance; *Phanerochaete chrysosporium*

Chang-GuiPan[a]Feng-JiaoPeng[b]Guang-GuoYing[c]. ([a]School of Marine Sciences, Guangxi University, Nanning, 530004, China[b] Department of Aquatic Ecology and Water Quality Management, Wageningen University, P.O. Box 47, 6700, AA Wageningen, The Netherlands[c] The Environmental Research Institute, MOE Key Laboratory of Environmental Theoretical Chemistry, South China Normal University, Guangzhou, 510006, China) Removal, biotransformation and toxicity variations of climbazole by freshwater algae *Scenedesmus obliquus.* Environmental Pollution. Volume 240 (2018) : 534-540

Climbazole (CBZ) is an antibacterial and antifungal agent widely used in personal care products. In this study, we investigated the interactions between climbazole (CBZ) and freshwater microalgae *Scenedesmus* obliquus (*S. obliquus*). Dose-effect relationships between CBZ concentrations and growth inhibitions or chlorophyll a content were observed. After 12 days of incubation, the algae density and chlorophyll a content in 2 mg/L treatment group was 56.6% and 15.8% of those in the control group, respectively. Biotransformation was the predominant way to remove CBZ in the culture solution, whereas the contribution of bioaccumulation and bioadsorption were negligible. More than 88% of CBZ was removed by *S. obliquus* across all treatments after 12 days of incubation, and the biotransformation of CBZ followed the first order kinetic model with half-lives of approximately 4.5 days at different treatments. CBZ-alcohol (CBZ-OH) was the only biotransformation product identified in algal solution. Moreover, the toxicity of biotransformation products was much lower than its corresponding precursor compound (CBZ). The results of this study revealed that *S. obliquus* might have a great impact on the environmental fates of CBZ and could be further applied to remove organic pollutants in aquatic environment.

Keywords: Climbazole; Green algae; Growth inhibition; Kinetics; CBZ-OH

Jefferson HonorioFranco[a], Bianca F.da Silva[a], Elisangela Franciscon G.Dias[b], Alexandre A.de Castro[c], Teodorico C.Ramalho[c], Maria Valnice BoldrinZanoni[a] ([a]Institute of Chemistry, State University "Julio de Mesquita Filho"- UNESP, Araraquara, São Paulo, Brazil[b] School of Technology, University of Campinas - UNICAMP, Limeira, São Paulo, Brazil[c] Department of Chemistry, Federal University of Lavras - UFLA, Lavras, Minas Gerais, Brazil) Influence of auxochrome group in disperse dyes bearing azo groups as chromophore center in the biotransformation and molecular docking prediction by reductase enzyme: Implications and assessment for environmental toxicity of xenobiotics. Ecotoxicology and Environmental Safety, Volume 160 (2018) : 114-126

Synthetic azo dyes have increasingly become a matter of great concern as a result of the genotoxic and mutagenic potential of the products derived from azo dye biotransformation. This work evaluates the manner in which reducing enzymes produced by *Escherichia* coli(*E. coli*) act

on three disperse dyes bearing azo groups, namely Disperse Red 73 (DR 73), Disperse Red 78 (DR 78), and Disperse Red 167 (DR 167). UV–Vis spectrophotometry, high-performance liquid chromatography with diode array detector (HPLC-DAD), and liquid chromatography mass spectrometry (LC-MS/MS) were applied towards the identification of the main products. Seven days of incubation of the azo dyes with the tested enzymes yielded a completely bleached solution. 3–4-Aminophenyl-ethyl-amino-propanitrile was detected following the biotransformation of both DR 73 and DR 78. 4-Nitroaniline and 2-chloro-4-nitroaniline were detected upon the biotransformation of DR 73 and DR 78, respectively. The main products derived from the biotransformation of DR 167 were dimethyl 3,3′-3-acetamido-4-aminophenyl-azanedyl-dipropanoate and 2-chloro-4-nitroaniline. The results imply that DR 73 lost the CN^- substituent during the biotransformation. Furthermore, theoretical calculations were also carried out aiming at evaluating the interaction and reactivity of these compounds with DNA. Taken together, the results indicate that DR 73, DR 78, and DR 167 pose health risks and serious threats to both human beings and the environment at large as their biotransformation produces harmful compounds such as amines, which have been widely condemned by the International Agency for Research on Cancer.

Keywords: Textile dye; Biotransformation; Azoreductase; Mass spectrometry; *Escherichia col*

HuikeDong[a] GuanghuaLu[ab] ZhenhuaYan[a]JianchaoLiu[a] MatthewNkoom[a] HaohanYang[a]. ([a]Key Laboratory of Integrated Regulation and Resources Development of Shallow Lakes of Ministry of Education, College of Environment, Hohai University, Nanjing 210098, China[b]Water Conservancy Project & Civil Engineering College, Tibet Agriculture & Animal Husbandry University, Linzhi 860000, China) **Responses of antioxidant and biotransformation enzymes in *Carassius carassius* exposed to hexabromocyclododecane. Environmental Toxicology and Pharmacology. Volume 62 (2018) : 46-53**

The ubiquitous existence of hexabromocyclododecane (HBCD) in environmental matrices has made it attractive to both field investigators as well as laboratory researchers. However, literature on the biological effects caused by HBCD on aquatic vertebrates seldom exist. This has inevitably increased the difficulty of toxicological assessment in the aquatic environment. Juvenile crucian carp (*Carassius carassius*) were exposed (flow-through) to different concentrations of technical HBCD (nominal 2, 20, 200 μg L^{-1}) for 7 days to determine the responses of antioxidant and biotransformation enzymes. HBCD was found to be increasingly bioconcentrated in the fish livers as time proceeds. Also, the contribution of α-HBCD exhibited an enhancement from 13% in the exposure solutions to 24% in crucian carp, still much lower than in wild fishes (ca. 80%). HBCD induced activities of antioxidant enzymes in most cases, as well as increased level of lipid peroxidation. In contrast to the weak response of 7-ethoxyresorufin-O-deethylase (EROD), 7-pentoxyresorufin-O-depentylase (PROD) activity was generally induced in a time-dependent manner with peaks at day 2. Phase II enzyme Glutathione-S-transferase (GST) showed a dose-dependent induction with maximums in the 20

μg L^{-1} treatment at all the four timepoints of 1, 2, 4 and 7 days. Some enzymatic responses showed good associations, indicating coordinated functions. To sum up, tHBCD exposure in the present circumstance had produced an ecological stress to crucian carp. The low levels of biotransformation and slow rates of bioisomerization suggest a possible long-term toxic effect, especially around HBCD point sources.

Keywords: HBCD; Oxidative stress; Antioxidant enzymes; Biotransformation enzymes; *Carassius carassius*

Mohammad YasinMohammad[a], AshokShakya[b], RamiaAl-Bakain[c], M.H.Haroon[d], M. IqbalChoudhary[ae] ([a] H. E. J. Research Institute of Chemistry, International Center for Chemical and Biological Sciences, University of Karachi, Karachi 75270, Pakistan[b]Department of Pharmaceutical Sciences, Faculty of Pharmacy and Medical Sciences, Al-Ahliyya Amman University, Amman 19328, Jordan[c]Department of Chemistry, Faculty of Science, The University of Jordan, Amman 11942, Jordan[d] Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University, Oluvil, Sri Lanka[e] Department of Biochemistry, Faculty of Science, King Abdulaziz University, Jeddah-21412, Saudi Arabia) **New monoterpenoid by biotransformation of thymoquinone using *Aspergillus niger.* Bioorganic Chemistry. Volume 80 (2018) : 212-215**

Microbial transformation of thymoquinone (5-isopropyl-2-methyl-cyclohexa-2,5-diene-1,4-dione) (**1**) by suspended cell-cultures of the plant pathogenic fungus *Aspergillus niger*resulted in the production of three metabolites. These metabolites were identified as 5-isopropyl-2-methyloxepin-1-one (**2**), 3-hydroxy-5-isopropyl-2-methylcyclohexa-2,5-diene-1,4-dione (**3**), and 5-isopropyl-2-methylbenzene-1,4-diol (**4**) by different spectroscopic methods. Metabolite **2** was found to be a new compound. Compound **4** showed a potent antioxidant activity.

Keywords: Thymoquinone; *Aspergillus niger;* Fungal transformation; Oxidation; Reduction; Antioxidant activity

NarasimmanLakshminarasimman[a] OscarQuiñones[b] Brett J.Vanderford[b] PabloCampo-Moreno[c] Eric V.Dickenson[b]Drew C.McAvoy[a] ([a] Department of Chemical and Environmental Engineering, University of Cincinnati, Cincinnati, OH 45221, USA[b]Water Quality Research and Development Division, Southern Nevada Water Authority, Henderson, NV 89015, USA[c]Cranfield Water Science Institute, Cranfield University, Cranfield, Beds MK43 0AL, UK) **Biotransformation and sorption of trace organic compounds in biological nutrient removal treatment systems. Science of The Total Environment. Volumes 640–641(2018) : 62-72**

This study determined biotransformation rates (k_{bio}) and sorption-distribution coefficients (K_d) for a select group of trace organic compounds (TOrCs) in anaerobic, anoxic, and aerobic activated sludge collected from two different biological nutrient removal (BNR) treatment systems located in Nevada (NV) and Ohio (OH) in the United States (US). The NV

and OH facilities operated at solids retention times (SRTs) of 8 and 23 days, respectively. Using microwave-assisted extraction, the biotransformation rates of the chosen TOrCs were measured in the total mixed liquor. Sulfamethoxazole, trimethoprim, and atenolol biotransformed in all three redox regimes irrespective of the activated sludge source. The biotransformation of *N*, *N*-diethyl-3-methylbenzamide (DEET), triclosan, and benzotriazole was observed in aerobic activated sludge from both treatment plants; however, anoxic biotransformation of these three compounds was seen only in anoxic activated sludge from NV. Carbamazepine was recalcitrant in all three redox regimes and both sources of activated sludge. Atenolol and DEET had greater biotransformation rates in activated sludge with a higher SRT (23 days), while trimethoprim had a higher biotransformation rate in activated sludge with a lower SRT (8 days). The remaining compounds did not show any dependence on SRT. Lyophilized, heat inactivated sludge solids were used to determine the sorption-distribution coefficients. Triclosan was the most sorptive compound followed by carbamazepine, sulfamethoxazole, DEET, and benzotriazole. The sorption-distribution coefficients were similar across redox conditions and sludge sources. The biotransformation rates and sorption-distribution coefficients determined in this study can be used to improve fate prediction of the target TOrCs in BNR treatment systems.

Keywords: Trace organic compounds; Pharmaceuticals and personal care products; Biotransformation; Sorption; Biological nutrient removal treatment

Luong N.Nguyen[a], Long D.Nghiem[a], SeungdaeOh[b] ([a]Center for Technology in Water and Wastewater, School of Civil and Environmental Engineering, University of Technology Sydney, Sydney, NSW 2007, Australia[b] Department of Civil Engineering, Kyung Hee University, 1732 Deogyeong-daero, Giheung-gu, Yongin-si, Gyeonggi-do 17104, Republic of Korea) **Aerobic biotransformation of the antibiotic ciprofloxacin by *Bradyrhizobium* sp. isolated from activated sludge. Chemosphere. Volume 211(2018) : 600-607**

Ciprofloxacin (CIP) is an antibiotic that is widely used to treat bacterial infections and is poorly biodegraded during wastewater treatment. In this study, a CIP-degrading bacterial strain (GLC_01) was successfully retrieved from activated sludge by enrichment and isolation. The obtained bacterial strain shares over 99% nucleotide identity of the 16S rRNA gene with Bradyrhizobium spp. Results show that Bradyrhizobium sp. GLC_01 degraded CIP via cometabolism with another carbon substrate following a first-order kinetics degradation reaction. CIP degradation by Bradyrhizobium sp. GLC_01 increased when the concentration of the primary carbon source increased. The biodegradability of the primary carbon source also affected CIP degradation. The use of glucose and sodium acetate (i.e. readily biodegradable), respectively, as a primary carbon source enhanced CIP biotransformation, compared to starch (i.e. relatively slowly biodegradable). CIP degradation decreased with the increase of the initial CIP concentration. Over 70% CIP biotransformation was achieved at 0.05 mg L^{-1} whereas CIP degradation decreased to 26% at 10 mg L^{-1}. The phylogenetic identification and experimental

verification of this CIP-degrading bacterium can lead to a bioengineering approach to manage antibiotics and possibly other persistent organic contaminants during wastewater treatment.

Keywords: Ciprofloxacin (CIP); *Bradyrhizobium;* Biotransformation; Cometabolism

TingruYin[a]Shu HarnTe[b], MartinReinhard[bc], YiYang[b], HuitingChen[b], YiliangHe[d], Karina Yew-HoongGin[ab] ([a]Department of Civil and Environmental Engineering, National University of Singapore, 1 Engineering Drive 2, Singapore 117576, Singapore[b]NUS Environmental Research Institute, National University of Singapore, 5A Engineering Drive 1, T-Lab Building, Singapore 117411, Singapore[c]Department of Civil and Environmental Engineering, Stanford University, Stanford, CA 94305, USA[d]School of Environmental Science and Technology, Shanghai Jiao Tong University, Shanghai 200240, China)
Biotransformation of Sulfluramid (N-ethyl perfluorooctane sulfonamide) and dynamics of associated rhizospheric microbial community in microcosms of wetland plants. Chemosphere. Volume 211 (2018) : 379-389

Although the use of Sulfluramid (N-ethyl perfluorooctane sulfonamide (N-EtFOSA)) has been restricted by the Stockholm Convention, it is still frequently detected in the environmental matrices and in use in some countries. Employing constructed wetlands as treatment systems requires understanding of the biodegradation process in the rhizosphere and the effect of contaminants on the microbes of wetlands. This study aimed to investigate the interactions between the microbial community and N-EtFOSA under aerobic and anaerobic conditions. Aerobic biotransformation of N-EtFOSA occurred with a half-life of 0.51 day and yielded 85.1 mol% PFOS of after 91 days. Kinetic modelling revealed that cleavage of the S__N was the rate-limiting degradation step. Biotransformation was not observed under anaerobic and anoxic conditions, suggesting that N-EtFOSA is recalcitrant to biodegradation without dissolved oxygen. Under aerobic condition, the presence of N-EtFOSA and its biotransformation products decreased the microbial richness and diversity and exerted selective pressure on the microbial community. Enrichment of *Methylocaldum* was significant (49%) in the presence of N-EtFOSA compared to unexposed conditions (11%), suggesting that *Methylocaldum* is relatively tolerant to N-EtFOSA and potentially degrading N-EtFOSA. Under anaerobic conditions, the microbial richness and diversity were not significantly altered by the presence of N-EtFOSA. Only *Methanomethylovorans* increased significantly in the spiked microcosm (30% vs. 20%). These findings provide knowledge for comprehending the contribution of N-EtFOSA to other PFASs in various environmental conditions, information about microbial community changes in response to PFASs and robust microbial species which can degrade N-EtFOSA in the environment.

Biomarker

Wei-mingYangJuan-juanChen (Department of Clinical Laboratory,The Second Affiliated Hospital of Nanchang University, Jiangxi Province Key Laboratory of Laboratory

Medicine, Nanchang 330006, Jiangxi, China) Advances in biomarkers for dermatomyositis. Clinica Chimica Acta. Volume 482 (2018) : 172-177

Dermatomyositis (DM) and polymyositis (PM) are heterogeneous complex autoimmune diseases involving muscle damage. Patients with DM and PM display a wide spectrum of clinical manifestations and serological biomarkers, which may mislead and delay the proper diagnosis. Therefore, specific biomarkers or indicators for diagnosing DM and PM and monitoring disease activity are essential. Significant progress has been made through identifying novel serological biomarkers for DM and PM in recent years. Our aim is to focus on novel biomarkers for diagnosing and monitoring disease activity in DM and PM to highlight their predictive value and applicability in clinical practice.

Keywords: Dermatomyositis; Biomarkers; Diagnosis; Disease activity

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Idiopathic pulmonary fibrosis (IPF) is a chronic, debilitating, fibrotic lung disease leading to respiratory failure and ultimately to death. Being the prototype of interstitial lung diseases, IPF is characterized by marked heterogeneity regarding its clinical course. Despite significant progress in the understanding of its pathogenesis, we still cannot reliably predict the course of the disease and the response to treatment of an individual patient. Non-invasive biomarkers, in particular serum biomarkers, for the (early) diagnosis, differential diagnosis, prognosis and prediction of therapeutic response are urgently needed. Numerous molecules involved in alveolar epithelial cell injury, fibroproliferation and matrix remodeling as well as immune regulation have been proposed as potential biomarkers. Furthermore, genetic variants of *TOLLIP*, *MUC5B*, and other genes are associated with a differential response to treatment and with the development and/or the prognosis of IPF. Additionally, the bacterial signature in IPF lungs, as shown from microbiome analyses, as well as mitochondrial DNA seem to have promising roles as biomarkers. Moreover, combination of multiple biomarkers may identify comprehensive biomarker signatures in IPF patients. However, there is still a long way until these potential biomarkers complete or substitute for the clinical and functional parameters currently available for IPF.

Keywords: Biomarkers; IPF; MUC5B; Matrix metalloprotease

Francesco PaoloSchenaMD*[†] Sharon NatashaCoxPhD*[†] ([]Policlinic, University of Bari, Bari, Italy[†]Laboratory Research, Schena Foundation, Valenzano, Bari, Italy) Biomarkers

and Precision Medicine in IgA Nephropathy. Seminars in Nephrology. Volume 38, Issue 5 (2018) : 521-530

The field of biomarker research in IgA nephropathy has experienced a major boost in recent years with the publication of a large number of scientific reports. Candidate biomarkers from blood, urine, and renal tissue obtained through the use of clinical chemistry, molecular biology, and omics have been proposed for translation in clinical practice. Nevertheless, individual biomarkers often lack sensitivity and specificity with the consequent impairment of disease specificity. This review, moving on from the analysis of the four-hit hypothesis, illustrates the biomarkers linked to the abnormal glycosylation process of IgA1 and the immune complex formation. It also describes other serum and urinary biomarkers. Given the profound insights into the pleiotropic function of a single biomarker that is specific for a pathophysiological mechanism, this review suggests a novel approach based on a panel of biomarkers that covers the entire pathogenic process of the disease. Clinical bioinformatics that integrate genetic, clinical, and bioinformatics data sets could optimize the specific value of each biomarker in a multimarker panel. This is a promising approach for precision medicine and personalized therapy in IgA nephropathy.

Keywords: Biomarkers; IgA nephropathy; serum; urine; kidney biopsy

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The treatment and prognosis of metastatic melanoma has changed substantially since the advent of novel immune checkpoint inhibitors (ICI), agents that enhance the anti-tumor immune response. Despite the success of these agents, clinically actionable biomarkers to aid patient and regimen selection are lacking. Herein, we summarize and review the evidence for candidate biomarkers of response to ICIs in melanoma. Many of these candidates can be examined as parts of a known molecular pathway of immune response, while others are clinical in nature. Due to the ability of ICIs to illicit dramatic and durable responses, well-validated biomarkers that can be effectively implemented in the clinic will require strong negative predictive values that do not limit patients with who may benefit from ICI therapy.

Keywords: Melanoma; Biomarker; Checkpoint inhibitor; PD-1; CTLA-4

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University of Southern California, 3616 Trousdale Parkway, Los Angeles, CA 90089-0371, USA[e]University of Minnesota Medical School, Minneapolis, MN 55455, USA) **Assessing biomarker syngeneity: An in situ approach using monoclonal antibodies. Organic Geochemistry. Volume 124 (2018) : 112-122**

Lipid biomarkers preserved in ancient rocks have the potential to reveal much about ancient ecosystems. However, establishing that the compounds of interest are syngenetic has proven to be an analytically challenging task. Traditional biomarker analyses rely on extraction of large quantities of powdered rock, making the association of molecules with sedimentary fabrics difficult, if not impossible. As an alternative approach, here we show that monoclonal antibodies that bind specifically to geolipids can be used as molecular probes for in situ detection and localization of such compounds. Monoclonal antibodies that bind to squalene and cross-react with the biomarker squalane were evaluated for labeling sediment-associated hydrocarbons. The anti-squalene antibodies were shown by dot immunoblotting with composed standards to cross-react also with other isoprenoids, such as phytol and its diagenetic products, suggesting reactivity towards acyclic isoprenoids. Then, the anti-squalene antibodies were shown to react with naturally occurring crude oils and, via an immunofluorescence-labeling approach, to bind to isolated organic-rich laminae in rocks from the Eocene Green River Formation known to contain squalane among other linear isoprenoids. These results suggest that squalane, or structurally similar organic biomarkers that cross-react with the antibodies, are confined to discrete organo-sedimentary fabrics within those rocks, providing evidence for their syngeneity. Depending on the specificity and sensitivity of the antibody/geolipid pair, an in situ antibody detection approach may be useful for establishing biomarker syngeneity in older rocks.

Keywords: Syngeneity; Lipid biomarker; Immunodetection; Squalane; Acyclic isoprenoids; Green River Formation

Clifford C.Walters[a], Frank C.Wang[a], Meytal B.Higgins[a], Marlene E.Madincea[b] ([a]ExxonMobil Research & Engineering Co., 1545 Route 22 East, Annandale, NJ 08801, United States[b]ExxonMobil Upstream Research Co., 22777 Springwoods Village Parkway, Spring, TX 77389, United States) **Universal Biomarker Analysis: Aromatic hydrocarbons. Organic Geochemistry. Volume 124 (2018) : 205-214**

Universal Biomarker Analysis is a GC×GC-ToFMS method that provides absolute quantification and non-targeted pseudo MS-MS for all resolved hydrocarbon components in petroleum and rock extracts. This is achieved by merging two chromatographic datasets obtained under field ionization (FI), which provides molecular ions, and electron impact (EI), which provides diagnostic fragment ions. We recently demonstrated this technique for the analysis of saturated biomarkers (Walters et al., 2018). Here, we show its application to aromatic biomarkers. Universal Biomarker Analysis is compared to conventional GC–MS for frequently analyzed aromatic hydrocarbons, such as the alkylated naphthalenes and biphenyls, mono- and tri-aromatic steroidal hydrocarbons to illustrate where this new method provides demonstrated

advantages. The technique is well suited for the analysis of rare species not commonly analyzed in targeted GC–MS/MS analyses. This is illustrated by the tentative identification of A/B-ring C_{26}-C_{29} diaromatic steroidal hydrocarbons in a crude oil, compounds that have been previously identified as minor components of immature rock extracts, and indications of previously unknown C_{26} methyl-triaromatic steroidal hydrocarbons.

Keywords: Comprehensive gas chromatography; GC×GC-ToFMS; Aromatic hydrocarbons; Aromatic biomarkers

TakeoFujii[a], AungNaing[b], ChristianRolfo[c], JoudHajjar[d] ([a]University of Hawaii Cancer Center, Honolulu, HI, United States[b]Department of Investigational Cancer Therapeutics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States[c]Thoracic Medical Oncology, Early Clinical Trials, University of Maryland Marlene and Stewart Greenebaum Comprehensive Cancer Center (UMGCCC), Baltimore, MD, United States[d]Section of Immunology, Allergy and Rheumatology, Texas Children's Hospital, Baylor College of Medicine, Houston, TX, United States) Biomarkers of response to immune checkpoint blockade in cancer treatment. Critical Reviews in Oncology/Hematology. Volume 130 (2018) : 108-120

Immune checkpoint inhibitors (ICPis) are emerging as the new corner stone of cancer treatment due to their ability to produce durable responses in patients with various cancers. But, objective responses to ICPis vary among each type of cancer. Further, treatment with ICPis is often associated with risk of developing immune-related adverse event, which are potentially life-threatening if untreated, indicating a need for patient selection. However, given the complexity of the tumor microenvironment and the dynamic interaction between tumor and immune cells, development of robust biomarkers to predict patients who are likely to respond to treatment with ICPis remains a challenge. In this review we present an overview of the immune monitoring strategies that are currently in use to enable appropriate patient selection.

Biofertilizer

HarekrushnaSwain[a], TotanAdak[a], Arup K.Mukherjee[a], Prasun K.Mukherjee[d], Pratap Bhattacharyya[c], Shantiprava Behera[a], Torit Baran Bagchi[b], Rashmishree Patro[a], Shasmita[a], Ansuman Khandual[a], M.K.Bag[a], T.K.Dangar[c], S.Lenka[a], M.Jena[a] ([a]Division of Crop Protection, ICAR-National Rice Research Institute, Cuttack, 753006, Odisha, India[b]Crop Physiology and Biochemistry Division, ICAR-National Rice Research Institute, Cuttack, 753006, Odisha, India[c]Division of Crop Production, ICAR-National Rice Research Institute, Cuttack, 753006, Odisha, India[d]Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Trombay, Mumbai, 400085, India) Novel *Trichoderma* strains isolated from tree barks as potential biocontrol agents and biofertilizers for direct seeded rice. Microbiological Research. Volume 214 (2018) : 83-90

This study is the first time report of utilization of *Trichoderma* spp. isolated from different tree bark from Odisha state of India for rice crop health management and higher productivity. Six

isolates of *Trichoderma* spp. were identified based on the morphological characteristics and species determination was performed by molecular assays. One of the isolated strains determined as *Trichoderma erinaceum* outperformed others. *Trichoderma erinaceum*controlled three soil borne plant pathogens i.e. *Rhizoctonia solani, Sclerotium rolfsii* and *Sclerotium oryzae* effectively under controlled condition and *R. solani* and *Helminthosporium oryzae* under filed condition. Seed treatments with the formulated isolates improved the germination rate of rice and enhanced vigour. These parameters along with higher chlorophyll content could be related to higher yield observed in two rice varieties; *Karuna and Sahabhagidhan*. Among the six isolates tested, *Trichoderma erinaceum* treatment recorded highest yield. Significantly higher expression of some stress related enzymes was observed in *Trichoderma* treated plants which helped in better crop growth both under biotic and abiotic stresses. These isolates helped both the varieties to accumulate more nutrients. This study proves that *Trichoderma erinaceum* obtained from tree bark may be incorporated in integrated rice crop management both as biocontrol agent and biofertilizer.

Keywords: *Trichoderma erinaceum;* Biocontrol; Biofertilizer; Stress enzymes; Sheath blight; Nutrient uptake; Direct seeded rice

SubhashPaul, AnimeshDutta, FantahunDefersha ([uaff]School of Engineering, University of Guelph, On, N1G2W1, Canada). **Biocarbon, biomethane and biofertilizer from corn residue: A hybrid thermo-chemical and biochemical approach. Energy. Volume 165, Part B, (2018): 370-384**

In this research a hybrid thermochemical and biochemical approach is proposed to produce biocarbon, biomethane and biofertilizer from corn residue using the concept of resource recovery from biowaste. In this approach, corn residue is first pretreated in hydrothermal carbonization process to produce solid biocarbon. Hydrothermal process water, a co-product of hydrothermal carbonization process underwent fast anaerobic digestion to produce biomethane and biofertilizer. Effects of operating conditions (process temperature and residence time) on both biocarbon and hydrothermal process water contents were studied. Four selected hydrothermal temperatures of 200^0C, 220^0C, 240^0C and 260^0C and their three corresponding residence times of 10 min, 20 min and 30 min were considered. Among these 12 hydrothermal processes, 240^0C for 30 min process produced hybrid bioenergy of 14.26 $MJkg^{-1}$ of raw corn residue with an overall energy yield of 78.65%. Biocarbon produced at 240^0C for 30 min and 260^0C for 10 to 30 min were comparable to pulverised coal used in power plants, which contained high heating values of 23.01 $MJkg^{-1}$ to 24.70 $MJkg^{-1}$. All anaerobic digestion digestate are nutrient enriched and useable as liquid fertilizer.

Keywords: Biocarbon; biogas; biofertilizer; hydrothermal process; anaerobic digestion

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TA A-82/J, 34398 Montpellier Cedex 5, France) Biochemical characterization and efficacy of *Pleurotus, Lentinus*and *Ganoderma* parent and hybrid mushroom strains as biofertilizers of attapulgite for wheat and tomato growth. Biocatalysis and Agricultural Biotechnology. Volume 16 (2018) : 63-72

Pleurotus, Lentinus and *Ganoderma* are mushrooms which have various properties and should be explored as bioresources for various uses such as biofertilizers for sustainable intensification of agriculture. *Pleurotus, Lentinus* and *Ganoderma* species and intra- and inter-specific/generic hybrids produced with the dual culture technique were evaluated for chitinase and esterase activities, phosphate solubilization ability, siderophore production, mycelia growth, and efficacy as biofertilizers using semi-quantitative assays. All parent and selected hybrid strains were assessed as biofertilizers in attapulgite for wheat and tomato cultivation. Correlations between biochemical characteristics, plant root and shoot biomass, and microbial loads and ergosterol content of tomato cultivation substrate post-harvest were determined. Biochemical characteristics studied were mushroom strain-specific, independent on mycelia growth rate and were altered in hybrids. Esterase production was strain-dependent and precipitates produced differed in size. This is the first report of siderophore production by *P. tuber-regium, L. squarrosulus* and *Ganoderma* sp. from Ghana as well as alteration of siderophore production by intra-species/generic and inter-generic hybrid strains. Biofertilizer efficacy of parent strains and intra- and inter-specific/generic hybrids was mushroom strain- and plant species-specific. *L. squarrosulus* strain SqW and *P. sajor-caju* strain PScW were most efficacious strains for wheat and tomato cultivation respectively. Fungal (3.65–5.40 cfu g^{-1}) and bacterial (0–6.43 cfu g^{-1}) colony counts after tomato cultivation varied among treatments. Ergosterol concentration in all treatments (0.07–0.96 μg g^{-1}) were higher than in control treatment (0.05 μg g^{-1}). Chitinase activity and siderophore production of mushroom strains positively correlated with both wheat and tomato growth. Utilization of mushrooms as biofertilizers will enhance food security.

Keywords: Colony counts; Chitinase activity; Ergosterol content; Esterase activity; Mushroom breeding; Siderophore production

Nivien Allam, NafadyElhagag, AhmedHassan, Mohamed HemidaAbd-AllaMagdy Mohamed KhalilBagy (Department of Botany and Microbiology, Faculty of Science, Assiut University, 71516 Assiut, Egypt) Effectiveness of eco-friendly arbuscular mycorrhizal fungi biofertilizer and bacterial feather hydrolysate in promoting growth of *Vicia faba* in sandy soil. Biocatalysis and Agricultural Biotechnology. Volume 16 (2018) : 140-147

The current study purposed to improve vegetative growth, nodules formation and biological dinitrogen fixation of *Vicia faba* L. (faba bean) grown in sandy soil by inoculation with bacterial feather hydrolysate fertilizer (BFH) and arbuscular mycorrhizal fungi (AMF). A potent feather-degrading bacterium was isolated from chicken feathers and molecular identified as *Bacillus licheniformis* ASU (Accession number KF446641). Two different native AMF were recovered from the sandy soil and identified as *Acaulospora* bireticulata and *Glomus* caesaris. Bacillus licheniformis has the capability to degrade the chicken feathers efficiently. Furthermore, it can

solubilize tricalcium phosphate and produce ammonia and IAA (indole acetic acid). Faba bean seeds were grown in pot experiments containing sandy soil inoculated with AMF or BFH individually or in combination. The application of AMF and BFH in combination significantly increased nodule formation and N_2-fixation. The total dry biomass of plants co-inoculated with AMF and BFH was increased significantly compared with non-inoculated plants. So, the combination with AMF and BFH has the potential to be developed as a useful biofertilizer in future. This paper is expected to afford a competitive economic outcome for sustainable cropping systems.

Keywords: Bacterial feather hydrolysate fertilizer; Biofertilizer; Mycorrhizal fungi; Sandy soil

Christian O.Asadu[a] Nebechukwu G.Aneke[a] Samuel O.Egbuna[a] Albert C.Agulanna[b] ([a]Department of Chemical Engineering, Enugu State University of Science and Technology, P.M.B 01660, Enugu, Nigeria[b]Projects Development Institute (PRODA) Emene Industrial Layout, Enugu, Nigeria) **Comparative studies on the impact of bio-fertilizer produced from agro-wastes using thermo-tolerant actinomycetes on the growth performance of Maize (Zea-mays) and Okro (Abelmoschus esculentus). Environmental Technology & Innovation. Volume 12 (2018) : 55-71**

The negative effect of chemical fertilizer in the soil has made it imperative for this research to compare the efficacy of using Biofertilizer produced from Agro-wastes as an alternative to chemical fertilizer. Bio-fertilizer was produced in this work by composting mixtures of sawdust plus chicken litter, sawdust plus sewage sludge and sawdust only, using microbial inoculums as the accelerator. Pilot scale study was performed with containers made of polyethylene (PET) as the composter. Actinomycetes were isolated from Soil mixed with Agro waste compost. Characterization of organisms showed that there were six genera of Actinomycetes isolated. Starch Casein Agar was used as the isolation media. Turning over of the compost piles was done twice every week for aeration. Parameters such as N, C, Organic Matter content, temperature etc. of the composts were evaluated every 5days interval till the end of composting and the results demonstrated that Organic matter and Carbon content decreased significantly with time in all the compost, nitrogen content of compost A and B increased with time, but nitrogen content of compost C decreased. The highest temperature recorded was 62.1 ° C after 20 days of composting of substrate B. The end product of composting was further evaluated for effectiveness as organic fertilizer in the field studies. The two plants tested in the field were Okro (Albemoschus esculentus) and Maize (Zea mays). Results obtained from the experiments showed that Biofertilizer enhanced the growth of Okro and maize and hence has the tendency to replace chemical fertilizer in future with amplified investigations.

Biocomposting

SarmisthaPaul[a], SubhasishDas[a], PrasantaRaul[b], Satya SundarBhattacharya[a] ([a]Soil and Agro Bio-engineering Lab, Department of Environmental Science, Tezpur University, Tezpur 784 028, India[b]Defense Research Laboratory (DRDO), Tezpur, Assam, India) **Vermi-sanitization of toxic silk industry waste employing *Eisenia fetida* and *Eudrilus eugeniae*: Substrate compatibility, nutrient enrichment and metal accumulation dynamics. Bioresource Technology. Volume 266 (2018) : 267-274**

Detoxification of silk processing effluents and sludge (SPES) through composting approaches is a new idea. This study examined the biodegradation potential of two epigeic earthworms (*Eisenia fetida* and *Eudrilus eugeniae*) in different SPES and cow dung (CD) mixtures in comparison with composting. N, P, S, Fe and Mn availability significantly increased upon vermicomposting compared to aerobic composting. The alkaline pH of the feedstocks satisfactorily neutralized under vermicomposting. The Ca-K availability and cation exchange dynamics readily stabilized due to vermicomposting. Interestingly, *Eisenia fetida* exhibited greater adaptability towards the toxic SPES materials than *Eudrilus eugeniae*, which was accompanied by 60–70% reduction of Cd, Cr, Zn and Pb levels in *Eisenia* system, whereas metal accumulation ability of *Eudrilus eugeniae* was remarkable. Moreover, both the species equally contributed in augmentation of beneficial (N-fixing and P-solubilizing) microorganisms in the feedstocks. Overall, nutrient enrichment and sanitizing potency of vermitechnology was explicitly manifested in SPES + CD (1:1) combination.

Keywords: Silk industry waste; Vermitechnology; Metal remediation; Microbial diversity

LineeGoswami[a] RupakMukhopadhyay[a] Satya SundarBhattacharya[b] PallabiDas[b] RinkuGoswami[c] ([a]Department of Molecular Biology & Biotechnology, Tezpur University, Napaam, Assam, India [b]Department of Environmental Science, Tezpur University, Napaam, Assam, India[c]Zoological Survey of India, Kolkata, India) **Detoxification of chromium-rich tannery industry sludge by *Eudrillus eugeniae:* Insight on compost quality fortification and microbial enrichment. Bioresource Technology. Volume 266 (2018) : 472-481**

Chromium-rich tannery sludge (TS) is a hazardous industrial waste. Although vermicomposting can be an effective remediation pathway; but, the unique waste degrading efficiency of *Eudrillus eugeniae* is least explored. The present work showcases an efficient earthworm-mediated protocol for TS sanitization deploying *E. eugeniae*. Changes in pH, TOC (%), nutrients (NPK), metals (Cr, Cd etc.) and microbial diversity were monitored in various *E. eugeniae* mediated TS based vermibed. Total N, P, and K availability increased by 2–5 folds upon vermicomposting with 3–4 folds reduction in C/N ratio. Moreover, substantial removal of Cr (89%), Cd (88%), and Zn (79%) was recorded in the substrate. Bioaccumulation of these metals in the gut significantly reduced the pollution load in the finished products. The corresponding augmentation of microbial density and low respiratory CO_2 release from the vermibeds substantiated the environmental proficiency of vermitechnology.

Keywords: Tannery sludge; *Eudrillus eugeniae;* Chromium toxicity; Compost quality; Vermicomposting; Microbial activity

AyumiShikata[a] JunjarusSermsathanaswadi[b] PhakhineeThianheng[c] SirilakBaramee[d] ChakritTachaapaikoon[d] RattiyaWaeonukul[d] PatthraPason[d] KhanokRatanakhanokchai[c] AkihikoKosugi[ae] ([a]Graduate School of Life and Environmental Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8572, Japan[b]Department of Chemical Technology, Faculty of Science and Technology, Suan Dusit University, 295 Nakhon Ratchasima Road, Dusit, Bangkok, 10300, Thailand[c]Enzyme Technology Laboratory, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (KMUTT), Bangkok, 10150, Thailand[d]Pilot Plant Development and Training Institute (PDTI), King Mongkut's University of Technology Thonburi (KMUTT), Bangkok, 10150, Thailand[e] Biological Resources and Post-harvest Division, Japan International Research Center for Agricultural Sciences (JIRCAS), 1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, Japan) **Characterization of an Anaerobic, Thermophilic, Alkaliphilic, High Lignocellulosic Biomass-Degrading Bacterial Community, ISHI-3, Isolated from Biocompost. Enzyme and Microbial Technology. Volume 118 (2018) : 66-75**

The generation of a complex microbial consortium is a promising approach for efficient biomass decomposition. An anaerobic thermophilic alkaliphilic microbial consortium with efficient degradation ability was screened from bovine manure compost using non-pretreated milling corn stover (CS) and rice straw (RS). A stable microbial consortium ISHI-3 with high degradation ability for CS and RS was isolated by the roll tube technique. ISHI-3 comprised *Herbivorax saccincola* and bacteria belonging to the classes *Pelotomaculum*, *Tepidanaerobacter*, and *Tepidimicrobium*, as determined by DGGE of the PCR-generated *16S rRNA* genes. Furthermore, metagenomics analysis using a *16S rRNA* library was carried out to determine the bacterial distribution during degradation of CS and RS. *H. saccincola* and bacteria belonging to *Pelotomaculum* were relatively abundant in the beginning to middle periods of culture with CS and RS whereas bacteria belonging to *Tepidanaerobacter* and *Tepidimicrobium* gradually increased in the population during the later stages. To understand the role of non-cellulolytic bacteria in the consortium, novel strains ET1 and GL4, which were most closely related to *Tepidimicrobium ferriphilum* and *Tepidanaerobacter acetatoxydans*, were isolated from ISHI-3. Based on their carbon source usage, morphology, and phylogenetic analysis, we propose that strains ET1 and GL4 should be classified as a novel genus or species. Bacteria ET1 and GL4 can utilize different organic compounds as carbon and energy sources such as organic acids, alcohols, sugars, and amino acids, showing a preference for organic acids and alcohols rather than sugars such as glucose and cellobiose. These results indicated that ET1 and GL4 help to accelerate efficient lignocellulose degradation of *H. saccincola*.

Biopesticides

Grace H.Smith[a], Joe M.Roberts[b], Tom W.Pope[b] ([a]Crop and Environment Research Centre, Harper Adams University, Newport, Shropshire, TF10 8NB, UK[b]Centre for Integrated Pest Management, Harper Adams University, Newport, Shropshire, TF10 8NB, UK) **Terpene based biopesticides as potential alternatives to synthetic insecticides for control of aphid pests on protected ornamentals. Crop Protection. Volume 110 (2018) : 125-130**

Biopesticides based on plant extracts offer a promising alternative to the use of conventional synthetic pesticides. However, biopesticide products must provide acceptable levels of control. To date, few studies have investigated the efficacy of biopesticide products under conditions that reflect commercial practice. Here we report results from three experiments, one completed under glasshouse conditions in 2014 and two completed under polytunnel conditions, in 2015 and 2016, respectively. These experiments tested the efficacy of three terpene based biopesticides used to control two aphid species, peach-potato aphid (Myzus persicae) and melon and cotton aphid (*Aphis gossypii*), on ornamental crops. The three biopesticide products tested were orange oil (60 g active ingredient per litre, formulated as a soluble liquid), the essential oil from *Chenopodium ambrosioides* variety nr. *ambrosioides*(16.75% active ingredient, formulated as an oil dispersion) and neem oil (1% active ingredient, formulated as emulsifiable concentrate). The biopesticides tested were applied as foliar sprays using a water volume of 600 l/Ha and all experiments were done at Harper Adams University, Shropshire, UK.

The biopesticide products tested gave statistically similar levels of control of *M. persicae*populations on pansy plants as the conventional synthetic insecticide flonicamid (500 g/kg active ingredient, formulated as a wettable granule) and spirotetramat (150 g/l active ingredient, formulated as an oil dispersion). All products reduced numbers of aphids by at least 85% during the experimental period. Orange oil also gave a similar speed of kill to flonicamid and was faster acting than spirotetramat, two conventional synthetic insecticides that are widely used to control aphid pests of ornamental crops. Against *A. gossypii* on *Hebe*, orange oil gave similar levels of control (90% reduction in aphid numbers) as flonicamid (98% reduction in aphid numbers), when applied with a spray interval of three days (as per label recommendation). The essential oil from *Chenopodium ambrosioides*variety nr. *ambrosioides* was not as effective as flonicamid but did significantly reduced (80% reduction in aphid numbers) numbers of *A. gossypii* on *Hebe* compared to a water control when applied with a spray interval of five days. Neem oil was not effective against *A. gossypii*. Importantly, there was little evidence of any phytotoxicity caused by any of the biopesticide products tested. The potential to use these products as part of an Insecticide Resistance Management (IRM) programme are discussed.

Keywords: Orange oil; Chenopodium ambrosioides variety nr. Ambrosioides; Neem oil; Azadirachtin; Myzus persicae; Aphis gossypii

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University, College of Agricultural and Veterinary Sciences, Department of Crop Protection, Rod. Prof. Paulo Donato Castellane km 5, CEP 14884-900 Jaboticabal, SP, Brazil[b]Araraquara University, Avenida Maria Antonia Camargo de Oliveira, Vila Suconasa, CEP 14807120 Araraquara, SP, Brazil) *Spodoptera albula* susceptibility to *Bacillus thuringiensis*-based biopesticides. Journal of Invertebrate Pathology. Volume 157 (2018) : 147-149

Single concentration and virulence (mean lethal concentration) bioassays were performed to evaluate the susceptibility of *S. albula* second instar larvae to seven *Bacillus thuringiensis*-based biopesticides. Bioassays were conducted using three replicates and repeated three times at 25 °C, 70 ± 10% RH, and a 12:12 (light/dark) photoperiod; mortality was recorded seven days after treatment. The results were subjected to a Tukey's test and Probit analysis. Agree, DiPel SC, and XenTari achieved mortality rates of up to 80%, with the first of these being the most virulent against *S. albula.* Different Dipel formulations showed different degrees of larvicidal activity.

Keywords: Microbialcontrol; Gray-streaked armyworm moth; Pest management

Erika PaolaGrijalba[a] CarlosEspinel[a] Paola EmiliaCuartas[a] Martha LilianaChaparro[a] Laura FernandaVillamizar[ab] ([a]Corporación Colombiana de Investigación Agropecuaria - Corpoica, Centro de Investigación Tibaitatá, kilómetro 14 vía Mosquera-Bogotá, Cundinamarca, Colombia[b]AgResearch, Forage Science, Lincoln Research Centre, Private Bag 4749, Christchurch 8140, New Zealand). *Metarhizium rileyi* biopesticide to control *Spodoptera frugiperda*: Stability and insecticidal activity under glasshouse conditions. Fungal Biology. Volume 122, Issue 11 (2018) : 1069-1076

The insect-pathogenic fungus *Metarhizium* rileyi is highly sensitive to nutritional and environmental conditions which makes it difficult to produce as a stable biopesticide. In this study, a Colombian isolate of this fungus was produced in bulk, and conidia were formulated as an emulsifiable concentrate (EC). The stability of formulated conidia was studied. Conidial viability was maintained at >85 % viability for 12 m under refrigeration and for >three months at 18 °C. The pH values were stable, while contaminant content was significantly reduced. The efficacy of the EC to control *Spodoptera frugiperda* (Smith) was correlated with the storage time using different mathematical models, and conservative values of six and 12 months at 8 °C and 18 °C respectively, were established. Finally, the EC was evaluated in maize plants under glasshouse conditions. The LC_{50} and LC_{90} were estimated to be 1.17×10^4 and 4.03×10^6 conidia/mL respectively and a 57 % reduction in recent damage of plants was achieved. This study demonstrated the potential of *M. rileyi*formulated as EC to control *S. frugiperda* in maize. Therefore, it is necessary to continue developing this biopesticide, in order to deliver a new tool to be integrated in pest management programs.

Keywords: Bioproduct; Fall armyworm; Formulation; *Nomuraea rileyi;* Shelf life

KanikaChowdhary[a], AshwaniKumar[b], SatyawatiSharma[a], RitikaPathak[a], MonikaJangir[a] ([a]Centre for Rural Development and Technology, IIT- Delhi, Hauz Khas, Delhi 110016, India[b]Metagenomics and Secretomics Research Laboratory, Department of Botany, Dr. Harisingh Gour University (A Central University), Sagar, 470003, M.P., India) **_Ocimum_ sp.: Source of biorational pesticides. Industrial Crops and Products. Volume 122 (2018) : Pages 686-701**

Ecologically sustainable agriculture is an inherently self-preserving farming system. It denotes conservation of both quantity and quality of agricultural produce for prolonged time without undue resource exhaustion and vitality loss of soil and environment. Ethnobotanical plants have been utilised for pest control since early times of agricultural evolution. Biochemical biopesticides derived from Lamiaceae family (Lavender, rosemary, sage and thyme) have been well documented in literature. The literature compiled in the present document summarises the intensity and impact of research carried out with respect to biopesticidal efficacy (fungicidal, adulticidal, larvicidal, nematicidal, antihelminthic, ovicidal, oviposition deterrence, repellency, acaricidal, antileishmanial, trypanocidal) exhibited by organic, aqueous extracts and essential oils of all *Ocimum* sp. together as a single piece of work. Further, future challenges involved in the development of an efficacious biopesticide at the field level along with prospective opportunities of nanoscience based agricultural biopesticides have been discussed. The knowledge and data organised in this manuscript can be utilised as a reference point for future investigators exploring the application of *Ocimum* sp. in fight against persistence pathogens and pest.

Keywords: *Ocimum* sp; Sustainable agriculture; Essential oils; Plant protection; Nano agri-pesticides

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The aim of this contribution was to obtain bioactive materials for stored grain protection and food preservation, by incorporating a biopesticide (1-octen-3-ol) in polyethylene (LDPE) films using supercritical CO_2–assisted impregnation. The influence of different pressures and depressurization rates on impregnation yield was investigated. Results revealed that the best

impregnation yield of biopesticide in the films ($Y = 3.39 \pm 0.27\%$) is associated with low depressurization rate (0.5 MPa min^{-1}) and mild pressure conditions (~9 MPa). The release kinetics of 1-octen-3-ol from the impregnated films was also investigated. In addition, the biocidal activity of impregnated films obtained at the best operational conditions was tested towards two of the main pests of stored grains. Films showed insecticidal activity against *Sitophilus zeamais* (100% mortality after 24 h) and also produced a decrease of the fungal growth rate of *Fusarium verticillioides* (55% inhibition).

Keywords: 1-octen-3-ol; LDPE films; supercritical CO_2-assisted impregnation; *F. verticillioides; S. zeamais*

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The red cotton bug, *Dysdercus koenigii* (Fabricius) is an important emerging economic pest of cotton, *Gossypium hirsutum* Linnaeus in Pakistan. Insecticides are the primary management tactics to suppress populations of this pest. However, resistance to insecticides evolves due to substantial and repeated applications. The resistance to pyrethroids, neonicotinoids and biopesticides have been evaluated in many pests worldwide, nevertheless lack of information in *D. koenigii.* Therefore, the aforementioned insecticide resistance in five field populations of *D. koenigii* collected from Multan, Makhdoom Rashid, Jahanian, Lodhran and Vehari districts of Punjab, Pakistan during 2015–2017 was determined by using seed dip method. Based on the present results, *D. koenigii* has developed moderate to very high resistance to acetamiprid (RR = 33–433) and imidacloprid (RR = 21–173), low to high resistance to emamectin benzoate (RR = 14–52), and very low to high resistance to spinosad (RR = 4.13–54), compared to the susceptible population. However, all field populations of *D. koenigii* remained susceptible to deltamethrin (RR = 0.62–2.17) and lambda-cyhalothrin (RR = 0.91–1.97). A rotational use of pyrethroids with provision of other integrated pest management tactics is recommended to manage insecticide resistance in *D. koenigii*.

Biodegradation

ZhuotongZeng[a1], YangLiu[b1], HuaZhong[bc1], RongXiao[a1], Guangming Zeng[ab], ZhifengLiu[b], MinCheng[b] CuiLai[b], ChenZhang[b], GuanshengLiu[b], LeiQin[b] ([a]Department of Dermatology, Second Xiangya Hospital, Central South University, Changsha 410011, Hunan, PR China[b]College of Environmental Science and Engineering, Hunan University and Key Laboratory of Environmental Biology and Pollution Control (Hunan University),

Ministry of Education, Changsha 410082, PR China[c]State Key Laboratory of Water Resources and Hydropower Engineering Science, Wuhan University, Wuhan 430070, PR China) Mechanisms for rhamnolipids-mediated biodegradation of hydrophobic organic compounds. Science of The Total Environment. Volume 634 (2018) : 1-11

The widespread existence of hydrophobic organic compounds (HOCs) in soil and water poses a potential health hazard to human, such as skin diseases, heart diseases, carcinogenesis, etc. Surfactant-enhanced bioremediation has been regarded as one of the most viable technologies to treat HOCs contaminated soil and groundwater. As a biosurfactant that has been intensively studied, rhamnolipids have shown to enhance biodegradation of HOCs in the environment, however, the underlying mechanisms are not fully disclosed. In this paper, properties and production of rhamnolipids are summarized. Then effects of rhamnolipids on the biodegradation of HOCs, including solubilization, altering cell affinity to HOCs, and facilitating microbial uptake are reviewed in detail. Special attention is paid to how rhamnolipids change the bioavailability of HOCs, which are crucial for understanding the mechanism of rhamnolipids-mediated biodegradation. The biodegradation and toxicity of rhamnolipids are also discussed. Finally, perspectives and future research directions are proposed. This review adds insight to rhamnolipids-enhanced biodegradation process, and helps in application of rhamnolipids in bioremediation.

Keywords: Rhamnolipids; Hydrophobic organic compounds; Microorganism; Biodegradation; Bioremediation

Miriam Ahuactzin-Pérez[cd], SaúlTlécuitl-Beristain[e], Jorge García-Dávila[e], Ericka Santacruz-Juárez[e], ManuelGonzález-Pérez[f], María ConcepciónGutiérrez-Ruíz[b] CarmenSánchez[a] ([a]Laboratory of Biotechnology, Research Centre for Biological Sciences, Universidad Autónoma de Tlaxcala, Ixtacuixtla, Tlaxcala, CP 90062, Mexico[b]Departamento de Ciencias de la Salud, Universidad Autónoma Metropolitana-Iztapalapa, CDMX, Mexico[c]Doctorado en Biología Experimental, Universidad Autónoma Metropolitana-Iztapalapa (UAM-I), Mexico[d]Facultad de Agrobiología, Universidad Autónoma de Tlaxcala, Ixtacuixtla, Tlaxcala, Mexico[e]Universidad Politécnica de Tlaxcala, San Pedro Xalcatzinco, Tepeyanco, Tlaxcala, CP 90180, Mexico[f]Universidad Popular Autónoma del Estado de Puebla, Puebla, CP 72410, Mexico) Kinetics and pathway of biodegradation of dibutyl phthalate by *Pleurotus ostreatus.* Fungal Biology. Volume 122 (2018) : 991-997

Dibutyl phthalate (DBP) is a plasticizer, whose presence in the environment as a pollutant has attained a great deal of attention due to its reported association with endocrine systemdisturbances on animals. Growth parameters, glucose uptake, percentage of removal efficiency (%E) of DBP, biodegradation constant of DBP (*k*) and half-life of DBP biodegradation ($t_{1/2}$) were evaluated for *Pleurotus ostreatus* grown on media containing glucose and different concentrations of DBP (0, 500 and 1000 mg l^{-1}). *P. ostreatus*degraded 99.6 % and 94 % of 500 and 1000 mg of DBP l^{-1} after 312 h and 504 h, respectively. The *k* was

0.0155 h^{-1} and 0.0043 h^{-1} for 500 and 1000 mg of DBP l^{-1}, respectively. $t_{1/2}$ was 44.7 h and 161 h for 500 and 1000 mg of DBP l^{-1}, respectively. Intermediate compounds of biodegraded DBP were identified by GC-MS and a DBP biodegradation pathway was proposed using quantum chemical calculation. DBP might be metabolized to benzene and acetyl acetate, the first would be oxidated to muconic acid and the latter would enter into the Krebs cycle. *P. ostreatus* has the ability to degrade DBP and utilizes it as source of carbon and energy.

Keywords: Basidiomycete; Biodegradation pathway; Constant of biodegradation; Plasticizer; Removal efficiency

DharmenderKumar (Department of Biotechnology, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, 131039 Sonepat, Haryana, India) Biodegradation of γ-Hexachlorocyclohexane by *Burkholderia* sp. IPL04. Biocatalysis and Agricultural Biotechnology. Volume 16 (2018) : 331-339

The lindane (γ-Hexachlorocyclohexane**,** HCH) is recalcitrant man-made pesticide and due to its past agriculture use and had toxicity to human, other living organisms and its metabolites detected in the environment. The microorganisms can transform and/ degrade it by the mechanism of transformation and biodegradation, respectively. In this study, the degrading bacteria was isolated from the soil sample taken from contaminated site by the enrichment culture method. The finally selected isolate IPL04 was characterized for γ-HCH degradation by supplementation of mineral salt medium with γ-HCH (10–100 mg/L). It should degrade 98 of g-HCH in 8 days. The isolate IPL04 was characterized by biochemical characterization, microscopic examination and 16S rRNA based sequencing. This isolate was identified as *Burkholederia* sp. and its 16S rRNA sequence was submitted to NCBI GenBank with accession number MF120286. The antibiotic sensitivity tests were also conducted. Effect of pH, temperature and incubation time was standardized during the degradation. The intermediates produced during the degradation by *Burkholederia* sp strain IPL04 were identified by FTIR and GC-MS analysis. The intermediates of biodegradation pathway were detected as c-pentachlorocyclohexane (c-PCCH), Trichloro-2,5-cyclohexadiene-1-ol (TCCH-1-ol), 2,5-dichlorohydroquinone (DCHQ), 1,2-benzenedicarboxlic acid. The metabolic pathway for the degradation by IPL04 was also proposed. This study leads to the finding that *Burkholederia* sp. strain IPL04 has lindane degradation potential and may be employed in γ-HCH degradation of lindane contaminated sites.

Keywords: Lindane; Biodegradation; Antibiotic sensitivity; Plate assay

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China) The effect of biodegradation on adamantanes in reservoired crude oils from the Bohai Bay Basin, China. Organic Geochemistry. Volume 123 (2018) : 38-43

The effect of biodegradation on adamantanes has been studied, based on a suite of genetically related crude oils with increasing degree of biodegradation, from the Miaoxi Depression, Bohai Bay Basin, China. Selectivity during biodegradation was observed for the adamantanes. The relative susceptibility to biodegradation of individual adamantane compounds was determined based on their compositional changes. Adamantanes with more alkyl substituents were generally more resistant to biodegradation, but exceptions also occurred. The position of alkylation had great control on the susceptibility to biodegradation. However, the more thermally stable compounds were not always more readily biodegraded, suggesting that the susceptibility of adamantanes is not directly controlled by thermodynamic stability. Selective biodegradation of adamantanes may be related to their stereochemical structures and demethylation could have occurred. Microbial alteration of adamantanes had negligible effects on the methyladmantane index, dimethyladamantane index 1, dimethyladamantane index 2, trimethyladamantane index 1 and trimethyladamantane index 2, suggesting that they could still be used to evaluate the thermal maturity of biodegraded crude oils. In contrast, the ethyladmantane index was significantly altered and thus is not valid for maturity assessment of biodegraded oils.

Keywords: Biodegradation; Diamondoids; Adamantane; Alkyladamantanes; Bohai Bay Basin

ZhengluWang, ZeqiongXu, XiqingLi (Laboratory for Earth Surface Processes, College of Urban and Environmental Sciences, Peking University, Beijing 100871, China) Biodegradation of methamphetamine and ketamine in aquatic ecosystem and associated shift in bacterial community. Journal of Hazardous Materials. Volume 359 (2018) : 356-364

Methamphetamine (METH) and ketamine (KET) are widely detected in surface waters and thus may pose threat to aquatic organisms. However, their degradation in aquatic systems and the effects on bacterial community were unknown. The present study investigated the biodegradation process of METH and KET in river waters and sediments. Three microcosms were examined over 40-days' incubation under (i) aerobic and illumination conditions, (ii) anaerobic condition exposed to light, (iii) anaerobic-dark condition. Statistically significant biodegradation of METH and KET ($1\ mg\ L^{-1}$) was observed in all treatments. The half-lives under the examined conditions indicate that the two drugs were refractory in aquatic environment. Moreover, there were no pronounced absorption and photolysis observed in this work. Illumina MiSeq sequencing analysis revealed that Methylophilaceae, Saprospiraceae, WCHB1–69, Desulfobulbaceae, Porphyromonadaceae, FamilyXI, Peptococcaceae, and Rhizobiaceae were the predominant candidatus families during KET and METH biodegradation, and the preponderance would impair other microorganisms' prosperity since them were scarcely detected in the wild. Meanwhile, canonical correlation analysis (CCA) indicates that METH as an environmental factor may affect bacterial community structure in field water samples.

Keywords: Methamphetamine; Ketamine; Biodegradation; Simulation microcosm; Bacterial community

JianfeiChen, ShuguangXie (State Key Joint Laboratory of Environmental Simulation and Pollution Control, College of Environmental Sciences and Engineering, Peking University, Beijing 100871, China) Overview of sulfonamide biodegradation and the relevant pathways and microorganisms. Science of The Total Environment. Volumes 640–641 (2018) : 1465-1477

Sulfonamide antibiotics have aroused increasing concerns due to their ability to enhance the resistance of pathogenic bacteria and promote the spread of antibiotic resistance. Biodegradation plays an important role in sulfonamide dissipation in both natural and engineered ecosystems. In this article, we provided an overview of sulfonamide biodegradation in different systems and summarized the relevant sulfonamide-degrading species and metabolic pathways. The removal of sulfonamides depends on a variety of factors, such as the type and initial concentration of sulfonamides, the properties of water or soil, and treatment process. The removal efficiency of sulfonamides by engineered ecosystems can be improved by optimizing their operating conditions. Much higher sulfonamide removal was also observed in upgraded or advanced treatment systems than in conventional activated sludge systems. Ammonia oxidation might promote sulfonamide biodegradation. In addition, sulfonamide-degraders from different bacterial genera have been isolated and classified, but no bioaugmentation practice has been reported. Different pathways have been detected in sulfonamide biodegradation. Further efforts will be necessary to elucidate in-situ degraders and the metabolic pathways and functional genes of sulfonamide biodegradation.

Keywords: Antibiotics; Biodegradation; Metabolic pathway; Microbial community; Sulfonamides

JoanaBendoraitieneEditaLekniute-KyzikeRamuneRutkaite (Department of Polymer Chemistry and Technology, Kaunas University of Technology, Radvilenu Rd. 19, LT-50254 Kaunas, Lithuania) Biodegradation of cross-linked and cationic starches. International Journal of Biological Macromolecules. Volume 119 (2018) : 345-351

The biodegradability and the influence of the degree of substitution of cationic groups or cross-linking level of starch were studied by using enzymatic hydrolysis and two aerobic degradation methods. Cationic starches with a degree of substitution varying from 0 to 0.54 were obtained by modifying native potato starch with 2,3-epoxypropyltrimethylammonium chloride, while cross-linked starches with a degree of cross-linking varying from 0 to 92.5% were obtained by reaction of native potato starch with epichlorohydrin. Enzymatic hydrolysis experiment was performed using α-amylase preparation, and aerobic degradation studies were carried out in liquid and solid media by using ISO 14855-2 and 14851 standards methods. The dextrose equivalent, molecular weight, viscosity and biodegradability parameters were used to assess biodegradation process. Biodegradability of modified starches decreased with increasing degree of modification. The

addition of cationic groups to starch to the extent >0.1 mol/mol$_{AGU}$ reduced the biodegradability of starch derivatives, and CS became non-biodegradable when DS ≥ 0.54. The cross-linking of starch by building the alkyl chain cross-links between the polysaccharide macromolecules reduced ultimate biodegradability of starch derivatives, when the degree of cross-linking was higher than 92.5%.

Keywords: Biodegradation; Cross-linked starch; Cationic starch; Enzymatic hydrolysis; Aerobic biodegradation

Jean-ReneThelusmond[a], EmilyKawka[a], Timothy J.Strathmann[b], Alison M.Cupples[a]. ([a]Department of Civil and Environmental Engineering, Michigan State University, East Lansing, MI 48824, USA[b]Department of Civil and Environmental Engineering, Colorado School of Mines, Golden, CO 80401, USA). **Diclofenac, carbamazepine and triclocarban biodegradation in agricultural soils and the microorganisms and metabolic pathways affected. Science of The Total Environment. Volumes 640–641 (2018) : 1393-1410**

The incomplete elimination of pharmaceuticals and personal care products (PPCPs) during wastewater treatment has resulted in their detection in the environment. PPCP biodegradation is a potential removal mechanism; however, the microorganisms and pathways involved in soils are generally unknown. Here, the biodegradation of diclofenac (DCF), carbamazepine (CBZ) and triclocarban (TCC) in four agricultural soils at concentrations typically detected in soils and biosolids (50 ng g^{-1}) was examined. Rapid DCF removal (<7 days) was observed under aerobic conditions, but only limited biodegradation was noted under other redox conditions. CBZ and TCC degradation under aerobic conditions was slow (half-lives of 128–241 days and 165–190 days for CBZ and TCC). Phylotypes in the *Proteobacteria*, *Gemmatimonadales* and *Actinobacteria* were significantly more abundant during DCF biodegradation compared to the controls (no DCF). For CBZ, those in the *Bacteroidetes*, *Actinobacteria*, *Proteobacteria* and *Verrucomicrobia*were enriched compared to the controls. *Actinobacteria* and *Proteobacteria* were also enriched during TCC biodegradation. Such differences could indicate these microorganisms are associated with the biodegradation of these compounds, as they appear to be benefiting from their removal. The impact of these PPCPs on the KEGG pathways associated with metabolism was also examined. Four pathways were positively impacted during DCF biodegradation (propanoate, lysine, fatty acid & benzoate metabolism). These pathways are likely common in soils, explaining the rapid removal of DCF. There was limited impact of CBZ on the metabolic pathways. TCC removal was linked to genes associated with the degradation of simple and complex substrates. The results indicate even low concentrations of PPCPs significantly affect soil communities. The recalcitrant nature of TCC and CBZ suggests soils receiving biosolids could accumulate these chemicals, representing risks concerning crop uptake.

Keywords: Diclofenac; Carbamazepine; Triclocarban; Pharmaceuticals; Biodegradation; Emerging contaminants

Rowena M.Briones, Wei-QinZhuang, Ajit K.Sarmah (Department of Civil & Environmental Engineering, Faculty of Engineering, The University of Auckland, Private Bag 92019, Auckland, 1142, New Zealand) Biodegradation of metformin and guanylurea by aerobic cultures enriched from sludge. Environmental Pollution. Volume 243, Part A (2018) : 255-262

Sewage sludge from a municipal wastewater treatment facility employing activated sludgeprocess was pre-incubated with varying substrates and mixtures of substrates including metformin (MET), guanylurea (GUA) and glucose. The biomass from enriched cultures separately utilising MET and glucose/GUA was then used to investigate the kinetics of aerobic biodegradation of MET and GUA, respectively, as individual substrates in batch reactors. The results showed that GUA can be completely degraded as a nitrogen source when glucose is provided as a carbon and energy source. On the contrary, MET can be biodegraded as a sole carbon and energy source. However, formation of by-product GUA in solution, which acts as a nitrogen source, rapidly increased the degradation rate of MET resembling autocatalytic behaviour. At low starting concentration of 5 mg/L, the specific substrate utilisation rates of MET and GUA were 0.0033 day^{-1} and 0.0013 day^{-1}, respectively, which is reported first time in this study. Out of the five biodegradation kinetic models used to describe substrate utilisation, the Quiroga-Sales-Romero (QSR) model was found to predict the measured MET and GUA degradation profile well supported by the goodness of fit parameters. Furthermore, the QSR model was able to describe the autocatalytic degradation of MET and the incomplete biodegradation of GUA in solution.

Biosensor

C.S.Pundir, Seema Jakhar,Vinay Narwal. (Department of Biochemistry, M.D.University, Rohtak-124001, (Haryana) India). Determination of urea with special emphasis on biosensors: A Review. Biosensors and Bioelectronics. Volume 123 (2018): 36-50

Urea is the major end product of nitrogen metabolism in humans, which is eliminated from the body mainly by the kidneys through urine but is also secreted in body fluids such as blood and saliva. Its level in urine ranges from 7–20 mg/dL, which drastically rises under patho-physiological conditions thus providing key information of renal function and diagnosis of various kidney and liver disorders. Increase in urea levels in blood, also referred to as azotemia or uremia. The chronic kidney disease (CKD) or end stage renal disease (ESRD) is generally caused due to the progressive loss of kidney function. Hence, there is an urgent need of determination of urea in biological fluids to diagnose these diseases at their early stage. Among the various methods available for detection of urea, most are complicated and require time-consuming sample pre-treatment, expensive instrumental set-up and trained persons to operate, specifically for chromatographic methods. The biosensing methods overcome these drawbacks, as these are simple, fast, specific and highly sensitive and can also be applied for detection of urea in vivo. This review presents the principles of various analytical methods for determination

of urea with special emphasis on biosensors. The use of various nanostructures and electrochemical microfluidic paper based analytical device (EμPAD) are suggested for further development of urea biosensors.

Keywords: Urea; Urea biosensors; Nano-materials; Immobilization; Serum; Urine

AnuradhaSoni[a], Rajat Kumar Surana[c], Sandeep Kumar Jha[ab] ([a]Centre for Biomedical Engineering, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, 110016, India [b]Department of Biomedical Engineering, All India Institute of Medical Sciences, New Delhi, 110029 India [c]Department of Textile Technology, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, 110016, India) **Smartphone based optical biosensor for the detection of urea in saliva. Sensors and Actuators B: Chemical. Volume 269 (2018) : 346-353**

In the present study, we have developed a smartphone based handheld optical biosensor for determination of urea in saliva. A simple strategy was adopted by immobilization of urease enzyme along with a pH indicator on a filter paper based strip. The strip changed color upon the reaction with urea present in saliva and the color change can be estimated using our smartphone based application based on RGB profiling. Calibration of the biosensor was carried out using spiked saliva samples and an exponentially decreasing calibration curve has been obtained for green pixel intensity in the broad range (10–1000 $mgdL^{-1}$) with a linear detection range of 10–260 $mgdL^{-1}$ and a response time of 20 s. The sensitivity reported for the biosensor in the clinically significant range was −0.005 average pixels $sec^{-1}/mgdL^{-1}$ with a LOD of 10.4 $mgdL^{-1}$. Studies carried out on spiked saliva samples showed a good correlation between salivary urea estimated using our biosensor against phenol-hypochlorite based spectroscopic procedure. Development of a smartphone based biosensor for urea estimation eliminates the need for procuring a dedicated instrument as well as trained technician for daily monitoring and saves time as compared to traditional laboratory methods of analysis.

Keywords: Smartphone based biosensor; Non-invasive biosensor; Salivary urea; Optical biosensor

FatemehEjeian[a] ParisaEtedali[a] Hajar-AlsadatMansouri-Tehrani[a] AsiehSoozanipour[a] Ze-XianLow[b] MohsenAsadnia[c]AsgharTaheri-Kafrani[a]AmirRazmjou[ad] ([a]Department of Biotechnology, Faculty of Advanced Sciences and Technologies, University of Isfahan, Isfahan 73441-81746, Iran[b]Department of Chemical Engineering, Monash University, VIC 3800, Australia[c]Department of Engineering, Macquarie University, Sydney, New South Wales 2109, Australia[d]UNESCO Centre for Membrane Science and Technology, School of Chemical Science and Engineering, University of New South Wales, Sydney 2052, Australia) **Biosensors for wastewater monitoring: A review. Biosensors and Bioelectronics. Volume 118 (2018): 66-79**

Water pollution and habitat degradation are the cause of increasing water scarcity and decline in aquatic biodiversity. While the freshwater availability has been declining through past decades,

water demand has continued to increase particularly in areas with arid and semi-arid climate. Monitoring of pollutants in wastewater effluents are critical to identifying water pollution area for treatment. Conventional detection methods are not effective in tracing multiple harmful components in wastewater due to their variability along different times and sources. Currently, the development of biosensing instruments attracted significant attention because of their high sensitivity, selectivity, reliability, simplicity, low-cost and real-time response. This paper provides a general overview on reported biosensors, which have been applied for the recognition of important organic chemicals, heavy metals, and microorganisms in dark waters. The significance and successes of nanotechnology in the field of biomolecular detection are also reviewed. The commercially available biosensors and their main challenges in wastewater monitoring are finally discussed.

Keywords: Wastewater monitoring; Organic materials; Heavy metals; Microorganisms; Biosensor

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A new conductometric biosensor based on coimmobilized urease and arginase has been developed for arginine determination in pharmaceutics. First, the main parameters of the selected method of immobilization (concentrations of arginase, urease, and glutaraldehyde, time of incubation) were optimized. An influence of the solution parameters (buffer ionic strength, capacity, pH, Mn^{2+} concentration) on the biosensor operation was studied, working conditions were optimized. After biosensor optimization, the main analytical characteristics were as follows. The limit of detection - 2.5 μM, the linear range - 2.5–500 μM, the sensitivity to arginine 13.4 ± 2.4 μS/mM, the response time - 20 s. The signals repeatability and operational stability in continuous exploitation were studied over one working day and during one week. Additionally, the selectivity of the developed biosensor towards arginine was essayed relative to other amino acids.

Keywords: Arginine; Arginase; Urease; Biosensor; Conductometry

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School of Life Sciences, Shanghai University, Shanghai, 200444, China). Fabrication of reusable electrochemical biosensor and its application for the assay of α-glucosidase activity. Analytica Chimica Acta. Volume 1026 (2018) : 140-146

A reusable biosensor has been fabricated in this work for the assay of α-glucosidase activity and the inhibitor screening. In this design, the aptamer of ATP is split as split aptamer 1 (Apt 1) and split aptamer 2 (Apt 2), and Apt 2 can link gold nanoparticles (AuNPs) modified with Apt 1 and 4-aminophenyl-α-D-glucopyranoside (pAPG). Consequently, the functional AuNPs can be immobilized onto the surface of gold electrode, allowing for salt-induced regeneration. In the presence of α-glucosidase, the glycosyl of pAPG is cut off, and the electroactive phenolic hydroxyls appear to give a strong current signal. Furthermore, the biosensor can be recovered very easily by incubating it in water to dissociate the AuNPs modified with Apt 1 and pAPG. So, a new biosensor for α-glucosidase activity detection and inhibitor screening is developed based on enzyme-activated signal generation and recovery. The biosensor may also exhibit good sensitivity for α-glucosidase determination with the detection limit 0.005 U/mL and can be reused by water-washing regeneration with good repeatability. Meanwhile this biosensor can also be utilized for inhibitor screening, which may have potential for clinical applications.

Keywords: Electrochemical biosensor; α-glucosidase; Inhibitor screening; Split aptamer

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Technological advances in engineering and cell biology stimulate novel approaches for medical treatment, in particular cell-based therapy. The first cell-based gene therapy against cancer was recently approved by the US Food and Drug Administration. Progress in cancer diagnosis includes a blood test detecting five cancer types. Numerous stem cell phase I/II clinical trials showing safety and efficacy will soon pursue qualifying criteria for advanced therapy medicinal products (ATMP), aspiring to join the first stem-cell therapy approved by the European Medicines Agency. Cell based therapy requires extensive preclinical characterisation of biomarkers indicating mechanisms of action crucial to the desired therapeutic effect. Quantitative analyses monitoring critical functions for the manufacture of optimal cell and tissue-based clinical products include successful potency assays for implementation. The challenge to achieve high quality measurement is increasingly met by progress

in biosensor design. We adopt a cell therapy perspective to highlight recent examples of graphene-enhanced biointerfaces for measurement of biomarkers relevant to cancer treatment, diagnosis and tissue regeneration. Graphene based biosensor design problems can thwart their use for health care transformative point of care testing and real-time applications. We discuss concerns to be addressed and emerging solutions for establishing clinical grade biosensors to accelerate human cell therapy.

Keywords: Biosensors; Graphene; Cancer; Cell therapy; Stem cells; Theranostics

AyubKarimzadeh[a], MohammadHasanzadeh[b], NasrinShadjou[c], Miguel de laGuardia[d] ([a]Pharmaceutical Analysis Research Center, Tabriz University of Medical Sciences, Tabriz, 51664, Iran[b]Drug Applied Research Center, Tabriz University of Medical Sciences, Tabriz, 51664, Iran[c]Nanotechnology Research Center, Urmia University, Urmia, Iran[d]Department of Analytical Chemistry, University of Valencia, Dr. Moliner 50, 46100, Burjassot, Valencia, Spain) **Peptide based biosensors. TrAC Trends in Analytical Chemistry. Volume 107 (2018) : 1-20**

This review provides an overview of the various types of (bio)sensors based on peptides for their analytical use, along with significant advances over the last several years in related technologies. So, it will be described: **i**) principles in biosensing using peptides **ii**) aspects of fabrication in the perspective of (bio)sensing applications **iii**) potential of electrochemical, electrochemiluminescence, photoelectrochemical, and optical (bio)sensors for the determination of target analytes within sub-nanomolar range also discussing the main problems in (bio)sensing **iv**) multiplex electrochemical and optical (bio)sensors, both with and without labels. **v**) Latest developments in the applications of (bio)sensors methods for detection of important analytes in real samples. **vi**) the application of nanotechnology and microfluidic technology on peptide based biosensing.

Keywords: Peptide; Biosensing; Cancer; Tumor biomarkers; Nanoscience and nanotechnology; Biotechnology; Nucleic acid; Protein; Enzyme; Electrochemistry

MiroslavPohanka[a], JitkaZakova[a], IvoSedlacek[b] ([a]Faculty of Military Health Sciences, University of Defence, Trebesska 1575, CZ-500 01 Hradec Kralove, Czech Republic[b]Czech Collection of Microorganisms, Department of Experimental Biology, Faculty of Science, Masaryk University, Kamenice 5, 625 00 Brno, Czech Republic) **Digital camera-based lipase biosensor for the determination of paraoxon. Sensors and Actuators B: Chemical. Volume 273 (2018) : 610-615**

This work is focused on construction of a biosensor containing unique bacterial homogenate with high lipase activity and colorimetric type of assay where camera of a smartphone was chosen as a detector. The biosensor was constructed as a tool of lipase inhibitors and paraoxon served as a representative analyte inhibiting the lipase.

Psychrophilic strains of bacteria isolated from in Antarctica were tested and the best isolate P4368 having huge lipase activity was chosen. Tween assay was performed as a standard method for lipase activity determination and indoxylacetate served as a substrate of lipase measurable by smartphone camera and R, G and B color channels digital analysis. Bacteria were homogenized and immobilized on polyvinylidene difluoride membrane and indoxylacetate was immobilized in the proximity of the homogenate. Paraoxon ethyl was analyzed by the standard method and by the camera-based biosensor.

The biosensor-based assay was found to determine paraoxon with limit of detection 3.72×10^{-8} mol/l and IC50 value for paraoxon was 4.00×10^{-6} mol/l. A volume 5 µl of sample was sufficient for the assay and the sample was applied directly without any processing.
In a conclusion, a simple colorimetric biosensor for the determination of venomous compounds like organophosphorus pesticides and nerve agents was constructed and promising analytical parameters were received during its characterization.

Keywords: Biosensor; Lipase; Fatty acid; Inhibition; Colorimetry; Phone; Camera; Image analysis; RGB model; Enzyme assay

MehranSoltani[1]Brady R.Davis[1]HayleyFordJ. Andrew D.NelsonBradley C.Bundy (Department of Chemical Engineering, Brigham Young University, Provo, UT, USA) **Reengineering cell-free protein synthesis as a biosensor: Biosensing with transcription, translation, and protein-folding. Biochemical Engineering Journal. Volume 138 (2018) : 165-171**

Biosensors highjack and reengineer biological systems for highly specific detection of diverse molecules. However, many traditional biosensor devices have slow response times and high operating costs and require specialized training and immobile lab equipment. In an effort to address these limitations, researchers have begun using cell-free protein synthesis (CFPS) systems as biosensors. CFPS-based systems provide the advantages of speed, portability, and robustness at a relatively low cost. Here, we review CFPS-based biosensors according to the three fundamental stages of CFPS: transcription, translation, and protein folding.

Keywords: Cell-free protein synthesis; Biosensor; *in vitro* protein synthesis; Protein biosensor; TX-TL CFPS

JafarMassah[a], KeyvanAsefpour Vakilian[ab]. ([a]Department of Agrotechnology, College of Abouraihan, University of Tehran, Tehran, Iran[b]Private Laboratory of Biosensor Applications, Hamadan, Iran). **An intelligent portable biosensor for fast and accurate nitrate determination using cyclic voltammetry. Biosystems Engineering. (2018): https://doi.org/10.1016/j.biosystemseng.2018.09.007**

During the last two decades, enzyme-based analytical biosensors have been introduced for sensitive and efficient nitrate determination. Generally, in these methods, nitrate is measured based on the biocatalytic reduction of nitrate to nitrite. Since the activity of the immobilised

enzyme on the working electrode (WE) reduces over time, the enzyme should be replaced after a small number of nitrate measurements, which limits the commercialisation of these biosensors. In this study, an intelligent portable biosensor is introduced which does not require frequent enzyme replacement. Instead, support vector machine learning method is utilised to predict the nitrate concentration considering the enzyme activity decrement over time. The introduced biosensor consisted of four main units: an enzyme-based three-electrode electrochemical unit, a signal processing and wireless data transfer unit, a decision making unit based on an application for iOS platform, and a unit for sharing the results through an internet of things (IoT)-based cloud server. Results showed that the trained support vector machine with polynomial kernel function resulted in promising nitrate prediction accuracy in which the values of R^2 and mean squared error (MSE) of the nitrate prediction were 0.93 and 0.0016, respectively. The prepared electrode was usable up to at least 10 days after the enzyme immobilisation for analysing nitrate in more than 400 samples without the need for enzyme replacement. Because of the cloud-server unit for online sharing of the results, the device operator was able to share the results with environmentalists and plant clinics who work in the field of integrated nutrient management.

Bioengineering

JuanitaMathews, MichaelLevin (Biology Department, and Allen Discovery Center at Tufts University, Medford, MA 02155, United States) The body electric 2.0: recent advances in developmental bioelectricity for regenerative and synthetic bioengineering. Current Opinion in Biotechnology. Volume 52 (2018) : 134-144

Breakthroughs in biomedicine and synthetic bioengineering require predictive, rational control over anatomical structure and function. Recent successes in manipulating cellular and molecular hardware have not been matched by progress in understanding the patterning software implemented during embryogenesis and regeneration. A fundamental capability gap is driving desired changes in growth and form to address birth defects and traumatic injury. Here we review new tools, results, and conceptual advances in an exciting emerging field: endogenous non-neural bioelectric signaling, which enables cellular collectives to make global decisions and implement large-scale pattern homeostasis. Spatially distributed electric circuits regulate gene expression, organ morphogenesis, and body-wide axial patterning. Developmental bioelectricity facilitates the interface to organ-level modular control points that direct patterning *in vivo*. Cracking the bioelectric code will enable transformative progress in bioengineering and regenerative medicine.

Sandeep Kumar, VishwakarmaChandrakala, LakkireddyAvinashBardia, NagarapuRaju, Syed Ameer, BashaPaspala, Md. AejazHabeebAleem AhmedKhan (Central Laboratory for Stem Cell Research & Translational Medicine, Centre for Liver Research and Diagnostics, Deccan College of Medical Sciences, Kanchanbagh, Hyderabad 500058, Telangana, India Dr. Habeebullah Life Sciences, Attapur, Hyderabad 500030, Telangana, India) Molecular

dynamics of pancreatic transcription factors in bioengineered humanized insulin producing neoorgan. *Gene*. Volume 675 (2018) : 165-175

The present study has been aimed to identify molecular dynamics of pancreatic transcription factors (pTFs) during events of directed trans-differentiation of human hepatic progenitor cells (hHPCs) into insulin producing cells (InPCs) within bioengineered humanized neoorgan. The study demonstrates applicability of acellularized whole splenic scaffold (ASOS) to generate insulin producing humanized transplantable neoorgan through activation of pancreatic transcription factors.

An efficient acellularization process was developed for xenogeneic rat spleen using change in different gradients of reagents perfusion through splenic artery for varying time points. The acellularized xenogeneic spleen scaffold was characterized thoroughly for preservation of extra-cellular matrix and retention of organ specific vasculature and mechanical properties. Further scaffolds were sterilized and repopulated with hHPCs which were triggered using a stage wise induction with growth factors and hyperglycemic challenge for trans-differentiation into InPCs. Dynamics of pTFs alone or simultaneously during induction process was identified using gene expression analysis and immunological staining.

The cells within the engineered neoorgan respond to growth factors and extrinsic hyperglycemic challenge and generate large number of InPCs under controlled dynamic regulation of pTFs. Highly controlled regulation of pTFs generates higher percentage of Nkx-6.1+/C-peptide+ cells within the engineered splenic scaffolds. Generation of high percentage of insulin and C-peptide positive cells in three-dimensional organ architecture responded better to hyperglycemic stimuli and produced higher quantity of insulin than 2D-culture system.

The present study provides a novel platform for designing effective regenerative strategies using whole organ scaffolds to control hyperglycemia under tight regulation of pTFs using humanized neoorgan system.

Keywords: Pancreatic transcription factors; Bioengineered humanized neoorgan; Insulin production; Hyperglycemia; Acellularization and repopulation

SaúlAlonso (Evolva SA, Duggingerstrasse 23, 4153 Reinach, Switzerland) Exploiting the bioengineering versatility of lactobionic acid in targeted nanosystems and biomaterials. Journal of Controlled Release. Volume 287 (2018) : 216-234

Lactobionic acid (LBA) has rapidly emerged as a strategic functionalization molecule in the development of nanoparticle-based platforms and biomaterials with promising therapeutic applications. Exploiting the multi-functionality of LBA has enabled to expand the drug loading, release and selective cellular uptake capacity of hepatoma-targeting chemotherapyand nanoparticle-based theranostic systems. The high liver-specificity displayed by LBA-conjugated dendrimers, micelles and nanoparticles has indeed reinforced the great potential of LBA in fine-tuning the surface engineering of promising drug carriers to combat hepatocellular carcinoma. Additionally, its cytocompatibility, selectivity and functionality confer unique properties to design synthetically engineered matrices with enhanced liver-specificity for liver

tissue engineering applications. Notably, the biospecific identification and biochemical cross-linking specificity found with the asialoglycoprotein receptor (ASGPR) have converted LBA into the perfect cell-targeting ligand for strengthening the recognition between novel designed nanocarriers and hepatocytes at cellular level. The present review overviews the latest advances in the galactosylation of target-specific nanocarriers and polymers *via* LBA functionalization with an emphasis on the great bioengineering versatility offered by this polyhydroxy bionic acid in the preparation of next-generation tools ranging from contrast imaging agents to galactosylated scaffolds for the diagnosis and treatment of hepatic diseases. Perspectives on the bioengineering approaches that can foster the design of multi-functional LBA-conjugated therapeutic nanoplatforms are also discussed.

Keywords: Lactobionic acid; Hepatoma-targeting chemotherapy; Targeted drug delivery; Liver tissue; engineering; Galactosylated scaffolds; ASGPR

Soon SengNg[abc], KouroshSaeb-Parsy[d], Samuel J.I.Blackford[a], Joe M.Segal[a], Maria PaolaSerra[a], MartaHorcas-Lopez[a], Da YoonNo[bce], SotirisMastoridis[a], WayelJassem[a], Curtis W.Frank[f], Nam JoonCho[g], HiromitsuNakauchi[h], Jeffrey S.Glenn[bc1], S. TamirRashid[ah1] ([a]Centre for Stem Cells and Regenerative Medicine & Institute for Liver Studies, King's College London, England, UK[b]Division of Gastroenterology and Hepatology, Department of Medicine, Stanford University School of Medicine, Stanford, CA, USA[c] Department of Microbiology and Immunology, Stanford University School of Medicine, Stanford, CA, USA[d]Department of Surgery, University of Cambridge and the Cambridge NIHR Biomedical Research Centre, Cambridge, UK[e]Department of Bioengineering, Stanford University, Stanford, CA, USA[f]Department of Chemical Engineering, Stanford University, Stanford, CA, USA[g]School of Materials Science and Engineering, Nanyang Technological University, Singapore, Singapore[h]Institute for Stem Cell Biology and Regenerative Medicine, Stanford University School of Medicine, Stanford, CA, USA) **Human iPS derived progenitors bioengineered into liver organoids using an inverted colloidal crystal poly (ethylene glycol) scaffold. Biomaterials. Volume 182 (2018) : 299-311**

Generation of human organoids from induced pluripotent stem cells (iPSCs) offers exciting possibilities for developmental biology, disease modelling and cell therapy. Significant advances towards those goals have been hampered by dependence on animal derived matrices (e.g. Matrigel), immortalized cell lines and resultant structures that are difficult to control or scale. To address these challenges, we aimed to develop a fully defined liver organoid platform using inverted colloid crystal (ICC) whose 3-dimensional mechanical properties could be engineered to recapitulate the extracellular niche sensed by hepatic progenitors during human development. iPSC derived hepatic progenitors (IH) formed organoids most optimally in ICC scaffolds constructed with 140 μm diameter pores coated with type I collagen in a two-step process mimicking liver bud formation. The resultant organoids were closer to adult tissue, compared to

2D and 3D controls, with respect to morphology, gene expression, protein secretion, drug metabolism and viral infection and could integrate, vascularise and function following implantation into livers of immune-deficient mice. Preliminary interrogation of the underpinning mechanisms highlighted the importance of TGFβ and hedgehog signalling pathways. The combination of functional relevance with tuneable mechanical properties leads us to propose this bioengineered platform to be ideally suited for a range of future mechanistic and clinical organoid related applications.

Keywords: Biomimetic materials; Liver stem cells; Bioengineering; Organogenesis

OlenaPogozhykh[ab1], VolodymyrProkopyuk[b1], OlgaProkopyuk[b], LarisaKuleshova[b], AnatoliyGoltsev[b], ConstançaFigueiredo[a], DenysPogozhykh[ab] ([a]Institute for Transfusion Medicine, Hannover Medical School, Carl-Neuberg-Straße 1, 30625 Hannover, Germany[b]Institute for Problems of Cryobiology and Cryomedicine, National Academy of Sciences of Ukraine, Pereyaslavskaya Str. 23, 61015 Kharkiv, Ukraine) **Towards biobanking technologies for natural and bioengineered multicellular placental constructs. Biomaterials. Volume 185 (2018) : 39-50**

Clinical application of a large variety of biomaterials is limited by the imperfections in storage technology. Perspective approaches utilizing low-temperature storage are especially challenging for multicellular structures, such as tissues, organs, and bioengineered constructs. Placenta, as a temporary organ, is a widely available unique biological material, being among the most promising sources of various cells and tissues for clinical and experimental use in regenerative medicine and tissue engineering. The aim of this study was to analyse the mechanisms of cryoinjuries in different placental tissues and bioengineered constructs as well as to support the viability after low temperature storage, which would contribute to development of efficient biobanking technologies. This study shows that specificity of cryodamage depends on the structure of the studied object, intercellular bonds, as well as interaction of its components with cryoprotective agents. Remarkably, it was possible to efficiently isolate cells after thawing from all of the studied tissues. While the outcome was lower in comparison to the native non-frozen samples, the phenotype and expression levels of pluripotency genes remained unaffected. Further progress in eliminating of recrystallization processes during thawing would significantly improve biobanking technologies for multicellular constructs and tissues.

Keywords: Placental tissues; Amniotic membrane; Alginate microspheres; Bioengineered constructs; Multipotent stromal cells; Biobanking.

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Bundang-gu, Seongnam-si, Gyeonggi-do 463-400, South Korea [c]Department of Neurosurgery, CHA University, Pangyo-Ro 335, Bundang-gu, Seongnam-si, Gyeonggi-do 463-400, South Korea [d]Department of Pharmaceutical Sciences, Department of Biomedical Engineering & Biointerfaces Institute, University of Michigan, Ann Arbor, MI 48109, USA[e]Molecular Imaging Program at Stanford (MIPS), and Bio-X Program, Department of Radiology, School of Medicine, Stanford University, Stanford, CA, 94305-5427, USA[f]Canary Center at Stanford for Cancer Early Detection, Department of Radiology, School of Medicine, Stanford University, CA, 94305-5427, USA[g]Stem Cells Integrative Engineering Laboratory, Department of Medical Biotechnology, Dongguk University, 32 Dongguk-ro, Ilsandong-gu, Goyang-si, Gyeonggi-do, 10326, South Korea) Bioengineered stem cell membrane functionalized nanocarriers for therapeutic targeting of severe hindlimb ischemia. Biomaterials, Volume 185 (2018) : 360-370

Bioengineering strategies to enhance the natural targeting function of nanocarriers would expand their therapeutic applications. Here, we designed bioengineered stem cellmembrane-functionalized nanocarriers (BSMNCs) harboring C-X-C chemokine receptor type 4 (CXCR4) to achieve robust targeting and also to increase their retention time in ischemic tissue. Stem cell membrane coated nanocarrier (SMNCs) or poly (lactic-*co*-glycolic acid) (PLGA) nanocarriers (PNCs) and BSMNCs were prepared by functionalizing PNCs with human adipose-derived stem cells (hASCs) membranes and hASCs engineered to overexpress CXCR4-receptor, respectively. The functionalization of PNCs with stem cell membranes derived from hASCs significantly enhance the nanocarrier penetration across endothelial cell barrier compare to PNCs. In addition, stem cell membrane functionalization on PNCs also significantly decreased the nanoparticles uptake in J774 (murine) and THP (human) macrophages respectively from 84% to 76%–29% and 24%. Interestingly, BSMNCs showed much higher level of accumulation in ischemic tissue than SMNCs. Systemic retro-orbital injection of BSMNCs loaded with VEGF into mice with hindlimb ischemia resulted substantially enhancement of blood reperfusion, muscle repair, and limb salvage compared to animals treated with SMNCs loaded with similar concentration of VEGF. The reported strategy could be used to create biocompatible and custom-tailored biomimetic nanoparticles with various hybrid functionalities, which may overcome the limitations of current nanoparticle-based therapeutic and imaging platforms.

Pollen Biotechnology

Rui-danWang[ad1], Guan-huaSu[b1], LinWang[ad], QingXia[ad], RuiLiu[ad], QunLu[ad], Jiu-liangZhang[acd] ([a]College of Food Science and Technology, Huazhong Agricultural University, Wuhan 430070, China[b]Department of Cardiology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China[c]Key Laboratory of Environment Correlative Dietology (Huazhong Agricultural University), Ministry of Education, Wuhan 430070, China[d]Wuhan Engineering Research Center of Bee Products on Quality and Safety Control, Wuhan 430070, China)

Identification and mechanism of effective components from rape (*Brassica napus* L.) bee pollen on serum uric acid level and xanthine oxidase activity. Journal of Functional Foods. Volume 47 (2018) : 241-251

This study was aimed at evaluating the hypouricemic effect of rape bee pollen from Qinghai province in China. Rape bee pollen crude extracts (RPCE) was obtained by n-butanol extraction and purified by polyamide resin and AB-8 resin respectively to generate five fractions (fraction 1–5). *In vitro*, fraction 5 had strongest inhibition on xanthine oxidase (XO) ($IC_{50} = 0.21 \pm 0.02$ mg mL^{-1}) among five fractions and had reversible and mixed inhibitory effect on XO. Fraction 5 was further purified and then generated fraction 5′. *In vivo*, fraction 5′ had lower serum UA level and could reduce serum BUN, Cr levels and hepatic XO activity more effectively than RPCE in potassium oxonate-induced hyperuricemic mice. Moreover, fraction 5′ had higher CAT activity and content of GSH in hyperuricemic mice. Six compounds including quercetin-3-O-(2″-O-glucopyranosyl)-glucopyranoside (peak 1), quercetin-3-O-(2″-O-glucopyranosyl)-rhamnopyranoside (peak 2), kaempferol-3-O-(2″-O-glucopyranosyl)-glucopyranoside (peak 3) and N′, N″-di-*p*-coumaroylspermidine (peak 4–6) in RPCE were identified by using HPLC-ESI-QTOF-MS/MS, whereas only peak 4 to 6 were found in fraction 5′. This study shows that rape bee pollen has potential clinical application value as an effective anti-hyperuricemia bioactive drug or functional food.

Keywords: Rape bee pollen; Hyperuricemia; Xanthine oxidase; Inhibition kinetics; Structural identification; Spermidines.

MinYao[a] Tao-BoAi[b] QiangMao[c] FangChen[a] Fo-ShengLi[a] LinTang[a] ([a] Ministry of Education Key Laboratory for Bio-Resource and Eco-Environment, Experimental Teaching Center of Biological Science, College of Life Science, Sichuan University, Chengdu 610064, Sichuan, China[b]Sichuan Institute for Food and Drug Inspection, Chengdu 610100, Sichuan, China[c]Chengdu Botanical Garden, Chengdu 610083, Sichuan, China) **Downregulation of *OsAGO17* by artificial microRNA causes pollen abortion resulting in the reduction of grain yield in rice. Electronic Journal of Biotechnology. Volume 35 (2018) : 25-32**

Pollen development is an important reproductive process that directly affects pollen fertility and grain yield in rice. Argonaute (AGO) proteins, the core effectors of RNA-mediated silencing, play important roles in regulating plant growth and development. However, few AGO proteins in rice were reported to be involved in pollen development. In this study, artificial microRNA technology was used to assess the function of *OsAGO17* in pollen development.

In this study, *OsAGO17*, a rice-specific gene, was specifically expressed in rice pollen grains, with the highest expression in uninucleate microspores. Downregulation of *OsAGO17* by artificial microRNA technology based on the endogenous osa-miRNA319a precursor was successfully achieved. It is found that downregulation of *OsAGO17* could significantly affect pollen fertility and cause pollen abortion, thus suggesting that *OsAGO17* functions in rice pollen

development. In addition, the downregulation of *OsAGO17* mainly caused a low seed-setting rate, thereby resulting in the reduction of grain yield, whereas the downregulation of *OsAGO17* did not significantly affect rice vegetative growth and other agricultural traits including number of florets per panicle, number of primary branch per panicle, and 100-grain weight. Furthermore, the result of subcellular localization analysis indicated that the OsAGO17 protein was localized to both the nucleus and the cytoplasm.
These results represent the first report of the biological function for *OsAGO17* in rice and indicate that *OsAGO17* may possibly play crucial regulatory roles in rice pollen development. It helps us to better understand the mechanism of pollen development in rice.

Keywords: Argonaute proteins; Artificial microRNA; Downregulation; Microspores; *Oryza sativa;* OsAGO17; Pollen abortion; Pollen development; Pollen fertility; Rice; RNA silencing

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Various samples of human viscera fragments, sponges, and cloth were collected from embalming jars belonging to members of the Medici family of Florence. One jar was labeled with the name Vittoria della Rovere, who died in March of 1694. This jar contained viscera fragments that were identified as a section of collapsed intestine. The intestine of the Vittoria della Rovere sample contained a large concentration of pollen belonging to the Myrtaceae family. The Myrtaceae pollen was sometimes observed in clusters during analysis, which is indicative of purposeful ingestion of flowers, buds, or a substance derived from floral structures. Thus, the high concentrations and clustering of Myrtaceae pollen grains recovered from this sample are reflective of dietary or medicinal practices. Scanning electron microscopy indicated that the pollen was from cloves, *Syzygium aromaticum*. It is most likely that Vittoria della Rovere consumed cloves for medicinal or culinary reasons shortly before death.

Keywords: Archaeopalynology; Embalming jars; Medicinal plants; Scanning electron microscopy; Myrtaceae; Italy; Medici.

Qiang-QiangLi[a], KaiWang[a], Maria CristinaMarcucci[b], Alexandra Christine Helena FranklandSawaya[c], LinHu[d], Xiao-FengXue[a], Li-MingWu[a], Fu-LiangHu[e]. ([a]Institute of Apicultural Research, Chinese Academy of Agricultural Sciences, Beijing, China[b]Laboratory of Natural Products, Pharmacy and Biotechnology Department, University Anhanguera of São Paulo, SP, Brazil[c]Faculty of Pharmaceutical Science, Universidade Estadual de Campinas, UNICAMP, Campinas, Brazil[d]Institutes of Biology and Medical Sciences, Soochow University, Suzhou, China[e]College of Animal Sciences, Zhejiang University, Hangzhou, China) **Nutrient-rich bee pollen: A treasure trove of active natural metabolites. Journal of Functional Foods. Volume 49 (2018) : 472-484**

Bee pollen is a mixture of plant pollen pellet with nectar and honeybee secretions. Due to its active natural metabolites with extensive nutritional and therapeutic properties, it is recommended as a treasure trove of human nutrition. The nutritional components in bee pollen include carbohydrates, proteins, lipids, vitamins, minerals, polyphenols, and a small percentage of other components. Previous studies demonstrated that bee pollen exhibit antioxidant, antibacterial, anti-inflammatory, anticarcinogenic, and antiallergic properties. This comprehensive review focused on the nutritional properties and potentially active phytometabolites (polyphenolic acids and flavonoids) of bee pollen and its therapeutic health benefits. We also covered the food safety and guidelines for the consumption with future industrial challenges of bee pollen.

Keywords: Bee pollen; Phytometabolites; Nutrition; Therapeutic benefits; Food safety

MondamMuniraja[a], GujjulaVijayalakshmi[a], MudeLakshmipathi Naik[a], VadlamudiVijaya Bhaskar[b], Patan ShaikSha Valli Khan[a] ([a]Department of Botany, Yogi Vemana University, Vemanapuram, 516003 Kadapa, Andhra Pradesh, India[b]College of Horticulture, Dr. Y.S.R. Horticulture University, Anantharajupet, 516105 Kadapa, Andhra Pradesh, India). **South African Journal of Botany. Volume 119 (2018) : 142-153**

The Anacardiaceae is a well-recognized family consists of an economically important nut and fruit crops. In this family, the studies on both anther wall and pollen development are very limited. The present paper describes a comparative study on the development of both anther wall and pollen of male and hermaphrodite flower buds of *Mangifera indica* L. var. Beneshan by combining light (LM), fluorescence (FM) and transmission electron microscopy (TEM). Moreover, a description of the anatomy of the sterile staminodes of male flower buds also provided. Our study showed that the (1) anther wall contains two cell thick middle layers, (2) the presence of a secretory type tapetum, (3) tapetum cells contain large and uninucleate nucleus, (4) the presence of simultaneous cytokinesis (5) haploid microspores arranged in tetrahedral tetrads (6) the pollen grains shed at two-celled stage, (7) druse type calcium oxalate (CaOx) crystals were found in idioblast cells of anther connective tissue (8) both the anther wall and pollen developmental events in male and hermaphrodite flowers were found to be similar and (9) staminodes have failed to differentiate and form pollen grains. Overall, the study confirms the placement of *M. indica* in the tribe Anacardieae of Anacardiaceae and also provides information

on correlation of the microspore development stage with flower bud and anther developmental stage for the establishment of *in vitro* culture for the production of doubled haploids in mango.

Keywords: Anacardiaceae; CaOx crystals; Doubled haploid; *Mangifera indica;* Microspore; Staminode

Su-LiShiHai-YanCheng, LeiWuZhi-HuaXieChaoGuShao-LingZhang (Centre of Pear Engineering Technology Research, State Key Laboratory of Crop Genetics and Germplasm Enhancement, Nanjing Agricultural University, Nanjing 210095, China) **Identification of *S*-genotypes in 18 pear accessions and exploration of the breakdown of self-incompatibility in the pear cultivar Xinxue. Scientia Horticulturae. Volume 238 (2018) : 350-355**

Self-incompatibility is a genetic mechanism in flowering plants that promotes outcrossing and prevents inbreeding. In this study, the reported 15 *S-RNase*alleles were isolated from 18 pear accessions that contained 14 different *S*-genotypes. The *S-RNase* alleles were only expressed in the style, not in the root, stem, leaf, fruit, sepal, and pollen. Pollen tube grew into self-styles and self-pollinated fruit set involved the breakdown of self-incompatibility in cv. Xinxue. However, the two *S-RNase* alleles in cv. Xinxue had identical amino acid sequences to those self-incompatible cultivars, and S_5- and S_6-*RNase*were normally expressed in style, indicating that the loss of self-incompatibility in cv. Xinxue likely resulted from pollen-part mutation. Further, S_5S_5 and S_6S_6genotyped individuals were identified in self-pollinated progeny, indicating that S_5 and S_6 genotyped pollen were compatible with the self-styles of cv. Xinxue. A genetic analysis showed that the segregation ratio of S_5S_5, S_5S_6, and S_6S_6 was approximately 0:2:1 ($\chi^2 = 3.505 < \chi^2_{0.05,\ 2} = 5.99$), which did not fit the theoretical ratio of 1:2:1 ($\chi^2 = 13.340 > \chi^2_{0.05,\ 2} = 5.99$), suggesting that the breakdown of self-incompatibility could be caused by modified factor(s) located outside of the *S*-locus. These results are useful for parental assignment and understanding self-incompatibility reaction.

Biotechnology Policy Issue

Jill J.McCluskey[a], JustusWesseler[b], Jason A.Winfree[c] ([a] School of Economic Sciences, Washington State University, USA [b]Agricultural Economics and Rural Policy Group, Wageningen University, The Netherlands[c]Department of Agricultural Economics and Rural Sociology, University of Idaho, USA) **The economics and politics GM food labeling: An introduction to the special issue. Food Policy. Volume 78 (2018) : 1-5**

This introduction to the special issue focuses on the economics of labeling genetically modified (GM) foods and implications of GM-labeling policies and the specific contributions of papers included.

Keywords: GMOs; Biotechnology; Labeling

JoséTena, MedialdeaJesús, A.Prieto, RuizCarmenFagoaga, GarcíaAntonioCalvo, CapillaJerónimo,Chirivella Martorell, JoelBueso Rodenas (Catholic University of Valencia San Vicente Mártir, Facultad de Veterinaria y Ciencias Experimentales, IMEDMAR, Spain) Potential of science to address the hunger issue: Ecology, biotechnology, cattle breeding and the large pantry of the sea. Journal of Innovation & Knowledge. Volume 3, Issue 2 (2018) : 82-89

The knowledge about the real possibilities that current science gives us is basic to support everything that is not negative either for men or for our environment. In this way, it is an advantage to win this battle against hunger with rational use of science advantages. In this paper, we start from the basis that the solution to the problems of hunger requires the multidisciplinary action of sciences and knowledge. We provide a reflection on the possibilities to be considered from disciplines such as ecology, biotechnology, veterinary and aquaculture. The need for ecological studies where the role of human beings as part of ecosystems is considered. In addition, advances in molecular biology and precision agriculture are analyzed, evaluating their advantages and associated problems, as well as understanding the role of veterinary science and animal genetic improvement in the problem of hunger. Finally, the bases the sustainable use of sea products and expectations generated by marine crops are presented.

Keywords: Hunger; Ecology; Biotechnology; Veterinary; Aquaculture

Tim K.Mackey[123]JohnAnnaloro[4] ([1]Department of Anesthesiology, University of California, San Diego School of Medicine, San Diego, CA, USA[2]Division of Infectious Diseases and Global Public Health, University of California, San Diego School of Medicine, Department of Medicine, San Diego, CA, USA[3]Global Health Policy Institute, San Diego, CA, USA[4]School of Law, University of San Diego, San Diego, CA, USA) 'Bioexit': navigating the policy and regulatory pathways for the biotechnology industry in a post-Brexit landscape. Drug Discovery Today. Volume 23, Issue 7 (2018) : 1324-1327

The withdrawal of the UK from the European Union (EU) is a complicated event. Although implications vary by industry, the biotechnology sector is especially vulnerable to the consequences of Brexit. Accordingly, here we evaluate potential repercussions under four post-Brexit political pathways: European Economic Area (EEA) affiliation (Norwegian Model); negotiated bilateral access (Swiss Model); limited participation in EU Customs Union (Turkish Model); or independence under the World Trade Organization (WTO) designation. We conclude that all four pathways fail to protect the mutually beneficial UK–EU biotechnology relationship and that alternative pathways need to be explored. Accordingly, we outline a suite of policy mechanisms aimed at ensuring continued EU–UK regulatory synergy, with the central aim of ensuring access to biomedical innovations and ensuring patient safety.

EkaterinaStreltsova[1], Jonathan D.Linton[12]. ([1]National Research University Higher School of Economics, Moscow, Russia[2]School of Management, University of Sheffield, Sheffield, UK) **Biotechnology Patenting in the BRICS Countries: Strategies and Dynamics. Treadns in Biotechnology. Volume 36, Issue 7 (2018) : 642-645**

The BRICS countries (Brazil, Russia, India, China, South Africa) account for 25% of global biotechnology patents. To understand the current and future landscape of the domain, it is important to better understand the capacity of these contributors. Here, we consider the thematic priorities, strategies, and key players of the BRICS countries in biotechnology patenting.

Keywords: Biotechnology; BRICS; patenting

AzhahamPerumal, Saravanan[a], ThangavelMathimani[b], GarlapatiDeviram[c], KarthikRajendran[de], ArivalaganPugazhendhi[f] ([a]Rajiv Gandhi School of Intellectual Property Law, Indian Institute of Technology Kharagpur, West Bengal 721302, India[b]Department of Energy and Environment, National Institute of Technology Tiruchirappalli, Tiruchirappalli-620015, Tamil Nadu, India[c]National Facility for Marine Cyanobacteria, Department of Marine Biotechnology, Bharathidasan University, Tiruchirappalli-620024, Tamil Nadu, India[d]Department of Biological and Ecological Engineering, Oregon State University, Corvallis, United States[e]MaREI Centre, Environmental Research Institute, University College Cork, Cork, Ireland[f]Innovative Green Product Synthesis and Renewable Environment Development Research Group, Faculty of Environment and Labour Safety, Ton Duc Thang University, Ho Chi Minh City, Viet Nam) **Biofuel policy in India: A review of policy barriers in sustainable marketing of biofuel. Journal of Cleaner Production. Volume 193 (2018) : 734-747**

Global warming issue due to the combustion of fossil fuel pushes the world to produce renewable and environmental friendly fuel from sustainable feedstock. There are several measures on different levels to reduce the global warming including clean energies from wind, solar, and biomass. There are different aspects in bringing these technologies into a reality including development of technology, economic feasibilities, environmental sustainability and finally, support from the government in the form of effective policies and public awareness. Adequate R&D efforts could overcome all the factors but only an effective policy could drive those efforts to reality. Therefore, in this connection this review initially addresses the present state of energy demand, progression of biofuel sources and the bottlenecks in microalgal biofuel production and commercialization. The biofuel policies are essential to change the world's dependence on fossil fuels for a better tomorrow. Hence, this review addresses the salient features of National Biofuel Policy of India that helps in regulating the biofuels production and their marketing. As a part of Policy implementation, government of India introduced several schemes and programs in last two-decades, which includes mandate blending of ethanol with gasoline, diesel with biodiesel, for the future clean energy vision, and incentivizing bio-based products/fuels. In addition, participation of both federal and state governments for clean energy

initiatives, capital investments and tax credits were described in detail. Many policies lack easy outreach among public and industries, which needs marketing by the government that secures a clean energy future in India. Though India is in the process of evolution, it might be quite difficult to enact a dedicative legislation to deal with the challenges of biofuel marketing. Therefore, recent initiatives and scope were summarized in this review for future endeavours.

Keywords: Biodiesel; Energy demand; India; Microalgae; Biofuel policy; Policy barriers

DanielleResnick[a], StevenHaggblade[b], SureshBabu[a], Sheryl L.Hendriks[c], DavidMather[b] ([a]International Food Policy Research Institute, 2033 K Street NW, Washington, DC 20006, USA[b]Michigan State University, Justin S. Morrill Hall of Agriculture, 446 West Circle Dr., Rm 202, East Lansing, MI 48824-1039, USA[c]Institute for Food, Nutrition and Well-being, University of Pretoria, Pirvate Bag X20, Hatfield, Pretoria 0081, South Africa) **The Kaleidoscope Model of policy change: Applications to food security policy in Zambia. World Development. Volume 109 (2018) : 101-120**

What drives policy reform after long periods of policy inertia? What factors shape the effectiveness of policy implementation following reform decisions? These questions increasingly concern the international donor and research communities, given the importance of policy environments in shaping development outcomes and the growing need to achieve development impact with scarce resources. To address these questions, this paper introduces the Kaleidoscope Model of policy change. Inductively derived from empirical examples in developing countries, political economy literature, and theoretical scholarship on the policy process, the model proposes a set of 16 operational hypotheses to identify the conditions under which policies emerge on the agenda and ultimately are implemented. The paper tests the model empirically in Zambia by evaluating eight policy reform episodes related to agricultural input subsidies and vitamin A fortification. Empirical application and hypothesis testing rely on rigorous process tracing using secondary sources and semi-structured interviews with a purposive sample of 58 stakeholders in Zambia. In the policy reforms studied, a majority of the KM's core variables proved robust across the two distinct policy domains, while a handful emerged as relevant only episodically. In an era of growing pressure on donor resources and government budgets, the Kaleidoscope Model offers a practical framework through which practitioners and researchers can assess when and where investments in policy reforms are most feasible given a country's underlying political, economic, and institutional characteristics.

Keywords: Agricultural input subsidies; Food security; Micronutrients; Policy process; Political economy; Zambia

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Research, Department of Community Ecology, Halle, Germany) Snipping around for food: Economic, ethical and policy implications of CRISPR/Cas genome editing. Geoforum. Volume 96 (2018) : 172-180

CRISPR/Cas genome editing has the potential to revolutionise agricultural biotechnology and breeding. Also, it can contribute to advancing modern agriculture in multiple respects and lead to shifts in market structure. However, genetic engineering is a highly contested and controversial societal issue. Thus, CRISPR/Cas poses new questions regarding preferences of consumers and producers, food ethics and governance. Precision, easiness-to-use and low costs of CRISPR/Cas make it a viable alternative to conventional breeding. Yet, nature-identical GMOs blur the boundary between nature and technology and result in non-traceability of modifications, which calls for a rethinking of regulatory approaches. Finally, the speed with which the technology advances contrasts with the pace of related societal debates and regulatory processes.

Keywords: Agricultural policy; Bioethics; Biotechnology; Food production; Genome editing; Governance

SerenaZacchigna, MauroGiacca (International Center for Genetic Engineering and Biotechnology (ICGEB), Trieste, Italy) The global role of biotechnology for non communicable disorders. *Journal of Biotechnology*. Volume 283 (2018) : 115-119

The World Health Organization (WHO) has tagged non-communicable diseases (NCDs) as one of the twenty-first century's major development challenges. NCDs account for over 15 million deaths annually and over 80% of those deaths occur in developing countries and among the poorest populations. Biotechnology presents unique opportunities to improve the early diagnosis and the treatment of NCDs. This review describes the major applications of biotechnology for a better clinical management of NCDs, i.e. the implementation of innovative diagnostic approaches and the production of innovative treatments, including those based on monoclonal antibodies, recombinant proteins, regulatory nucleic acids and cell-based therapies for regenerative medicine. In this context, it also examines the major challenges faced by biotechnology in developing countries.

Agricultural Biotechnology

Michael L.Nuccio[a], MatthewPaul[b], Nicholas J.Bate[a], JonathanCohn[a], Sean R.Cutler[c] ([a]Syngenta Crop Protection, LLC., 9 Davis Drive, Research Triangle Park, NC, 27709, USA[b]Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ, UK[c]Plant Cell Biology and Chemistry, Botany and Plant Sciences Chemistry Genomics Building, University of California Riverside, CA, 92521, USA) Where are the drought tolerant crops? An

assessment of more than two decades of plant biotechnology effort in crop improvement. Plant Science. Volume 273 (2018) : 110-119

Since the dawn of modern biotechnology public and private enterprise have pursued the development of a new breed of drought tolerant crop products. After more than 20 years of research and investment only a few such products have reached the market. This is due to several technical and market constraints. The technical challenges include the difficulty in defining tractable single-gene trait development strategies, the logistics of moving traits from initial to commercial genetic backgrounds, and the disconnect between conditions in farmer's fields and controlled environments. Market constraints include the significant difficulty, and associated costs, in obtaining access to markets around the world. Advances in the biology of plant water management, including response to water deficit reveal new opportunities to improve crop response to water deficit and new genome-based tools promise to usher in the next era of crop improvement. As biotechnology looks to improve crop productivity under drought conditions, the environmental and food security advantages will influence public perception and shift the debate toward benefits rather than risks.

Keywords: Drought tolerance; GMO; Crop genetic engineering; Agricultural biotechnology

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Overcoming barriers to innovation in food and agricultural biotechnology. Trends in Food Science & Technology. Volume 79 (2018) : 204-213

The food and agricultural biotechnology (FAB) sector is poised to respond to some of society's most pressing challenges, including food security, climate change, population growth, and resource limitation. However, to realize this promise, substantial barriers to innovation must be overcome. Here, we draw upon industry experience and innovation management literature to analyze FAB innovation challenges, as well relevant frameworks for their resolution. In doing so, we identify two major FAB innovation challenges: specialized adoption uncertainty, and complex product-market fit across convergent value chains. We propose that these innovation challenges may be overcome by 1) prioritizing the establishment of organizational and social technology legitimacy, and 2) leveraging technology-market matching methods and open innovation practices.

Keywords: Food and agricultural biotechnology; Innovation management; Adoption barriers; Uncertainty analysis; Technology-market matching; Convergence-driven value chains; Open innovation; Product-market fit

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Pakistan[b]Department of Energy and Environment, Dawood University of Engineering & Technology, M.A Jinnah Road, Karachi 74800, Pakistan[c]Institute of Environmental Engineering and Management, Mehran University of Engineering & Technology, Jamshoro, 76062, Sindh, Pakistan[d,] Department of Environmental Engineering and Energy, Myongji University, Yongin, Gyeongki, 17058, Republic of Korea[e]Department of Chemical Engineering, COMSATS Institute of Information Technology, Defence Road, Lahore, Pakistan) **Exploring the potential of microalgae for new biotechnology applications and beyond: A review. Renewable and Sustainable Energy Reviews. Volume 92 (2018) : 394-404**

The potential of microalgae as an alternative energy source has been adequately studied. However, exclusive use of microalgae as an energy feedstocks cannot warrant their scalability and economical sustainability due to the high cost involved in their biomass processing. The co-processing of microalgae biomass with other related bio-refinery applications can offset their cost and improve their sustainability. Thus, it triggers up the need of exploring the potential of microalgae biomass beyond their typical use. Microalgae offer interesting features to qualify them as alternative feedstocks for various bio-refinery applications. Microalgae have unique abilities to utilize them for industrial and environmental applications. Thus, this review discusses to expand the scope of integrating microalgae with other biotechnological applications to enhance their sustainability. The use of microalgae as a feed for animal and aquaculture, fertilizers, medicine, cosmetic, environmental and other biotechnological applications is thoroughly reviewed. It also highlights the barriers, opportunities, developments, and prospects of extending the scope of microalgae. This study concludes that sustained research funding, and a shift of microalgae focus from biofuels production to bio-refinery co-products can qualify them as promising feedstocks.

Moreover, technology integration is inevitable to off-set the cost of microalgae biomass processing. It is expected that this study would be helpful to determine the future role of microalgae in bio-refinery applications.

Keywords: Microalgae; Sustainability; Bio-refinery; Biotechnological applications

Kuan-JuChen[a], Thomas L.Marsh[a], Peter R.Tozer[b], Suzette P.Galinato[c] ([a]School of Economic Sciences, Washington State University, United States[b]School of Agriculture and Environment, Massey University, Palmerston North, New Zealand[c]IMPACT Center, School of Economic Sciences, Washington State University, United States). **Biotechnology to sustainability: Consumer preferences for food products grown on biodegradable mulches. Food Research International. (2018). https://doi.org/10.1016/j.foodres.2018.08.013**

This study evaluates consumer preferences for an agricultural product grown on biodegradable mulch film, which is an environmentally friendly soil cover that sustains plant growth, but that avoids the environmental harm of plastic pollution from non-biodegradable mulches in the field

or upon disposal. Using a dichotomous-choice contingent valuation method, we assessed the willingness to pay for strawberries grown on biodegradable mulch with a randomized information treatment on 1510 consumers across different regions of the United States. On average, consumers are willing to pay 10.3% more for food –strawberries in our case– grown on biodegradable mulches. Consumers who are female, earn a higher income, have stronger environment-friendly attitudes, or received the information treatment on the benefits of biodegradable mulches, also expressed more willingness to pay a premium price for strawberries grown on biodegradable mulches. Our findings support that consumers are willing to internalize a price premium for food products on biodegradable mulches, suggesting that agricultural producers could realize private benefits from price premiums that could, in turn, generate social benefits by increasing biodegradable mulch use, leading to a reduction of plastic pollution. By providing empirical evidence on the potential adoption of biotechnology in the food production system, our results allow agricultural crop producers to make more informed decisions on growing and pricing strategies. Our research will also facilitate agricultural scientists and policymakers to articulate industry-supporting policies for sustainable development.

Keywords: Biodegradable mulches; Consumer preference; Contingent valuation; Strawberry; Sustainability policy; Willingness to pay

TizianoGomiero (Independent Scholar, Consultant, Fellow at the Department of Environmental Studies)[ab] ([a]Mogliano Veneto, TV, Italy[b]Masaryk University, Brno, Czech Republic) Agriculture and degrowth : State of the art and assessment of organic and biotech-based agriculture from a degrowth perspective. Journal of Cleaner Production. Volume 197, Part 2 (2018) : 1823-1839

Agriculture stands as the foundation of modern human societies. Any changes in social functioning should seriously consider how to guarantee people a proper supply of food, in terms of both quantity and quality. Degrowth is a movement that aims at achieving a radical change in the societal metabolism of societies, toward a more frugal, sustainable and convivial lifestyle. The movement envisages a society where concepts as sharing, conviviality, care, commons, justice could stand at its foundation, and replace the call for economic growth, which is, obviously, biophysically unsustainable. This paper aims to (1) review how agriculture has been addressed within the degrowth discourse, (2) analyse the relation between agriculture and societal metabolism and its relevance from a degrowth perspective, (3) discuss how different agricultural techniques and technologies may represent appropriate technologies (*sensu* Schumacher, 1973), and meet the call for conviviality (*sensu* Illich, 1975). The latter point focusses on a comparison between organic agriculture (OA, which bans the use of agrochemicals and Genetically Modified Organisms - GMOs) and biotech-based agriculture (BTA, reliant on GMOs). The paper points out that although many relevant socioeconomic, political and environmental issues have been addressed by degrowth scholars, agriculture is still poorly analysed. Recommendations are made with regard to studying possible alternative transition paths, by assessing their impact on society's structure and functioning. It is argued that

"conviviality" and "appropriate technology" concepts are rather complex and multifaceted. Therefore, different practices might be considered convivial and appropriate under some criteria, and not under others. With regard to conviviality, organic agriculture might not fully respond to the call for autonomy. Notwithstanding claims made by GMOs supporters, BTA does neither suit the call for appropriate technology, nor represent a convivial tool under any criteria.

Bioenergy

PetirPapilo[a], Marimin[b], ErlizaHambali[bc], Imas S.Sitanggang[d] ([a]Department of Industrial Engineering, State Islamic University Sultan Syarif Kasim Riau, Pekanbaru, Indonesia[b]Department of Agro Industrial Technology, Bogor Agricultural University, Bogor, Indonesia[c]Surfactant and Bioenergy Research Center (SBRC), Bogor Agricultural University, Bogor, Indonesia[d]Department of Computer Science, Bogor Agricultural University, Bogor, Indonesia) **Sustainability index assessment of palm oil-based bioenergy in Indonesia. Journal of Cleaner Production. Volume 196 (2018) : 808-820**

This paper reported the status of Indonesian sustainable palm oil-based bioenergy development. The sustainability assessment of palm oil-based bioenergy has become a critical issue due to its positive impact to the foreign exchange savings in Indonesia. Otherwise, several negative appraisements, especially in the social and environment aspect have caused disapproval of Indonesian bioenergy products in the global energy market, as well as in the European Union. The status of sustainability which is described by the sustainability index has been obtained from the multidimensional scaling analysis. This study was conducted through several stages, including: (1) Determining the sustainability indicators which are most appropriate for palm oil-based bioenergy in Indonesia, and also a recommendation in the establishment of Indonesia Bioenergy Sustainability Indicators. (2) Assessing the sustainability index through the multidimensional scaling analysis. The focus group discussion has recommended 10 sustainability indicators. Indonesia Bioenergy Sustainability Indicators was divided into 2 indicators on the environmental aspects, 3 indicators on the social aspects and 5 indicators on the economic aspects. Meanwhile, on the environmental aspect (waste management and clean production) was subdivided into 3 sub indicators. The results of the sustainability assessment have obtained the average score index of 35.02% which indicates that the Indonesian sustainability status of the palm oil based bioenergy is still low (less sustainable). This research also showed the level of sustainability of each aspects, which is the score index of the economic aspects of 38.03% (less sustainable), the social aspect of 16.07% (unsustainable) and environmental aspect of 50.97% (sustained moderate). In conclusion, these sustainability index are expected to be useful as the foundation of determining the best strategy for future Indonesian bioenergy development.

Keywords: Bioenergy; Palm oil; Sustainability index; Sustainability indicators

SalahKamel[ab], Hoda AbdEl-Sattar[bc], DavidVera[c], FranciscoJurado[c] ([a]State Key Laboratory of Power Transmission Equipment & System Security and New Technology, College of Electrical Engineering, Chongqing University, Chongqing 400030, China[b]Department of Electrical Engineering, Faculty of Engineering, Aswan University, 81542 Aswan, Egypt[c]Department of Electrical Engineering, University of Jaén, 23700 EPS Linares, Jaén, Spain) **Bioenergy potential from agriculture residues for energy generation in Egypt. Renewable and Sustainable Energy Reviews. Volume 94 (2018) : 28-37**

Recently, biomass represents about 14% of primary energy consumption and expected to provide 50% of world total primary energy consumption by 2050. This paper clarifies an appraisal of the possibilities available in Egypt to become one of the countries of the production of bioenergy, especially from the crop remnants of agriculture production. Egypt annually produces a large amount of biomass of up to 40 million tons. Unfortunately, instead of the possibility of exploiting these wastes to contribute to the energy sector and economic growth, about 52% of these wastes are disposed of by direct burning, which may cause many environmental problems. The only widespread form of biomass use in Egypt is biogas used in rural areas. In addition, the potential theoretical energy from the most important crop residues available in Egypt is evaluated according to previous studies. It is found that energy of 189.76 PJ/year can be produced from dry crop residues of 12.5 million tons/year. For livestock residues, specifically cattle manure, it is estimated in this study that the potential biogas in Egypt of 7.2 million head of cattle is 53.2 million m3 / day with a total potential energy of 699 TJ per year. However, the potential of bioenergy depends largely on the availability, geographical distribution and accessibility of the actual waste. The most likely areas for these potentials are Middle Delta and Upper Egypt. This could potentially develop a long-term strategy for the smart use of vital waste available for bioenergy production to be economically profitable and sustainable.

Keywords: Bioenergy; Biomass; Renewable energy; Residues; Egypt

T.J.Townsend, D.L.Sparkes, S.J.Ramsden, N.J.Glithero, P.Wilson (School of Biosciences, University of Nottingham, Sutton Bonington Campus, Loughborough LE12 5RD, United Kingdom) **Wheat straw availability for bioenergy in England. Energy Policy. Volume 122 (2018) : 349-357**

In an effort to meet energy demands while reducing carbon emissions, crop residues, such as wheat straw, have been investigated for their use as feedstock for biofuel production. In order to identify the feasibility of utilising crop residues as bioenergy feedstock, a postal survey was conducted to determine current farm business wheat straw use, destination and potential future supply. The survey responses showed a bias towards larger, more commercially-minded farms, therefore capturing a large area of straw production. Results demonstrated a wide range of responses to both current straw use and potential for the supply of straw to different markets in the future. Interestingly, even for a very generous payment for straw, 28.5% of straw currently chopped and incorporated would not be sold, suggesting that straw supply for bioenergy

feedstock is likely to be more limited than previously assumed. However, higher prices for straw would encourage farmers to explore ways of increasing straw yield.

Keywords: Bioenergy; Wheat; Postal survey; Straw

David J.Smith[a], DeanCurrent[b], CandiSchulman[b], K. WilliamEaster[c] ([a]USDA, Economic Research Service, 355 E Street SW, Washington, DC 20024, USA[b]University of Minnesota, Center for Integrated Natural Resource and Management, Department of Forest Resources, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA[c]University of Minnesota, Department of Applied Economics, 1994 Buford Avenue, St. Paul, MN 55108, USA) **Willingness to produce perennial bioenergy crops: A contingent supply approach. Biomass and Bioenergy. Volume 117 (2018) : 161-172**

In order to reduce economic and national security risks, U.S. energy policy, in 2005 and 2007, mandated production of renewable biofuels. By 2010, the renewable biofuel industry was consuming approximately one-third of domestic corn and soybean production. To meet this growing demand, conservation and pastureland has been cultivated with corn and soybean, resulting in a reduction in ecosystem services. Perennial bioenergy crops (e.g., switchgrass) offer a more sustainable alternative. However, unlike annual crops, farmers and landowners have little experience with perennial bioenergy crop production. Uncertainty in production and prices may impact the supply of these novel crops into an emerging market. Using a contingent supply method, we show that agricultural landowners are willing to produce perennial bioenergy crops, given competitive returns, but only on a portion of their land.

Keywords: Bioenergy; Economics; Supply; Production; Cellulosic; Perennial

AlirezaAslani[a] , TaniaMazzuca-Sobczuk[b], SepidehEivazi[c], KavehBekhrad[a] ([a]Department of Renewable Energy and Environment, Faculty of New Sciences and Technologies, University of Tehran, Iran[b]Department of Engineering, Chemical Engineering Area, University of Almería, Almería, Spain[c]Department of IT Management, Faculty of Management, Shahid Beheshti University, Iran) **Analysis of bioenergy technologies development based on life cycle and adaptation trends. Renewable Energy. Volume 127 (2018) : 1076-1086**

Energy has a strategic role in economic and social development of the countries. Therefore, security of energy supply is one of the main concerns of the governments. Due to the environmental effects, limitations, as well as fluctuations of the fossil fuels, utilization of replacement energies such as renewable energy sources is one of the main policies in order to overcome to the energy concerns. Among renewable energy sources, bioenergy and its related technologies is very important for researchers and policy makers. Although different bioenergy technologies have been developed, understanding the market and commercial potentials of each technology is very important. To respond, assessment of different bioenergy technologies would

be the best solution, because it evaluates both technical and market acceptance of a technology. This article is to analyze diffusion and adaptation of bioenergy energy technologies based on a technology assessment method, Hype cycle diagram. The hype cycle diagram combines technologies life-cycle and adaptation of a technology. First, the main bioenergy technologies are discussed. Afterwards, the diffusion diagram of each technology is drawn based on life cycle analysis and patent registrations. Next, the adaptation of each technology is investigated. Finally, by combination of both diagrams for each technology, the situation and future of the bioenergy technologies will be discussed.

Keywords: Energy; Bioenergy; Bioenergy technologies; Hype diagram

MohdAlsaleh, A.S.Abdul-Rahim (Faculty of Economics and Management, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia) Determinants of cost efficiency of bioenergy industry: Evidence from EU28 countries. Renewable Energy. Volume 127 (2018) : 746-762

Most previous bioenergy industry studies have focused on how to achieve a specific level of production. However, very few studies concentrate on the cost and the allocative and technical efficiency methods to achieve rational resource utilization. In light of the increase in the bioenergy industry's economic competitiveness within the energy market through proper allocation and utilization of available resources, this article analyzed the impact of country-specific and macroeconomic determinants of cost efficiency rate in the bioenergy industry in the EU28 zone. The fixed effects and random effect models have been used through the unbalanced data panel analysis method to examine the effect of EU28 region countries' development status and external economic determinants on the level of cost efficiency in the bioenergy industry in EU28. The findings show that the cost efficiency rate of the bioenergy industry among developing members are equal to those of developed members. The empirical results appear to suggest that cost efficiency has a different influence on the technical and allocative efficiency levels. It was found that capital cost, labor cost, GDP, inflation and interest rate affect the cost efficiency of the bioenergy industry in EU28 developing and developed members during the period of this study.

Keywords: Bioenergy industry; Cost efficiency; EU28 region

RajaChowdhury[a], JhumaSadhukhan[b], MarziaTraverso[c], Patricia L.Keen[d] ([a]Dept. of Civil Engineering, Indian Institute of Technology, Roorkee, India[b]Center of Environmental Strategy, University of Surrey, Guildford, UK[c]Institute of Sustainability in Civil Engineering, RWTH Aachen University, Germany[d]Dept. of Civil Engineering, University of British Columbia, Canada) Effects of residence time on life cycle assessment of bioenergy production from dairy manure. Bioresource Technology Reports. Volume 4 (2018) : 57-65

This study simulated the effect of time on bioenergy production from dairy manure and associated variation in energy demand and GHG emission in Ohio and Hawaii. Increasing the

residence-time (RT) decreases the bioenergy-production in a nonlinear-fashion, for both the states (Ohio and Hawaii). Using the main scenario in Hawaii, the highest bioenergy production for 30 days RT was 11.2×10^4 GJ. Life-cycle-assessment of produced bioenergy showed that energy requirement and GHG emission of the produced-bioenergy (GJ) varied from 0.65 to 0.67 and 28–35 kg CO_2/GJ bioenergy respectively. Year-round bioenergy production through main scenario was more advantageous with respect to bioenergy production and GHG emission. Decreasing nitrogen concentration for algal biomass production increased the bioenergy production significantly with a reduced energy demand and marginally increased GHG emission. Hence, the LCA model predicted that running a biorefinery for short residence time, and using diluted waste, could provide bioenergy with reduced energy requirement and GHG-emission.

Nano Biotechnology

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Redox-responsive nano-carriers as tumor-targeted drug delivery systems. European Journal of Medicinal Chemistry. Volume 157 (2018) : 705-715

With ever increasing scientific knowledge and awareness, research is underway around the globe to design new types of stimuli (external/internal) responsive nano-carriers for biotechnological applications at large and biomedical/pharmaceutical in particular. Based on literature evidence, stimuli-responsive carriers have been classified into four major categories, i.e. (1) physical, (2) chemical, (3) biological, and (4) dual (combination of any of the first three classes). Among various types, redox-responsive nano-carriers are of supreme interests and discussed here in this review. The difference in redox potential in tumor and normal tissue is considered as a potential target for tumor targeting leading to the development of redox-responsive drug delivery systems (DDS). In this regard, a high concentration of glutathione in tumor/intracellular environment has extensively been exploited. Disulfide bonds were found as a promising tool for designing redox-responsive which tend to cleave in a reductive environment forming sulfhydryl groups. Many nano-carriers have been explored widely to control tumor growth. These systems were used against the tumor xenograft animal model and showed improved tumor targeting with tumor growth inhibition. Herein, an effort has been made to summarize various aspects from design to development of numerous types of redox-responsive DDS including liposomes, micelles, nanoparticles, nanogel and prodrug based nanomedicines. An emphasis is also given on various types of nano-carriers with special reference to the tumor-

targeted drug delivery applications. Also, dual responsive nano-carriers (in addition to redox-responsive) have also been briefly discussed. Towards the end of the chapter, the information is also given on their future perspectives.

Keywords: Redox responsive drug delivery systems; Tumor targeting; Stimuli-responsive; Nanoparticles; Nano-carriers; Biomedical applications

Mohammad RezaKasaai (Department of Food Science and Technology, Sari Agricultural Sciences and Natural Resources University, Khazar Abad road, Km. 9, P.O. Box, 578, Sari, Mazandaran, Iran) Zein and zein -based nano-materials for food and nutrition applications: A review. Trends in Food Science & Technology. Volume 79 (2018) : 184-197

Zein, a byproduct of corn with renewable resources, unique hydrophobic/hydrophilic character, film/fiber forming and antioxidant properties, is a promising biopolymer for food and nutrition applications. The advantages in properties and efficiencies of nano materials over bulk counterparts are the basis of their unique nature in novel technologies. These advantages also expand their possible applications.
An effort has been made to review on applications of zein/zein-based nano-materials in various branches of food (except food packaging) and nutrition sectors. The effects of various parameters affecting preparations and properties of the nano-materials are also discussed. Nano-encapsulation of foods and nutrients is the major section of this study.

(i) the average size of zein nanoparticles reported to be 50–200 nm; (ii) the functions of zein nanomaterials were multiples: a carrier of delivery (food, beverage, and nutrient) systems; a shell or a core of encapsulated systems; or a food ingredient; (iii) zein-based nano-materials have been used for encapsulation of food and nutrient components including lipids; essential oils; fat soluble vitamins; food colorants; flavors; and natural anti-oxidants; (iv) the bioavailability of food and nutrient components such as folic acid, vitamin D_3, curcumin, beta-carotene, and resveratrol was improved by employing the zein-nanoparticles in comparison with the bulk counterparts; and (v) bioactive substances with potential applications for food and nutrition sectors were stabilized by zein/zein-based nano-materials.

Keywords: Zein; Zein-based; Nano-materials; Food; Nutrition; Nanotechnology

HuaixianXiao[1], NaLiu[1], KeTianShixiangLiuFeiGe (Department of Environment, College of Environment and Resources, Xiangtan University, Xiangtan 411105, PR China) Accelerated effects of nano-ZnO on phosphorus removal by *Chlorella vulgaris*: Formation of zinc phosphate crystallites. Science of The Total Environment. Volume 635 (2018) : 559-566

Nanoparticles have been reported to induce toxicity to aquatic organisms, however, their potential impacts on phosphorus removal from wastewater by algae are unclear. In this study, the effects of nanoparticle ZnO (nano-ZnO) on phosphate (PO_4^{3-}) removal by a green alga *Chlorella* vulgaris were investigated. We found that PO_4^{3-} removal efficiency was

accelerated with high concentrations of nano-ZnO (0.04–0.15 mM) but reduced with low concentrations of nano-ZnO (0.005–0.04 mM) compared to the control (without nano-ZnO), suggesting that PO_4^{3-} removal efficiency by *C. vulgaris* was related to nano-ZnO concentrations. Moreover, we observed changes of nano-ZnO morphology and detected element P on the surface of nano-ZnO by using transmission electronic microscopy (TEM) combined with energy dispersive X-ray spectroscopy (EDX), indicating that PO_4^{3-} was interacted with nano-ZnO or the dissolved Zn^{2+} from nano-ZnO. Furthermore, we confirmed this interaction induced the formation of $Zn_3(PO_4)_2$ crystallites sedimentation by employing X-ray diffraction analysis (XRD) and X-ray photoelectron spectroscopy (XPS), which finally accelerates the removal of PO_4^{3-}.

Keywords: Nano-ZnO; Phosphorus removal; Crystallites; Algae

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Construction of zinc-incorporated nano-network structures on a biomedical titanium surface to enhance bioactivity. Applied Surface Science. Volume 453 (2018) : 263-270

Surface topography had been identified as a crucial property that affects osseointegration; thus, topographical modification was the most frequently adopted technique in titanium-based implant research. In this study, ethyl cellulose was employed as an additive to construct a zinc-incorporated nano-network layer onto a titanium surface by the sequential treatments of spin-coating, high-temperature calcination, and alkali heat corrosion. SEM results showed that 20 mg/mL of ethyl cellulose was optimal to fabricate a relatively flat porous coating, and the ideal nano-network structures formed by only 4 h of corrosion. Other results of XPS and ICP further proved that zinc ions were successfully incorporated into the final samples (Ti-Zn0.1, Ti-Zn0.3, and Ti-Zn0.4). Moreover, the *in vitro* cellular (*e.g.*, CCK-8, ALP, mineralization) and bacterial assays presented that Ti-Zn0.3 substrates not only had the greatest proliferation and differentiation capacities for osteoblasts but also possessed relatively strong antibacterial abilities for both *Escherichia coli* and *Staphylococcus aureus*. This study provided a new way to rapidly construct the pro-osteogenesis and antibacterial nano-network structures on titanium surfaces for orthopedic application.

Keywords: Titanium; Nano-network; Zinc; Antibacterial; Osteogenesis

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Department of Bioengineering, School of Life Sciences and Biotechnology, Shanghai Jiao Tong University, 800 Dong-Chuan Road, Shanghai 200240, China) Nano-spectroscopic imaging of proteins with near-field scanning optical microscopy (NSOM). Current Opinion in Biotechnology. Volume 54 (2018) : 106-113

Understanding the hierarchical structure of proteins at their fundamental length scales is essential to get insights into their functions and roles in fundamental biological processes. Near-field scanning optical microscopy (NSOM), which overcomes the diffraction limits of conventional optics, provides a powerful analytical tool to image target proteins at nanoscale resolution. Especially, by combining NSOM with infrared (IR) or Raman spectroscopy, near-field nanospectroscopic imaging of a single protein is achieved. In this review, we present the recent technical progress of NSOM setup for nanospectroscopic imaging of proteins, and its application to nanospectroscopic analysis of protein structures is highlighted and critically reviewed. Finally, current challenges and perspectives on application of NSOM in emerging areas of industrial, environmental and medical biotechnology are discussed.

MuhammadAdeel[a], Muhammad Bilal[b], Tahir Rasheed[a], Ashutosh Sharma[c], Hafiz M.N.Iqbal[d] ([a]School of Chemistry & Chemical Engineering, State Key Laboratory of Metal Matrix Composites, Shanghai Jiao Tong University, Shanghai 200240, China[b]School of Life Science and Food Engineering, Huaiyin Institute of Technology, Huaian 223003, China[c]Tecnologico de Monterrey, Campus Queretaro, School of Engineering and Sciences, Epigmenio Gonzalez 500, CP 76130 Queretaro, Mexico[d]Tecnologico de Monterrey, Campus Monterrey, School of Engineering and Sciences, Ave. Eugenio Garza Sada 2501, Monterrey, N.L. CP 64849, Mexico) Graphene and graphene oxide: Functionalization and nano-bio-catalytic system for enzyme immobilization and biotechnological perspective. International Journal of Biological Macromolecules. Volume 120, Part B (2018) : 1430-1440

Graphene-based nanomaterials have gained high research interest in different fields related to proteins and thus are rapidly becoming the most widely investigated carbon-based materials. Their exceptional physiochemical properties such as electrical, optical, thermal and mechanical strength enable graphene to render graphene-based nanostructured materials suitable for applications in different fields such as electroanalytical chemistry, electrochemical sensors and immobilization of biomolecules and enzymes. The structural feature of oxygenated graphene, i.e., graphene oxide (GO) covered with different functionalities such as epoxy, hydroxyl, and carboxylic group, open a new direction of chemical modification of GO with desired properties. This review describes the recent progress related to the structural geometry, physiochemical characteristics, and functionalization of GO, and the development of graphene-based novel carriers as host for enzyme immobilization. Graphene derivatives-based applications are progressively increasing, in recent years. Therefore, from the bio-catalysis and biotransformation viewpoint, the biotechnological perspective of graphene-immobilized nano-bio-catalysts is of supreme interest. The structural geometry, unique properties, and functionalization of graphene

derivatives and graphene-based nanomaterials as host for enzyme immobilization are highlighted in this review. Also, the role of GO-based catalytic systems such as microfluidic bio-catalysis, enzyme-based biofuel cells, and biosensors are also discussed with potential future perspectives of these multifaceted materials.

Name of Journals

1. Acta Biotechnologica
2. Aerobiologia
3. Annual Review-Plant Pathology
4. Annual Review- Ecology and Systematics
5. Annual Review-Biochemistry
6. Annual Review-Biomedical Engineering
7. Annual Review-Biophysics and Biomolecular Structure
8. Annual Review-Microbiology
9. Annual Review-Pharmacology and Toxicology
10. Annual Review-Phytopathology
11. Annual Review-Physiology
12. Annual Review-Plant Physiology
13. Annual Review-Public Health
14. African Journal of Biotechnology
15. Applied and Environmental Microbiology
16. Applied Microbiology & Biotechnology
17. Aquaculture
18. Allergy
19. Australian Journal of Plant Physiology
20. Biocatalysis and Transformation
21. Biocontrol
22. Biocontrol Potential and its exploitation in sustainable Agriculture
23. Biodegradation
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25. Biodiversity and Conservation
26. Biological Agriculture and Horticulture
27. Biomass and Bioenergy
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29. Biomedical Engineering
30. Bioresource Technology
31. Bioscience, Biotechnology and Biochemistry
32. Biosensors-and –Bioelectronics
33. Bioseperation
34. Biotechnolgy Letters
35. Biotechnology Advances
36. Biotechnology and Applied Biochemistry

37. Biotechnology and Bioengineering
38. Botanical Review
39. Canadian Journal of Microbiology
40. Cell & Tissue Banking
41. Clinical Microbiology Reviews
42. Critical Reviews in Biotechnology
43. Crop Research Hisar
44. Current Microbiology
45. Current Opinion in Biotechnology
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47. Cytotechnology
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49. Ecological Engineering
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51. Environmental Conservation
52. Environmental Research
53. Environmental Pollution
54. Enzyme and Microbial Techynology
55. Every Man's Science
56. Environmental Imapct Assessment Review
57. Fems Microbiology & Ecology
58. Food & Agricultural Immunology
59. Global Environmental Change
60. Hydrometallurgy
61. Immunological Research
62. Indian Agriculturist
63. Indian Biologist
64. Indian Farming
65. Indian Journal of Agricultural Science
66. Indian Journal of Biotechnology
67. Indian Journal of Ecology
68. Indian Journal of Experimental Biology
69. Indian Journal of Environmental Toxicology
70. Indian Journal of Environmental Health
71. Indian Journal of Plant Physiology
72. International Biodeterioration & Biodegradation
73. International Journal of Biotechnology
74. International Journal of Phytoremediation
75. Journal of Applied Sciences and Environmental Management
76. Journal of Agriculture and Environmental Ethics

77. Journal Biological Control
78. Journal of Bacteriology
79. Journal of Chemical Technology & Biotechnology
80. Journal of Environmental Management
81. Journal of Food Science and Technology-Mysore
82. Journal of Hazardous Materials
83. Journal Indian Association Environment Management
84. Journal Indian Pollution Control
85. Journal of Indian Soil Science
86. Journal of Industrial Microbiology & Biotechnology
87. Journal of Scientific and Industrial Research
88. Microbial Review
89. Microbiological Research
90. Molecular Biotechnology
91. Mycological Research
92. Mycorrhizal Biology
93. Nature
94. Nature Biotechnology
95. New Biotechnology
96. Perspectives-in-Biotechnology
97. Pesticide research Journal
98. Pestology
99. Plants and Soil
100. Process Biochemistry
101. Pollution
102. Pollution Research
103. Reviews in Environmental Science and Biotechnology
104. Research Journal Chemistry & Environment
105. Sciences
106. Science & Culture
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109. Trends in Biotechnology
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111. World Journal of Biotechnology
112. World Journal of Microbiology and Biotechnology
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